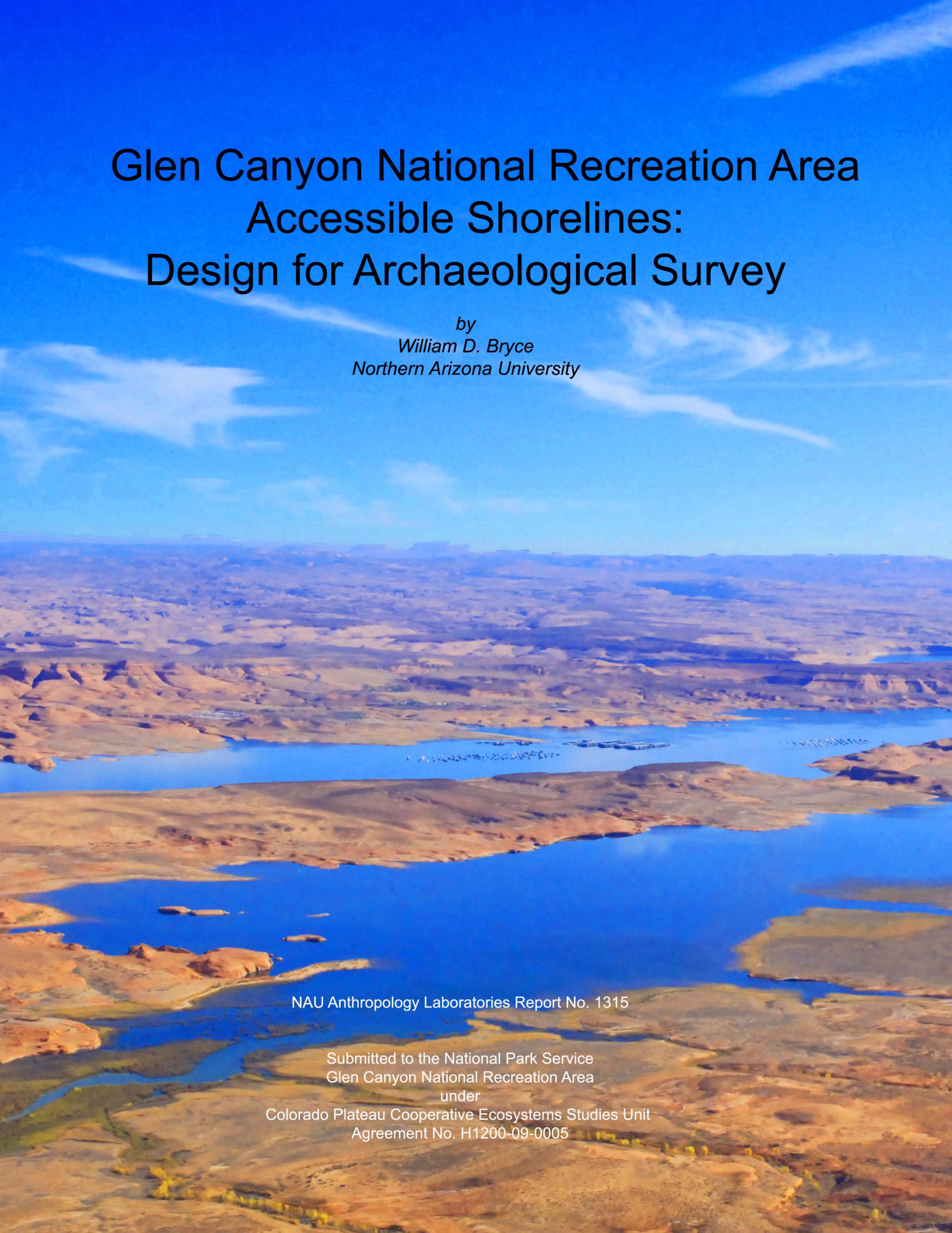

Glen Canyon National Recreation Area Accessible Shorelines: Design for Archaeological Survey

by
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Northern Arizona University

NAU Anthropology Laboratories Report No. 1315

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Chapter 1.
Priority Shorelines in Glen Canyon National Recreation Area

This document provides a research design for archaeological inventory of seven priority shoreline areas in Glen Canyon National Recreation Area (GCNRA). Northern Arizona University (NAU) has designed the strategies provided herein to satisfy GCNRA's archaeological inventory obligations under Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA). Included in this document are a brief history of the project, methods for establishing sampling criteria, and a course of action for conducting archaeological inventory within each specified shoreline area, including Stanton Creek, Farley Canyon, White Canyon, Blue Notch, Crosby Canyon, Warm Creek, and Red Canyon (Figure 1.1). Outlined courses of action for each shoreline area are aimed at meeting GCNRA's compliance needs, focusing on 100% pedestrian survey, but include sampling strategies, in concert with survey suggestions and nearby site types to provide information on potential sites within the present project areas. NAU suggests complete survey of the delineated shoreline area APEs, providing sampling parameters as a secondary option. The survey design functions to expedite GCNRA's Section 106 compliance efforts for accessible shoreline areas within GCNRA boundaries. The project concerns the accessible shoreline areas designated for off-road vehicle (ORV) use and determined as priority areas of concern regarding Section 106 compliance due to high levels of visitor activity.

Project History

In 1972, President Nixon issued Executive Order (EO) 11644 in furtherance of the National Environmental Policy Act of 1969 (NEPA). EO 11644, amended by EO 11989, establishes policies to control the use of off-road vehicles on public lands. The protection of resources present on public lands required by EO 11644 defines the major concern of this project. Further amendment by EO 11989 established Section 9. Section 9 requires the head of the agency managing the public lands to close any areas or trails used by off-road vehicles that are adversely effecting cultural or historic resources until the affects have been eliminated or prevented from occurring in the future.

The GCNRA General Management Plan, approved in 1979, identified shoreline areas along Lake Powell where road access would be permitted, and in 1988, GCNRA incorporated intensive management actions for each road accessible shoreline area. In 1988, the full pool levels (3,700 feet amsl) defined the accessible shorelines. However, in the past 22 years, the levels of Lake Powell have decreased, landlocking the designated ORV areas and increasing access to areas previously restricted by topographic barriers and the full pool level. Initially, GCNRA management followed the precedence established by the draft Environmental Impact Statement (EIS) and allowed ORV operators to follow the receding shoreline and use the newly opened areas for recreational purposes. This practice led to the use of unprescribed routes and access to large expanses of land outside of the delineated accessible shorelines, and the potential for adverse affects to natural and cultural resources, including illegal excavation, collection of artifacts present on the modern ground surface, impacts to features through foot and motor vehicle traffic, dismantling of structures, and defacing of rock art.

In response, GCNRA developed a list of twelve prioritized accessible shorelines for cultural resources inventory to comply with Section 106. The level of visitor activity dictated the prioritization. Later consultation and consideration of shoreline area closure due to the low lake levels decreased the number of priority shorelines in danger of potential adverse affect to seven areas. The seven areas include priorities 1-6 and 8 of the original list, namely Stanton Creek, Farley Canyon, White Canyon, Blue Notch, Crosby Canyon, Warm Creek, and Red Canyon. GCNRA defined the Area of Potential Effect (APE) for each of the shoreline areas as follows:

> APE boundaries extend from the original shoreline designations (NPS 1988) at full pool (ca. 3700 ft) to potential lower lake elevations (ca. 3600 ft) with restrictions along perimeters represented by 35 degree slopes and topographical barriers. Lateral boundaries remained at full pool elevation (ca. 3700 ft) (unless intersected by areas of 35 degree slope) anticipating that vehicular traffic is concentrated along the newly exposed drainages and low lying areas as lake levels decrease. (Baker 2010)

As noted by GCNRA, the draft EIS justifies defining the APEs based on full pool, low pool, and natural topographic features.

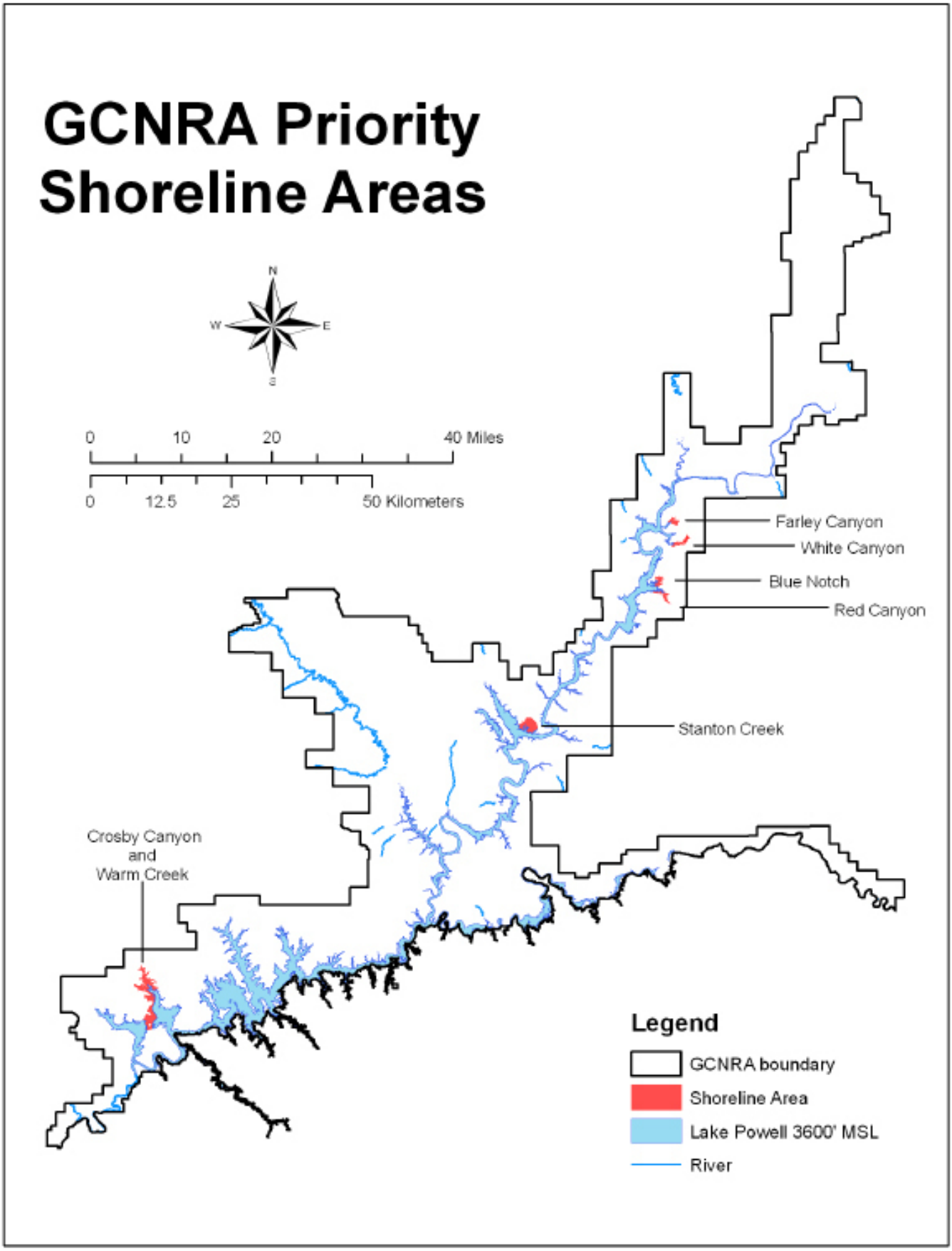

Figure 1.1. Location of the seven priority shoreline areas (Stanton Creek, Farley Canyon, White Canyon, Blue Notch, Crosby Canyon, Warm Creek, and Red Canyon) within GCNRA boundaries.

GCNRA selected the Stanton Creek, Farley Canyon, White Canyon, Blue Notch, Crosby Canyon, Warm Creek, and Red Canyon shoreline areas as priority locations. The low lake levels providing increased access to large blocks of land previously inaccessible by ORVs in combination with high volumes of visitation dictated priority determination. Impacts to cultural resources from ORV use, "include both unintentional and intentional vandalism. Unintentional vandalism results from driving across sites, creating non-motorized and motorized trails across or near sites with fragile features, and dispersed camping on sites. Intentional vandalism includes site damage or destruction from illegal excavation and the collection of surface artifacts" (Baker 2010). The purpose of this research design, therefore, is to provide an inventory strategy appropriate to addressing the specific archaeological interests and needs of the National Recreation Area (NRA), as well as satisfying GCNRA's Section 106 obligations.

Implementation of this research design will contribute to GCNRA's continued compliance with Section 110 of the NHPA and satisfy GCNRA's Section 106 obligations for the seven shoreline areas, taking into account the impacts of unregulated recreational use on previously isolated areas encompassing cultural resources. The resulting archaeological data will be used by GCNRA in the planning and design of park activities to avoid undue degradation of park resources, and in the design of future archaeological inventory activities within the NRA shoreline areas.

Shorelines and Cultural Resources

The dam building boom carried out by the Bureau of Reclamation (BOR) during the first half of the twentieth century included four areas of the Upper Colorado River Basin. Glen Canyon Dam is one of four dams built to harness the Colorado River for hydrological and electrical needs. Congress authorized the BOR to build the four dams, including Glen Canyon, in 1956. The Historic Sites Act (HSA) of 1935 required the National Park Service (NPS) to fulfill the responsibility of preserving the antiquities within the area. NPS negotiated emergency research contracts to fulfill the requirement. University of Utah (UU) and the Museum of Northern Arizona (MNA) completed archaeological work within the canyon systems and tributaries of the Colorado and San Juan Rivers (Jennings 1998).

The Glen Canyon Project resulted in the location and recording of approximately 2,000 archaeological sites, with dozens excavated as mitigation measures (Geib 1996). Archaeological research within the lowland full pool zone of Lake Powell occurred during the early years of the project. The lowland area, defined as all canyons, rivers, and tributaries below 4,000-4,500 feet (Geib 1996), encompassed a large number of sites providing a broad outline of prehistoric occupation within Glen Canyon. The inevitable impacts to many of the sites by the impending flooding of the area required mitigation through excavation before Glen Canyon Dam construction. Post-dam construction, archaeological work within the lowland areas along Lake Powell included projects such as marina development, road installation and improvement, and similar projects concerning development for recreational use (Geib 1996).

As Geib (1996) notes, the lowland area encompasses multiple resources significant for human occupation. Resources include a permanent source of water, faunal habitats and floral communities, arable alluvium, deposits of high quality siliceous stone, and natural shelters. The Glen Canyon Project and later projects established occupation and exploitation of Glen Canyon from Paleoindian into protohistoric times (Geib 1996). While Jennings (1998) notes that the considerable time depth of archaeological remains are chronologically discontinuous and exhibit spatial differentiation within Glen Canyon, Geib (1996) provides contradictory information indicating continuous occupation of Glen Canyon. Regardless, initial Archaic to Late Archaic hunter-gatherers exploited the high grade stone sources, floral communities, and faunal resources of the lowlands, occupying naturally occurring shelters. The same resources and arable alluvium provided an ideal location for Early Agriculturalists growing maize. The permanent water and arable alluvium also provided ideal locations for early Formative-era groups, and later period Ancestral Puebloans, including the Fremont, Kayenta, and Mesa Verde branches that occupied the region during the PII and PIII periods (Geib 1996).

After dam construction and the inception of the Glen Canyon National Recreation Area, use of the lowland area by tourists and recreational enthusiasts increased to a high of 3.5 million visitors annually in the early to mid 1990s. Visitation slightly decreased, with sustained visitation of approximately 2 million people annually from the mid-1990s to the present (NPS online). Unfortunately, a small percentage of these visitors maintain disrespectful and indifferent outlooks toward cultural resources resulting in "deliberate vandalism, looting, [and] point collecting" in addition to general site degradation (Geib 1996:3). The impacts rendered the lowland area sites in poor condition, particularly rockshelters (Geib 1996). Only one of the seven shoreline areas,

Warm Creek, encompasses recorded sites. Two recorded sites occur within the current Warm Creek shoreline project area. Sites are known, however, within a 1-mile radius of the other priority shorelines, and are used herein to construct site identification probabilities.

Cultural resource concerns regarding ORVs and related visitor impacts to shoreline areas focus on site type and the potential for effects caused by and human activities. Previous studies (Geib 1996) and observations indicate the site types most susceptible to ORV activities include rockshelters, high visibility areas, and shaded locations; sites with standing architecture; open sites in unstable sediments, and rock art sites, as discussed below:

A. Rock shelters, high visibility areas prone to visitation due to curiosity, location of shade, and the potential for privacy. These locations often contain complex sites with a variety of features that can include delicate and perishable materials not found in open settings. In addition, natural shelters may contain complicated natural and cultural sedimentary stratigraphy. Sites in these locations can suffer from the immediate and cumulative physical impacts of ORVs and visitation, increased erosion, trampling and sedimentary churning, and impacts to sensitive features. Physical impacts from visitation include artifact collection and various forms of vandalism including illegal excavation, graffiti, and defacement.

B. Sites with standing architecture or exposed architectural features, including historic and prehistoric sites, that may be subject to ORV and visitor impacts. Standing walls at both historic and prehistoric sites can attract visitors, resulting in immediate and significant impacts to those structures. Even sites with only a few courses of intact masonry would be included in this category, as any adverse impacts to the intact portions of these walls will result in unacceptable levels of damage.

C. Open sites in sensitive locations, such as in erosive soils or subject to the entrenchment of water courses, or ebb of the shoreline, and those sites with discreet features such as hearths, slab features, soil staining, middens, and other features that are susceptible to impacts from ORVs as well as visitation resulting in trampling, vandalism, and collection. The location defines this designation, not the site type. Accordingly, sensitive locations may include site types as diverse as a lithic scatter on an unstabilized gravel bar as well as a habitation site in erosive soils. Sites in erosive sediments suffer from natural weathering impacts that are exacerbated by ORV travel and visitor trampling. Features such as middens, hearths, and fire cracked rock (FCR), lithic debitage and artifact concentrations are easily disturbed by ORVs. Once disturbed, the features lose integrity and scientific value affecting the overall condition of the site. In certain contexts, cumulative impacts due to disturbance and erosion can quickly and irreversibly impact these features, especially in sensitive soils and in areas of active riparian activity. ORV and visitor impacts may at first seem restricted to the modern ground surface, sparing buried slab features, such as slab-lined hearths, storage features, and pit houses. Observation has shown that, especially with softer sandstones, this is not always the case. Hard sandstone slabs may help to enclose and protect some features, but softer sandstones may weather quickly. As the upper margins of soft sandstone slabs are exposed through erosion and weathering, these slabs can be quickly broken down by exposure to the elements and disturbances such as ORV use and visitor trampling. The lack of protection provided by the slabs may result in the rapid loss of feature integrity, or the complete feature, through additional exposure, erosion, ORV trailing, and human trampling.

D. Rock art sites accessible to visitors through ORV travel, especially sites located in highly visible areas. Vandalism is by far the most important factor concerning impacts to rock art. Vandalism includes defacement, removal of rock art panels, and unintentional impacts sustained over time, such as touching and rubbing. In addition, ORV, and visitation due to the use of ORVs may impact rock art sites through impacts such as inadvertently disturbing surfaces exhibiting rock art panels and impacting associated archaeological remains.

The above-listed situations demonstrate two details vitally important to the development of the research design included herein. First, certain site types are more easily damaged by ORV use and the subsequent visitor

impacts than others, and second, that while site type is important, the location of sites is also a factor, so much so that location commonly supersedes site type in the context of Section 106 compliance. The small size of the project shoreline areas and often-time consuming travel to the areas resulting from topographic restrictions, argues for complete, 100% inventory of the priority areas. In addition, the lack of geological, pedological, and floral variability along the confined elevation of the shoreline areas nullifies stratified sampling procedures.

To provide options, however, this research design provides sampling strategies based on GCNRA's prioritization, accessibility, and topography.

Chapter 2.
Data Sources and the Geographical Information System (GIS)

This chapter provides the GIS data sources and applications employed in the subsequent chapters to assess the relationship between important site-specific and environmental variables in each accessible shoreline.

This document makes use of multiple GIS resources, including digital elevation models (DEM); polygon shapefiles for soils and dominant vegetation; point, line, and polygon shapes for springs, rivers, and Lake Powell; point and polygon shapes for known cultural sites and previously conducted cultural resources inventories; and polygon shapes establishing county, GCNRA, and individual shoreline boundaries. All GIS data used in this document derive directly from GCNRA, from project maps digitized by Tesa Villalobos in 2010, and/or from GIS files created specifically for use in this document.

Included in the subsequent chapters are map sets containing digital elevation model (DEM), slope, vegetation, soil, and geology information for the seven priority shorelines, with each shoreline area corresponding with the shapefiles provided by GCNRA archaeologists to define the project areas.

Each map contains a set of attributes consistent through the remainder of this document. Because the illustrations are consistent throughout the chapter, we outline and explain the illustrative schema here. We detail each of the attributes and any relevant source information necessary to document the origin of said attributes.

All maps are projected in NAD_1983_UTM_Zone_12N, in the geographic coordinate system GCS_North_American_1983. Whenever necessary, coverages, shapefiles, and rasters were clipped to illustrate the shorelines and surrounding areas located within the GCNRA boundary.

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 the shoreline areas. On each DEM, known cultural sites (Cultural site), previous archaeological inventories (Previous survey), rivers - including rivers, creeks, and intermittent streams (River), roads (Road), and of course, the shoreline areas (Shoreline area).

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

DEMs: The DEM used in this document was provided by GCNRA under the raster dataset title "bigmerge." No metadata were provided with the dataset.

Cultural Sites: Cultural site information derives from the GCNRA cultural shapefile (cultural_CSI). Although no metadata were provided for the shapefile, this database is 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 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 and used to identify the cultural resources inventories previously conducted in each shoreline area. In addition, a dissolved version of the merged file 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 shoreline area.

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.

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 one another. All deviations were included 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.

Shoreline areas: NPS originally developed a prioritized list of twelve shoreline areas. Brian Sweatland provided maps illustrating six of the 12 areas including, Farley Canyon, White Canyon, Blue Notch, Crosby Canyon, Warm Creek, and Bullfrog. These maps were georeferenced and used as shapefiles (Shoreline area) for the six areas. The remaining six areas were defined based on the general spatial location definitions given by NPS with map sets entitled Projected Shoreline area.

After submittal of the first shoreline areas design draft in February, 2010, and subsequent consultation by NPS with NEPA specialists, GCNRA archaeologist Thann Baker provided GIS shapefiles for the highest priority (n = 7) areas, including Stanton Creek, Farley Canyon, White Canyon, Blue Notch, Crosby Canyon, Warm Creek, and Red Canyon. These seven areas define priority areas 1-6, and 8 on the list originally outlined by Sweatland (Appendix A), and are the focus of the remaining chapters in this document.

Buffers: On each DEM map panel, a 800 meter (1/2 mile) and 1600 meter (1 mile) buffer are provided to show sites and environmental zones within those distances of each shoreline area.

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 describe this file as derived from digitized 7.5 Topographic paper maps, and proclaims this coverage as the "Glen Canyon NRA official boundary."

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%, and 75-100%. These are the values displayed on each slope map panel.

Dominant Vegetation Map Panels

Dominant Vegetation: 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 in and around each shoreline. Coding descriptions for each MUSYM code are provided in Appendix C of Smiley (2010). The coding is also available as the Word document GLCA_MUG_8oct09 included with the original Soils_Draft_SoilInfo folder.

Geology Map Panels

The geology information used in this document has complicated origins. Provided with the original GCNRA information was a folder entitled 'Geology." This folder contained folders entitled: 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.

The seven shoreline areas fall within three geographic locations. The five geology layers provided for the project cover all or portions of the shoreline areas. Geology for each shoreline area derived from the following listed files:

Bullfrog:

The Bullfrog geographic location encompasses one of the shoreline areas: Stanton Creek. The provided geology layer, Lower Escalante, covers a portion of Stanton Creek.

Stanton Creek:

The provided Lower Escalante geology data cover a

portion of the region. The Lower Escalante geology layer covered only the lower half of the Stanton Creek area. This coverage was provided through:

LowerEscalante/Autoplay/MP-06-3DM/shapefiles/geounits.shp

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.

Hite:

The Hite geographic location encompasses four of the shoreline areas: Blue Notch, Red Canyon, Farley Canyon, and White Canyon. Hite Crossing and WhiteGoodHope geology layers cover Hite.

Blue Notch and Red Canyon:

WhiteGoodhope\AutoPlay\MP-08-3DM (White Canyon)\Shapefiles\Geology\GeologicUnits.shp

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.

Farley Canyon and White Canyon:

WhiteGoodhope\AutoPlay\MP-08-3DM (White Canyon)\Shapefiles\Geology\GeologicUnits.shp

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.

Wahweap:

The Wahweap geographic location encompasses two of the shoreline areas: Crosby Canyon and Warm Creek. The Smoky Mountain geology layer covers the Wahweap areas.

Warm Creek and Crosby Canyon:

SmokyMountain/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 resources, geologic hazards.* Utah Geological and Mineral Survey Bulletin 124

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

Geology - Not Identified:

All portions of GCNRA for which geological information was not provided are simply classed as "Not Identified" within this document. This includes the north portion of Stanton Creek.

Chapter 3.
Bullfrog Region Shoreline(s): Stanton Creek

Total Area
1,342.30 acres

Elevation Range amsl:
1,097.28 - 1,185.5 meters (3600 - 3890 feet)

The Bullfrog region encompasses priority shoreline Stanton Creek, which totals 1,342.30 acres. Stanton Creek provides the major waterway into the shoreline area, but Bullfrog Creek also feeds into the area from the north. Figure 3.1 depicts the Stanton Creek shoreline area, 1/2- and 1-mile buffers around the project area, associated known cultural resources inventories and sites within the project area and buffer zones, and the 3,600 feet and 3,700 feet levels of Lake Powell.

Previous Inventories

Three previous cultural resources inventories are known within the Bullfrog region vicinity (Table 3.1). All inventories occurred in the 1980s and 1990s within 1 mile of the Stanton Creek shoreline area, with the Neal and Wenker (1997) survey recording five archaeological sites south of the proposed Stanton Creek project area.

Table 3.1. Summary of previous cultural resources inventories within 1-mile of the Stanton Creek shoreline.

Survey Reference[1]	Purpose	Acres[2]	Intensity	No. Sites
Kincaid 1986j	Halls Crossing toilet	1.06	Inspection	0
Neal and Wenker 1997	Bullfrog Region developed areas	299.50	15-m spacing	5
Vetter 1985	Access Road	6.26	10-m spacing	0

[1] Short citations correspond to GCNRA's cultural resources library/ database. Full references are available from GCNRA.
[2] Listed acreage accounts for areas surveyed within 1-mile of the shoreline area, and does not provide full project acreage for inventories extending outside the current project areas.

Known Archaeological Sites

Sixteen known cultural sites are located in the vicinity of the Stanton Creek shoreline area, with three located within 1/2-mile and an additional 13 located within 1-mile of the proposed project area (Table 3.2). Of these sites, only one (GLCA01037) has a known affiliation (Formative), and 11 have known attribute information, with eight described as artifact scatters, one with a single structure, one described as having a possible hearth, and the Formative site consisting of rock art.

Table 3.2. Known archaeological sites in the vicinity of the Stanton Creek shoreline area.

ASMIS No.	Type[1]	Affil.[2]	In[3]	1/2m [4]	1m[5]
GLCA00706	S	U		X	
GLCA01036	F	F		X	
GLCA01037	F	U		X	
GLCA00733	AS	U			X
GLCA00734	AS	U			X
GLCA00751	U	U			X
GLCA01233	AS	U			X
GLCA01477	U	U			X
GLCA01478	U	U			X
GLCA01480	U	U			X
GLCA01479	U	U			X
GLCA01671	AS	U			X
GLCA01672	AS	U			X
GLCA01674	AS	U			X
GLCA01677	AS	U			X
GLCA01678	AS	U			X

[1] U = Unknown, S = Structural, F = Feature site, AS = Artifact scatter
[2] U = Unknown, F = Formative
[3] Within the current shoreline boundary
[4] Within 1/2 mile (800 meters) of the current shoreline boundary
[5] Withing 1 mile (1600 meters) of the current shoreline boundary

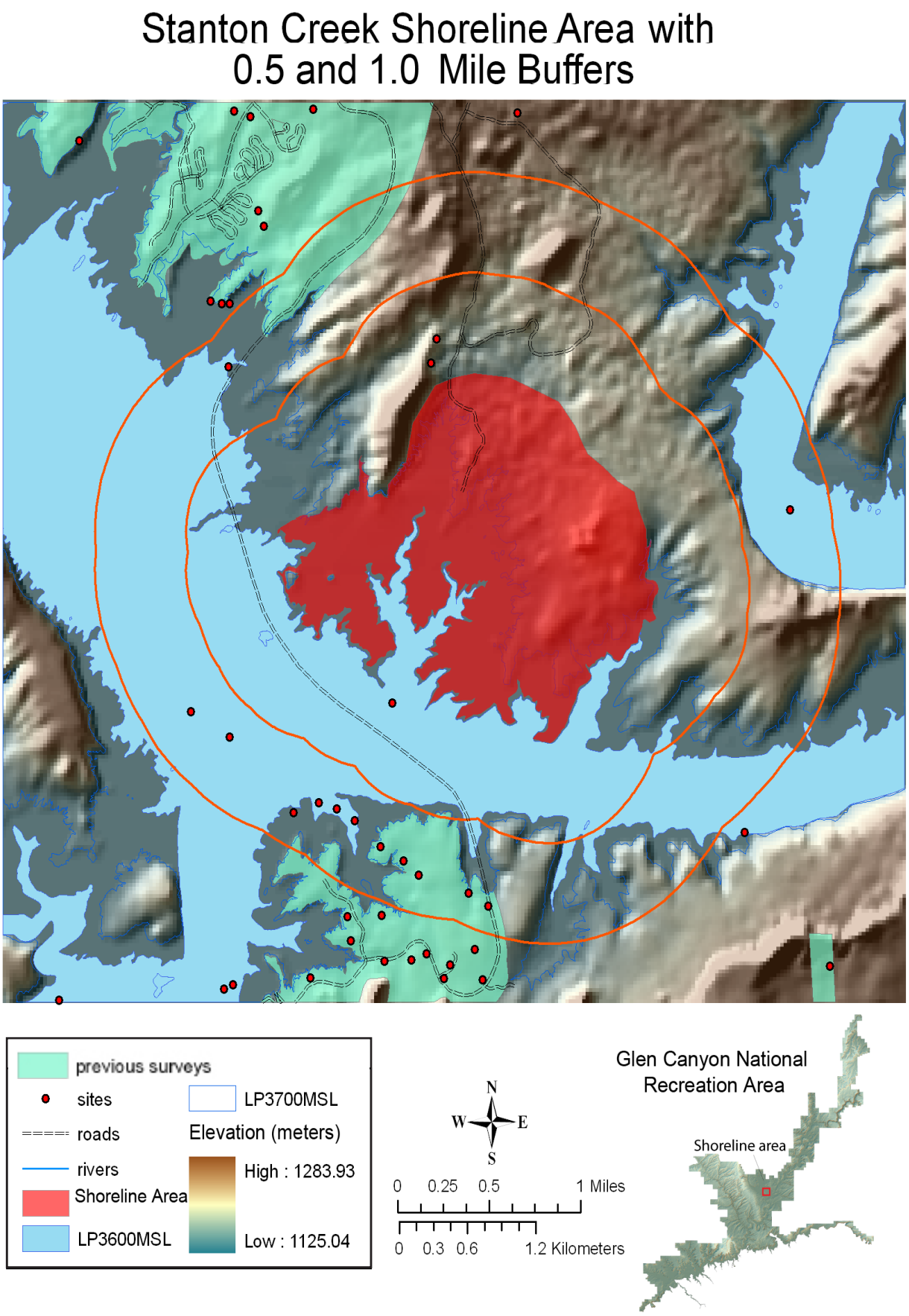

Figure 3.1. The Bullfrog region Stanton Creek shoreline location with vicinity sites and surveys depicted.

Environment: Context and Constraints

The Stanton Creek shoreline lies between 1,097.28 - 1,185.5 meters (3,600 - 3,890 feet), extending above the full pool level of Lake Powell. With few exceptions, the environmental data, including vegetation, soils, geology, and slope is largely lacking, with each category having been classed as 'water' in the respective datasets. However, by drawing from the surrounding environment, and deriving the relationships of the vicinity cultural resources to that environment, NAU provides a generalized environmental context for the Bullfrog region priority shoreline, and when possible, makes recommendations as to how to proceed with actual on-the-ground inventory of the Stanton Creek shoreline area.

Vegetation

The identified primary dominant vegetation zones within the Stanton Creek shoreline include blackbrush (0.8 percent) and shadscale (61.4 percent), with the remainder of the vegetation (37.8 percent) being unidentified due to the inundation of Lake Powell (Table 3.3; Figure 3.2).

Table 3.3. Vegetation of the Bullfrog region shoreline vicinity.

Dominant Species	Acres	%	No. Sites
Not identified	507.20	37.8	11
Blackbrush (*Coleogyne ramosissima*)	11.40	0.8	0
Shadscale *(Atriplex confertifolia)*	823.70	61.4	5
Total	**1342.30**	**100**	**16**

The dominant species present within these zones include shadscale (*Atriplex confertifolia*) and blackbrush (*Coleogyne ramosissima*). Of the 16 sites known in the vicinity of the Stanton Creek shoreline, only five are located in regions for which the vegetation is currently known. All five are artifact scatters recorded by Neal and Wenker (1997) within the shadscale vegetative community. The remaining sites (n = 11) occur in areas for which the vegetative communities are either unknown or recorded as 'water' because of the Lake Powell inundation.

Soils

The provided data show five soil types within the vicinity of the Stanton Creek shoreline area (Table 3.4). Moenkopi-Rock outcrop comprises 39 percent of the area, followed in descending acreage by Rock outcrop-Torriorthents, Myton gravelly sandy loam, and Farb-Pagina-Rock outcrop. As is typical of shoreline locations, however, the majority of the shoreline soil data is simply reported as 'water' because of the Lake Powell inundation (Figure 3.3).

In the Stanton Creek priority shoreline project vicinity, sites are located on Moenkopi-Rock outcrop soil (n = 5) and Rock outcrop-Torriorthents complex soils (n = 2), with the remainder (n = 9) of the known vicinity sites located in areas classed as 'water' or 'unknown' in the available databases. The five sites located on the Moenkopi-Rock outcrop soils are flaked stone artifact scatters recorded by Neal and Wenker (1997). The two sites on Rock outcrop-Torriorthents complex soils include the Formative rock art site (GLCA01036) and the affilitation-unknown site (GLCA01037) with a possible hearth feature.

Table 3.4. Stanton Creek soil types.

Soil Type	MUSYM	Acres	%	No. Sites
Farb-Pagina-Rock outcrop	224	55.9	4.2	0
Moenkopi-Rock outcrop	225	524.1	39.1	5
Myton very gravelly sandy loam	347	35.5	2.6	0
Rock outcrop-Torriorthents complex	366	1.8	0.1	2
Water	999	725	54.0	9
Total	**---**	**1342.3**	**100**	**16**

Geology

The provided data cover the south half of the Stanton Creek shoreline area. The data indicate the Stanton Creek shoreline area contains Alluvial river terrace gravels, Carmel Formation, Entrada Sandstone, and Page Sandstone. In addition, Lake Powell covers a portion of the geology, resulting in a portion of the area described as water. The northern portion of the shoreline area is currently unmapped and unidentified (Figure 3.4; Table 3.5).

None of the sixteen sites within a 1-mile buffer of the Stanton Creek shoreline area are present on known geological formations. Nine of the sites occur within Lake Powell. Unmapped geology underlies five of the sites and two sites are situated on unidentified geology.

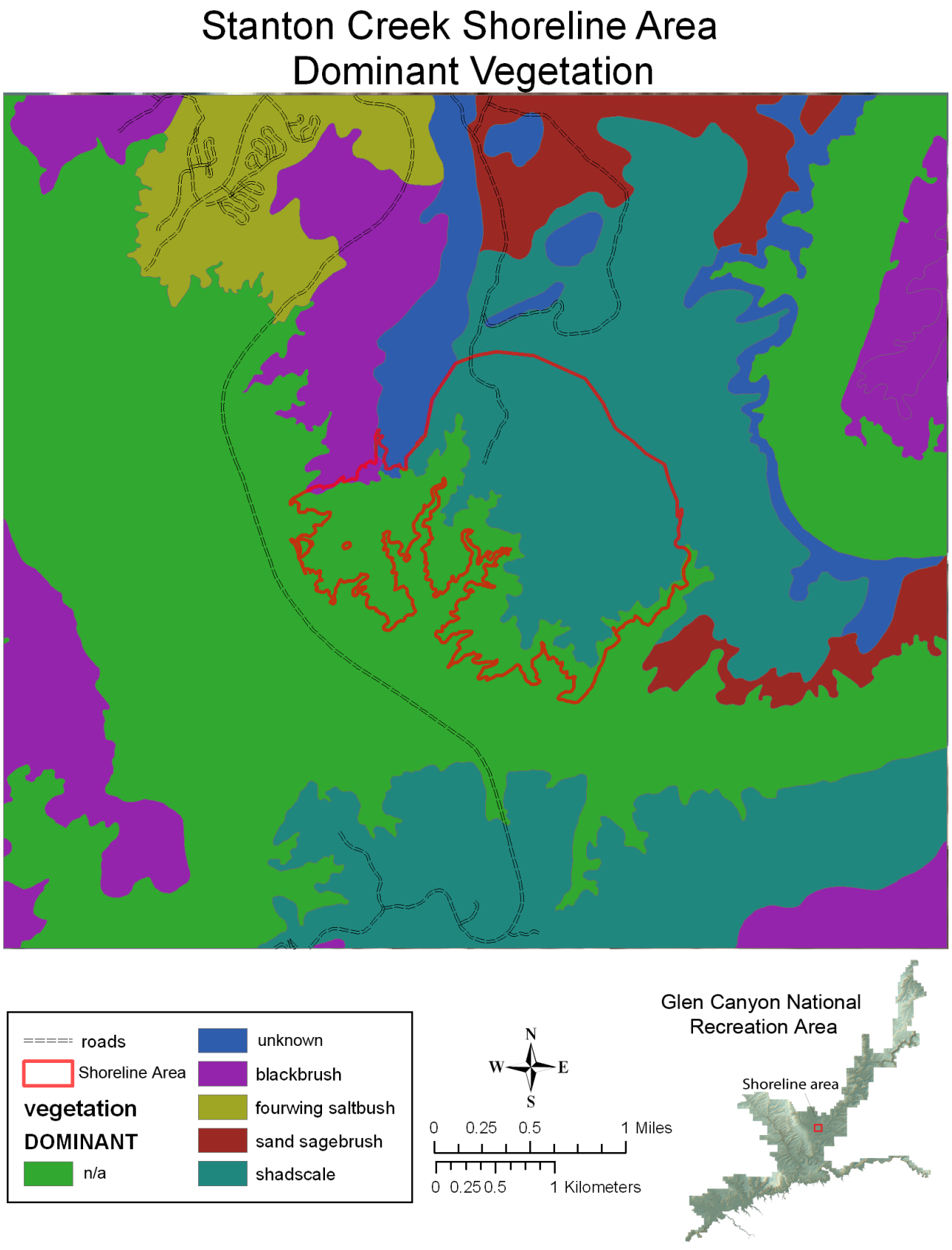

Figure 3.2. The Bullfrog region Stanton Creek shoreline vicinity vegetation.

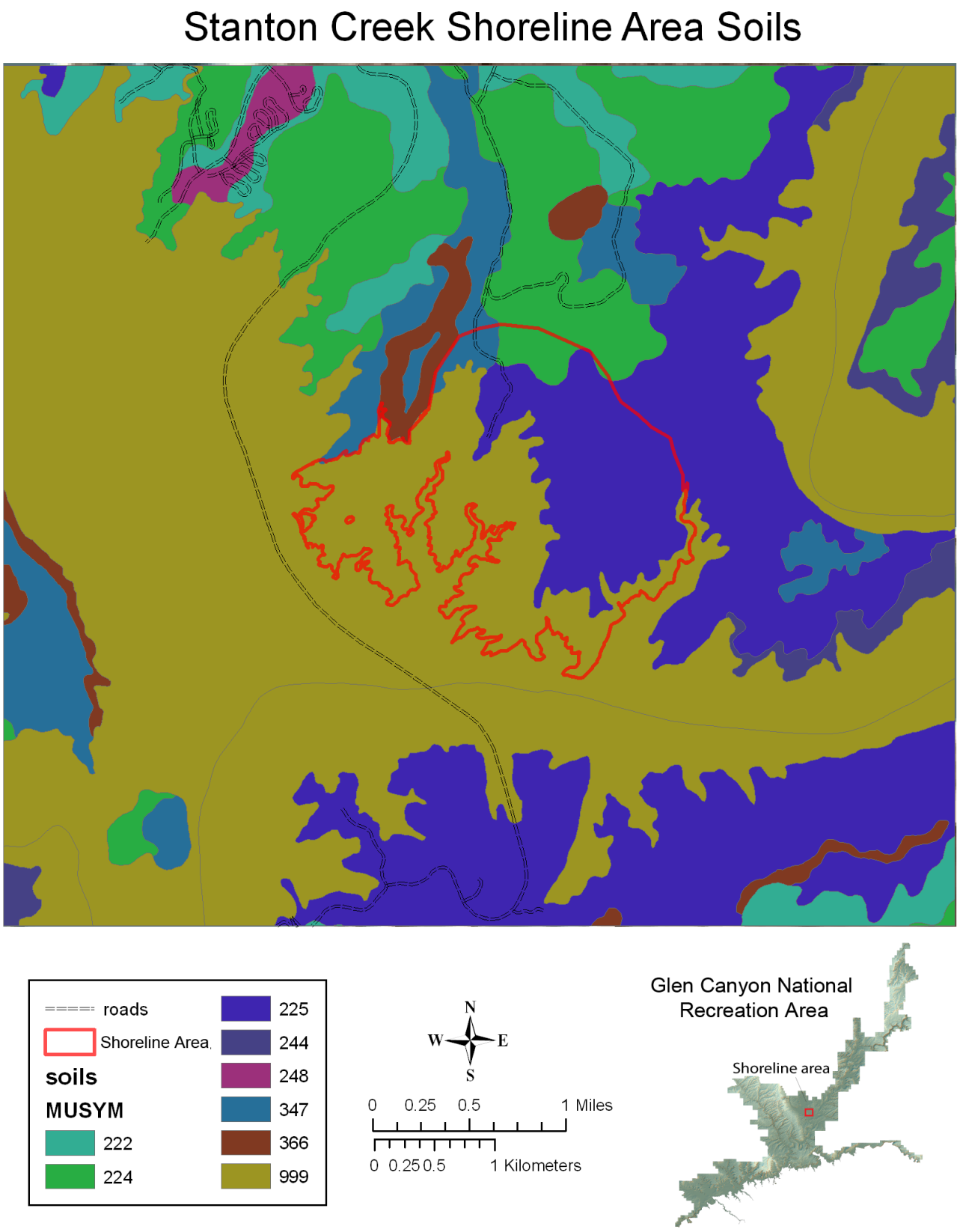

Figure 3.3. The Bullfrog region Stanton Creek shoreline vicinity soils.

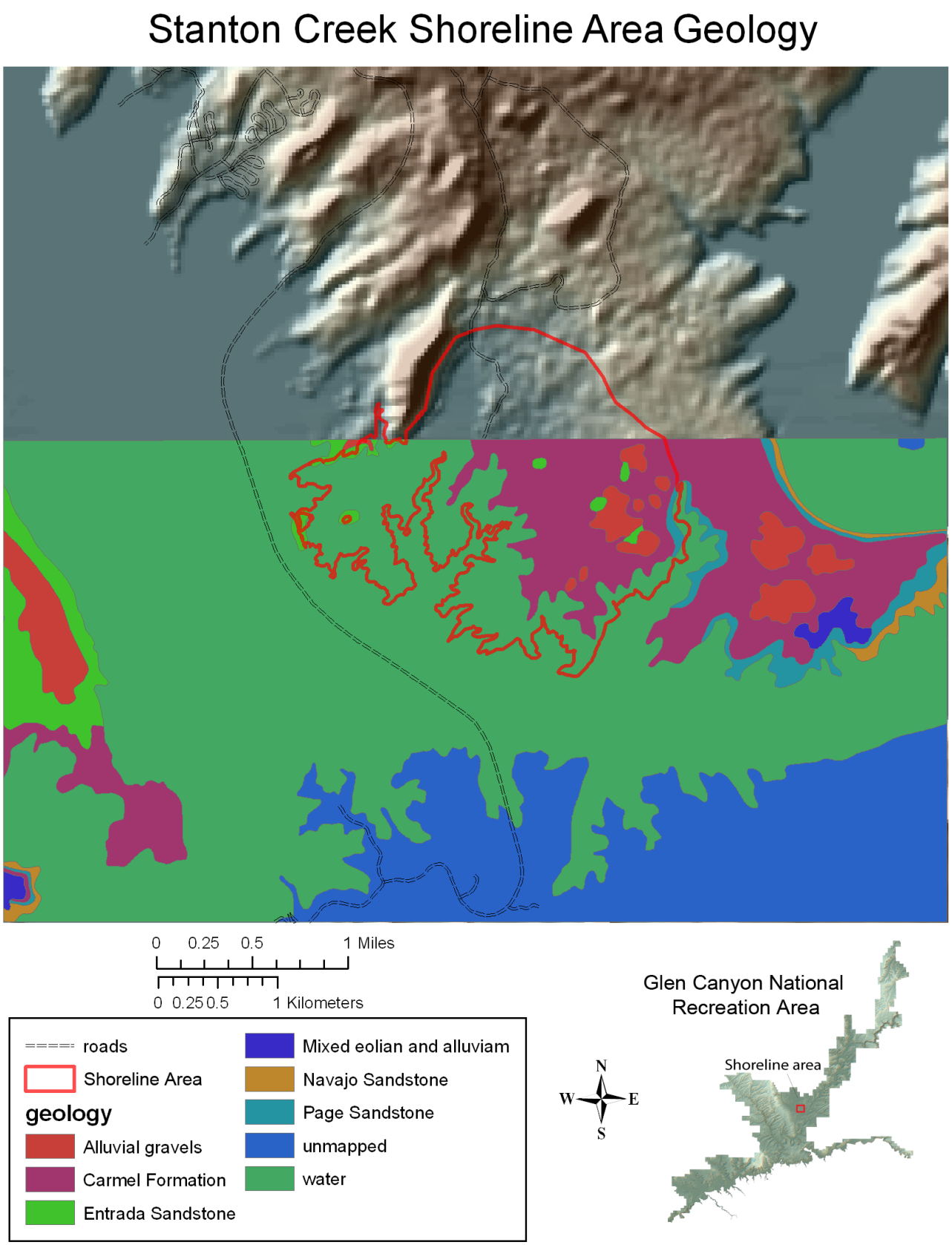

Figure 3.4. The Bullfrog region Stanton Creek shoreline vicinity geology. Note that for the northern half of the project area, geological information is not currently available.

Table 3.5. Stanton Creek shoreline area geology.

Geology	Symbol	Acres	%	No. Sites
Alluvial river terrace gravel	Qat	60.3	4.5	0
Carmel Formation	Jc	376.1	28.0	0
Entrada Sandstone	Je	25.7	1.9	0
Page Sandstone	Jp	8.5	0.6	0
Unmapped	n/a	233.6	17.4	5
Not identified	n/a	105	7.8	2
Water	999	533.1	39.7	9
Total	---	**1342.3**	**100**	**16**

Slope

As with the other environmental categories for the Stanton Creek areas, the slope data is lacking for a large portion of the project shoreline. In this case, the lack of data appears to be the result of the DEM being drafted when the lake levels were at or near full pool (Figure 3.5). However, the eastern portion of the project area does evince slope variability, with 104.96 acres (7.82 percent) exceeding 20 percent slopes. Only the highest of these slope areas, however, can be excluded from survey, as GCNRA reports unauthorized roads, although more common at lower slopes, do begin to traverse 25-degree (46.6 percent) slopes (Thann Baker, personal communication, 6/14/2010).

Survey Design and Recommendations

NAU's immediate recommendation is for 100 percent survey of the Stanton Creek shoreline. The natural boundaries of the proposed survey area are not conducive to broken-block surveys, and the general lack of environmental data and/or variation does not allow for viable stratified sampling of the shorelines.

However, in the event that GCNRA opts to sample the Bullfrog region shorelines, NAU suggests two separate survey options - one that focuses on the region immediately surrounding the road(s) providing access to the shorelines, and one that focuses specifically on the shoreline area below the full pool level of 3,700 feet amsl.

Survey Option 1

Survey Option 1 focuses on the region immediately surrounding the road providing access to the Stanton Creek shoreline, as the primary impetus for cultural resources survey in these areas is unauthorized ORV use.

At present, the Bullfrog region shoreline can by accessed by county road (CR) 530, which drops into the Stanton Creek area from the north. The area immediately surrounding the CR 530 access point in the Stanton Creek shoreline area accounts for 583.30 acres, or 43.46 percent of the total proposed project area. NAU selected this area using proximity to CR 530, natural topography, and the existing northern boundaries of the original Stanton Creek shoreline (Figure 3.6).

Recommended access for Survey Option 1 is by road, simulating ORV access and providing adaptive flexibility to the sampling strategy employed based on field observations of actual disturbance and damage along the shorelines. East-west oriented transects set perpendicular to CR 530 are logistically best in terms of survey crew access and changes to the survey strategy.

Survey Option 2

Survey Option 2 focuses on the actual Stanton Creek shoreline, defined as the area between the 3,600-ft level and the full pool level of 3,700 feet amsl. This area accounts for 688.15 acres (51.27 percent) of the original project area, as depicted in Figure 3.7. Either boat or vehicular access is acceptable with this survey option, as are either north-south or east-west oriented transects.

Additional Options

Lower sampling fractions, as listed below, are also possible, but difficult to assign without field-visits to identify high-impact ORV areas:

2 percent: 26.85 acres
5 percent: 67.12 acres
11 percent: 147.65 acres
16 percent: 214.77 acres
20 percent: 268.46 acres

In all instances, ground-visibility is expected to be excellent, with large portions of the ground bare of vegetation, when vegetation is indeed present. Additional recommendations based on GCNRA's prioritization of the shorelines is included in the final chapter of this document.

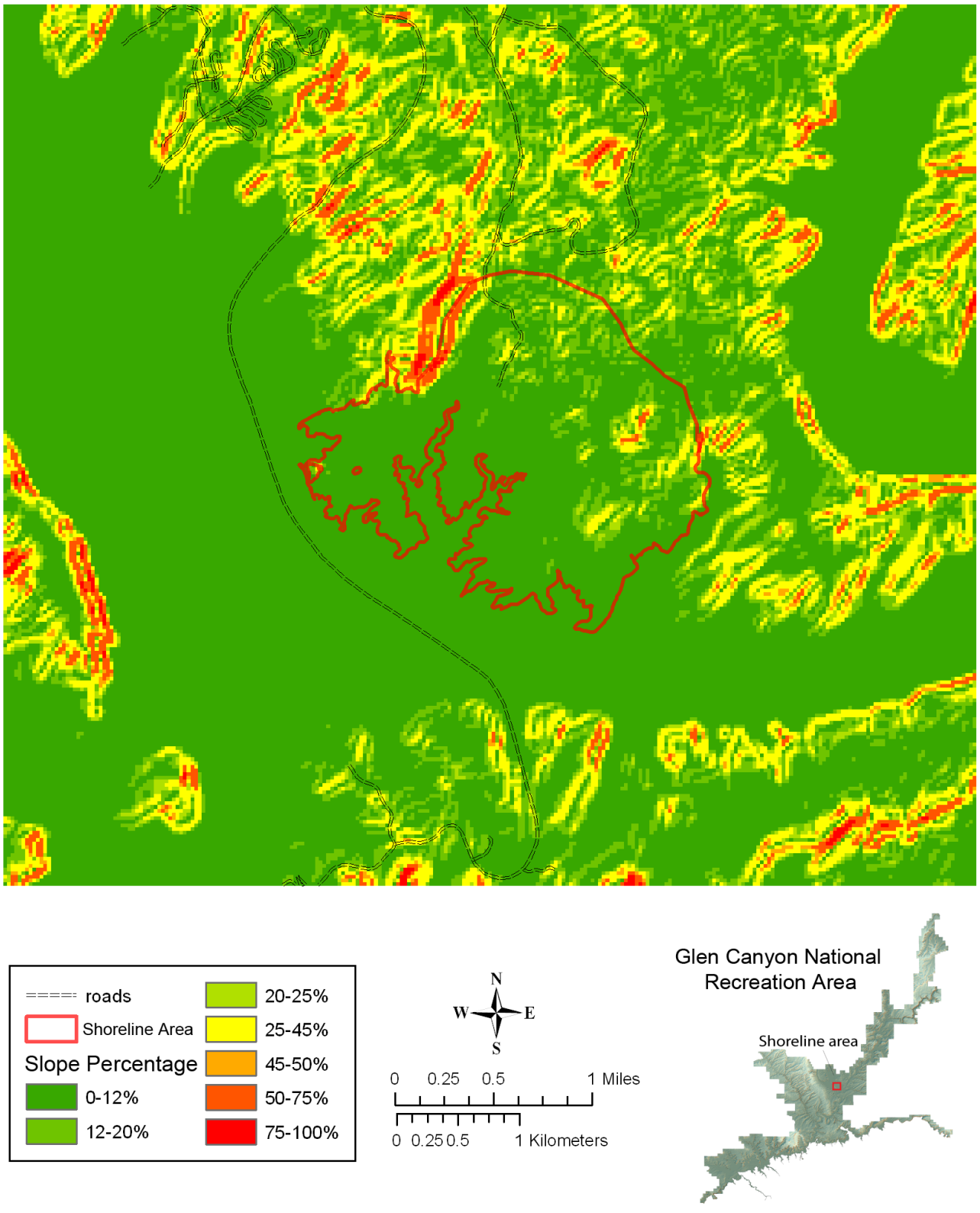

Figure 3.5. The Bullfrog region Stanton Creek shoreline slope.

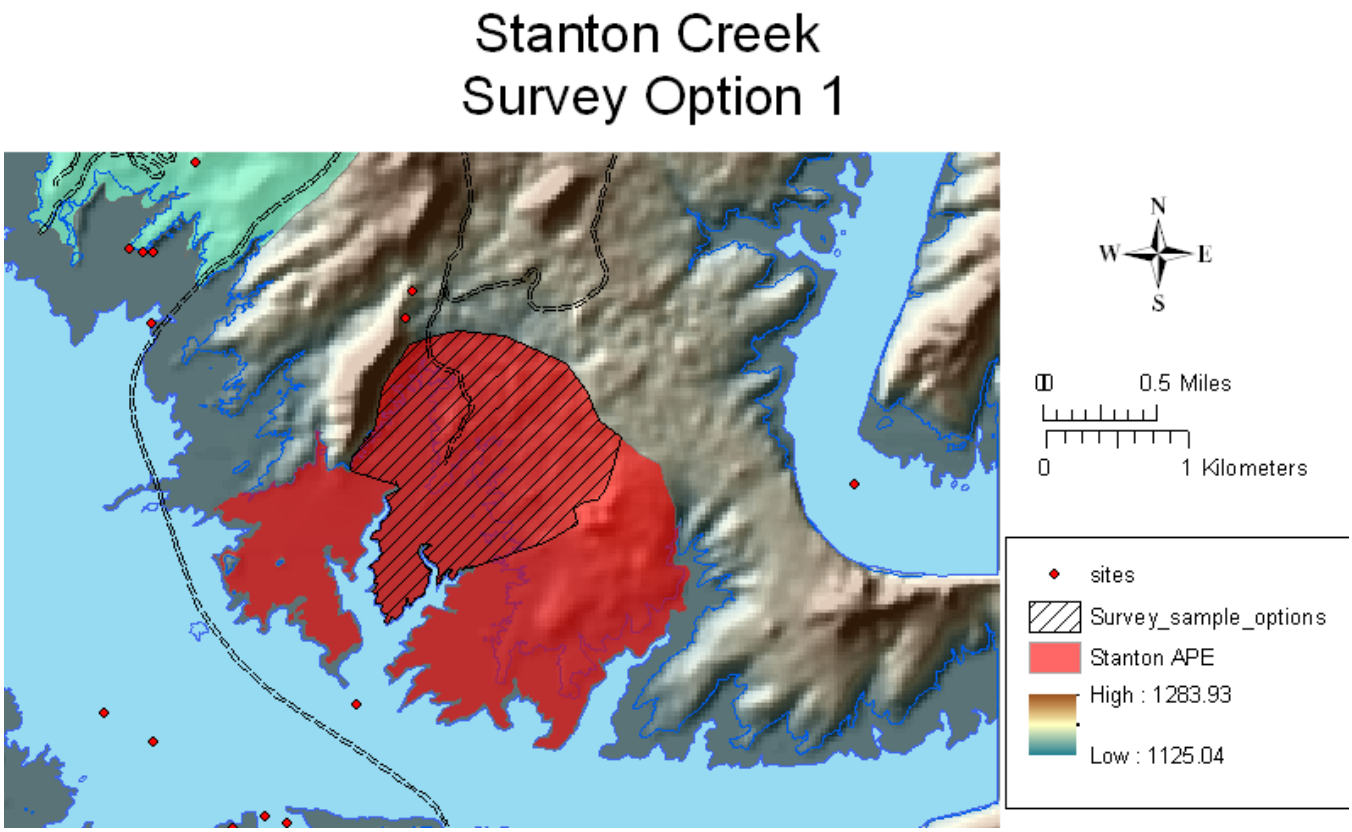

Figure 3.6. The Bullfrog region Stanton Creek shoreline sample survey Option 1.

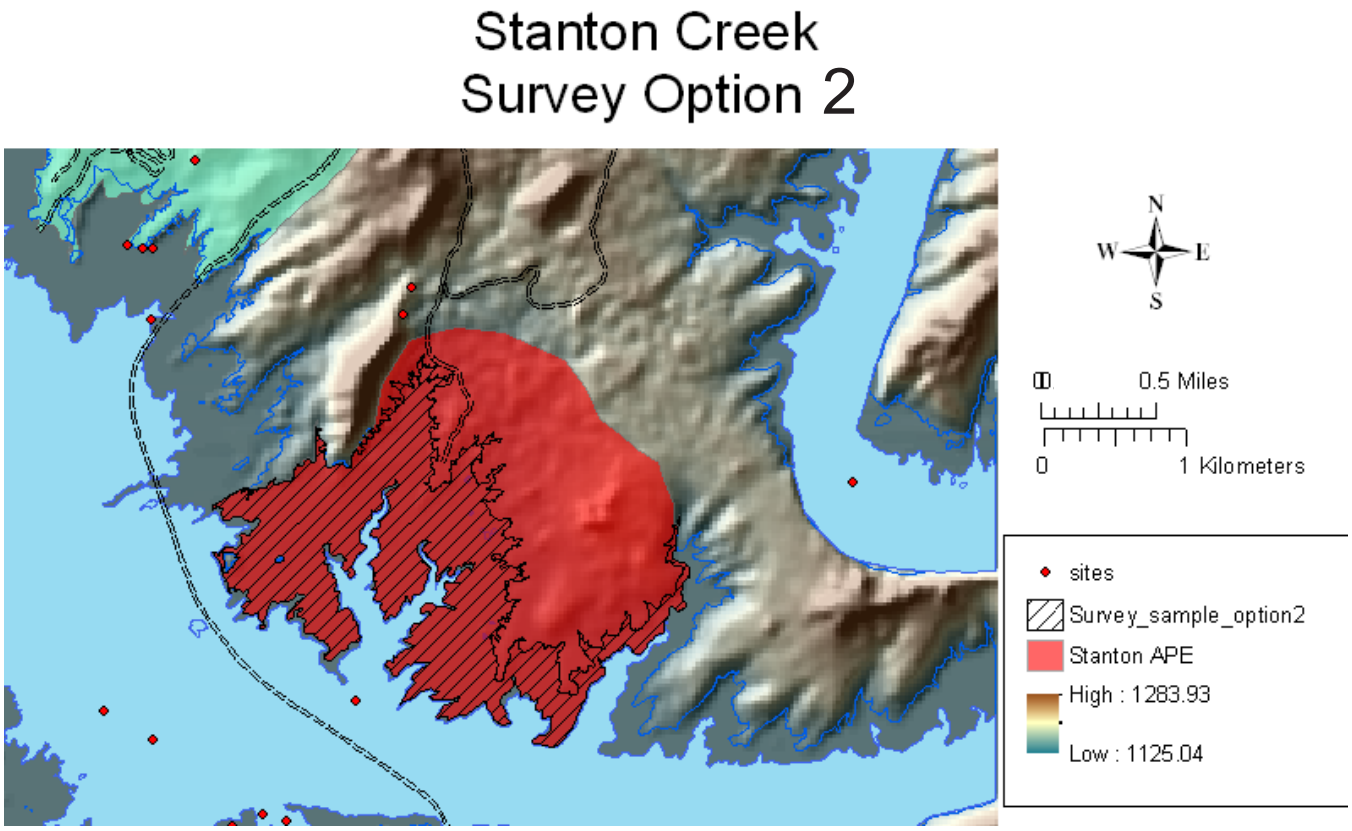

Figure 3.7. The Bullfrog region Stanton Creek shoreline sample survey Option 2.

Chapter 4.
Hite Region Shoreline(s):
Farley Canyon

Total Area
277.78 acres

Elevation Range amsl:
1,097.28 - 1,130.81 meters (3600 - 3710 feet)

The Hite region encompasses priority shorelines Farley Canyon, White Canyon, Blue Notch, and Red Canyon. This chapter reports specifically on Farley Canyon, which accounts for 277.78 acres of shoreline. Figure 4.1 depicts the Farley Canyon shoreline area, 1/2- and 1-mile buffers around the project area, associated known cultural sites within the project area and buffer zones, and the 3,600 feet and 3,700 feet levels of Lake Powell.

Previous Inventories

No cultural resources inventories are known in or around the Farley Canyon shoreline, as defined for this project.

Known Archaeological Sites

Three known cultural sites are located within 1/2-mile of the Farley Canyon shoreline, with no additional sites located in or around (within 1-mile) of the proposed project area (Table 4.1). Of the three known sites, affiliation and site type are known for only one site (GLCA01602), an Ancestral Puebloan site consisting of an isolated PII-III ceramic vessel, corn cob, and associated artifacts.

Environment: Context and Constraints

The Farley Canyon shoreline lies between 1,097.28 - 1,130.81 meters (3600 - 3710 feet), with the latter just above the full pool level of Lake Powell. With few exceptions, the environmental data, including vegetation, soils, geology, and slope is largely lacking, with each category having been classed as 'water' in the respective datasets. However, by drawing from the surrounding environment, and deriving the relationships of the vicinity cultural resources to that environment, NAU provides a generalized environmental context for the Farley Canyon priority shoreline, and when possible, makes recommendations as to how to proceed with actual on-the-ground inventory of the shoreline.

Table 4.1. Known archaeological sites in the vicinity of the Farley Canyon shoreline area.

ASMIS No.	Type[1]	Affil.[2]	In[3]	1/2m [4]	1m[5]
GLCA01490	U	U		X	
GLCA01491	U	U		X	
GLCA01602	Iso. Pot	AP		X	

[1] U = Unknown
[2] U = Unknown, AP = Ancestral Puebloan
[3] Within the current shoreline boundary
[4] Within 1/2 mile (800 meters) of the current shoreline boundary
[5] Within 1 mile (1600 meters) of the current shoreline boundary

Vegetation

The identified primary dominant vegetation zones within the Farley Canyon shoreline area includes blackbrush (53.04 percent) and shadscale (37.69 percent), with a portion of the area (19.11 percent) exhibiting unidentified vegetation cover (Table 4.2; Figure 4.2).

The dominant species present within these zones include shadscale (*Atriplex confertifolia*) and blackbrush (*Coleogyne ramosissima*), with fourwing saltbush (*Atriplex canescens)* common as a secondary species. Of the three sites known within 1/2 mile of the Farley Canyon project area, two are located in shadscale, and the third - the PII-III site, is located in the blackbrush community.

Table 4.2. Vegetation of the Farley Canyon shoreline vicinity.

Dominant Species	Acres	%	No. Sites
Not identified	77.3	27.8	0
Blackbrush (*Coleogyne ramosissima*)	147.4	53.0	1
Shadscale *(Atriplex confertifolia)*	53.1	19.1	2
Total	**277.9**	**100**	**3**

Figure 4.1. The Hite region Farley Canyon shoreline area.

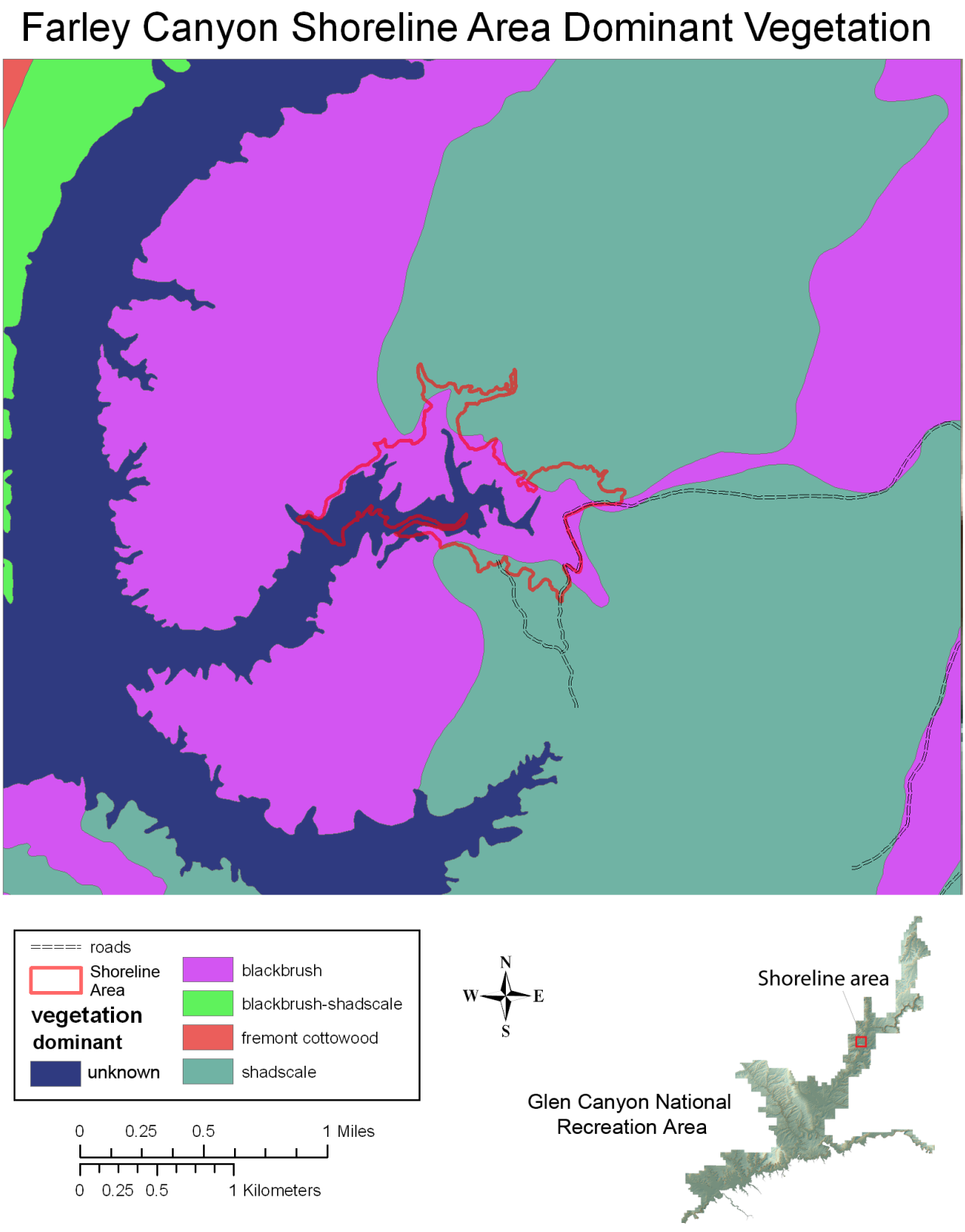

Figure 4.2. The Hite region Farley Canyon shoreline area vegetation.

Soils

The provided data show three soil types within the vicinity of the Stanton Creek shoreline area (Table 4.2). Rock outcrop-Torriorthents complex soils comprise 15.2 percent of the area, followed by Somorent family-outcrop soils (6.1 percent), and Tsaya-Rock outcrop soils (0.4 percent). As is typical of shoreline locations, however, the majority of the shoreline soil data is simply reported as 'water' because of the Lake Powell inundation (Figure 4.3).

Of the three cultural sites known within 1/2-mile of the Farley Canyon shoreline, the PII-III site is situated on the Tsaya-Rock complex, and the others are underlain by Somorent family-outcrop soils.

Table 4.3. Farley Canyon soil types.

Soil Type	MUSYM	Acres	%	No. Sites
Rock outcrop-Torriorthents complex	366	42.2	15.2	0
Somorent family-rock outcrop	348	17.0	6.1	2
Tsaya-Rock outcrop	324	1.0	0.4	1
Water	999	217.7	78.3	0
Total	**---**	**277.9**	**100**	**3**

Geology

The available data for the Farley Canyon shoreline is far more complete than that for any other shoreline discussed in this document, and illustrates the variable geological formations underlying the Hite region. The geological formations include alluvial river terrace gravels, alluvial and eolian deposits, lacustrine deposits, Organ Rock Shale, the upper member of the Moenkopi Formation, and White Rim Sandstone (Figure 4.4; Table 4.4).

Of the three sites within the vicinity of the Farley Canyon shoreline area, Organ Rock Shale underlays the two sites for which cultural affiliation and site type data is currently lacking, and the upper member of the Moenkopi Formation underlies the PII-III site.

Slope

The slope of Farley Canyon is variable, but primarily less than 12-20 percent (Figure 4.5). Escarpments along the northern and southern boundaries of the shoreline area increase substantially in slope. However, the areas of steep slope account for a small portion of the areas and do not affect the sampling strategy. The escarpments do pose natural boundaries in determining survey area, transect orientation, and access into the shoreline areas, as discussed below.

Table 4.4. Farley Canyon shoreline area geology.

Geology	Symbol	Acres	%	No. Sites
Alluvial and eolian deposits	Qae	19.78	6.40	0
Alluvial terrace gravel deposits	Qat	63.86	20.65	0
Lacustrine deposits	Ql	25.54	8.26	0
Organ Rock Shale	Po	189.35	61.22	2
Upper Member Moenkopi Formation	Trmu	4.46	1.44	1
White Rim Sandstone	Pwr	6.31	2.04	0
Total	**---**	**309.3**	**100**	**3**

Survey Design and Recommendations

NAU's recommendation is for 100 percent survey of the Farley Canyon shoreline, with no alternatives provided herein. The reason for this decision is two-fold - first, the size of the Farley Canyon shoreline is relatively small (277.78 acres), and second, access requires vehicle travel first on Highway 95 and then CR 630, which is costly because of the northern location of the shoreline within GCNRA boundaries and the potentially primitive nature of the road.

Ground-visibility is expected to be excellent, with large portions of the ground bare of vegetation, when vegetation is indeed present. Natural boundaries and a latitudinal long axis suggests north-south transect orientation, or division of the project area into east and west halves with east-west transects. Additional recommendations based on GCNRA's prioritization of the shorelines is included in the final chapter of this document.

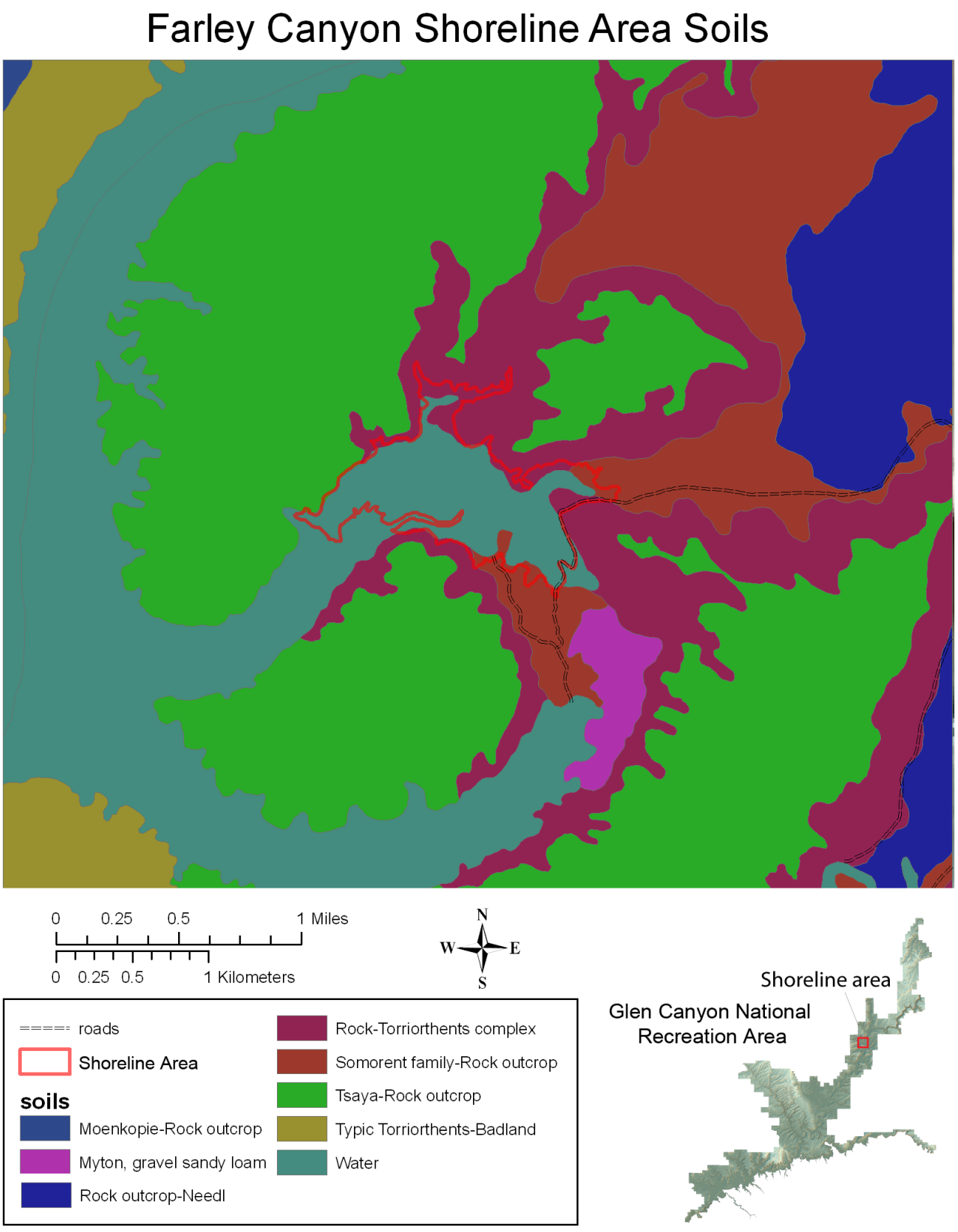

Figure 4.3. The Hite region Farley Canyon shoreline area soils.

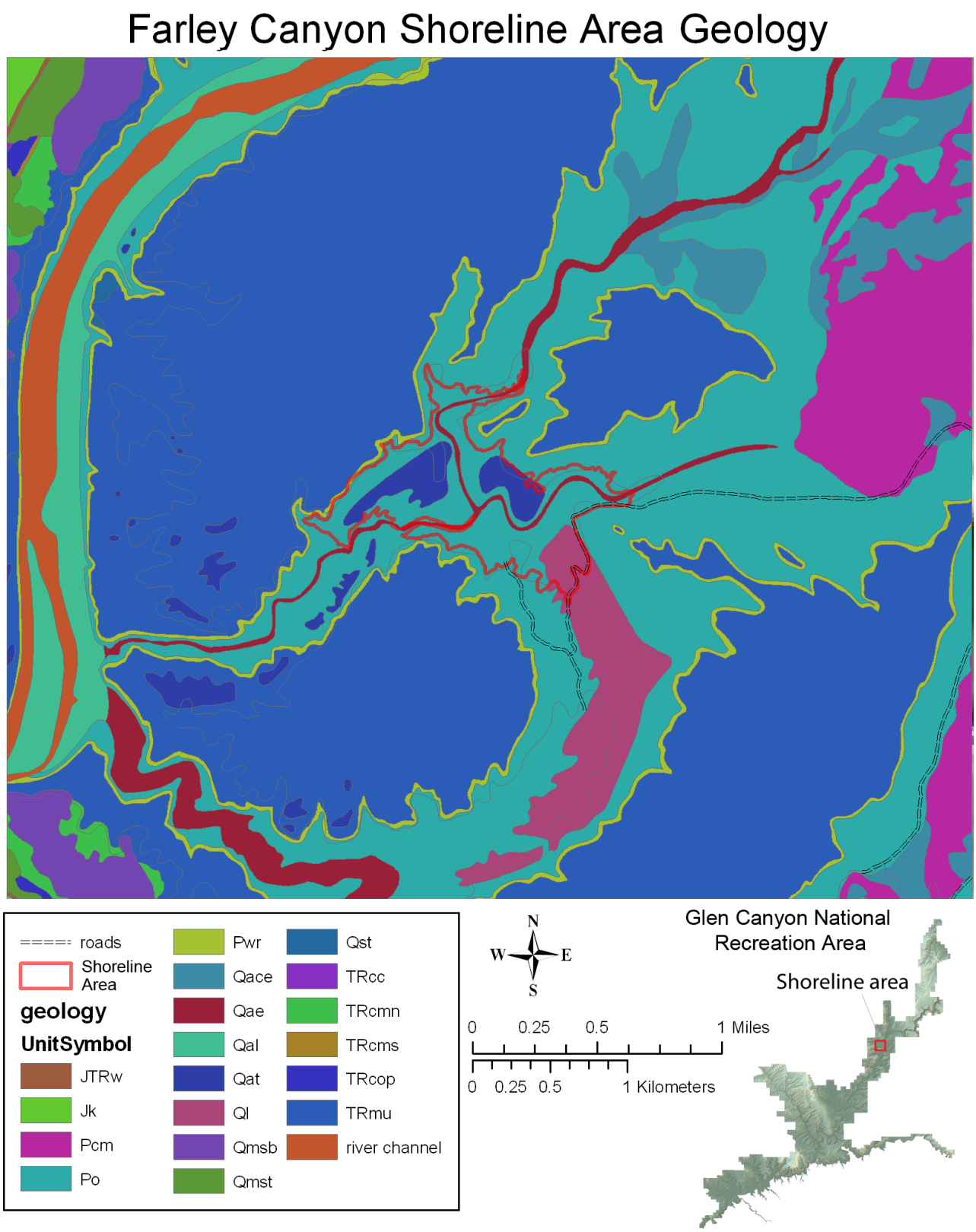

Figure 4.4. The Hite region Farley Canyon shoreline area geology.

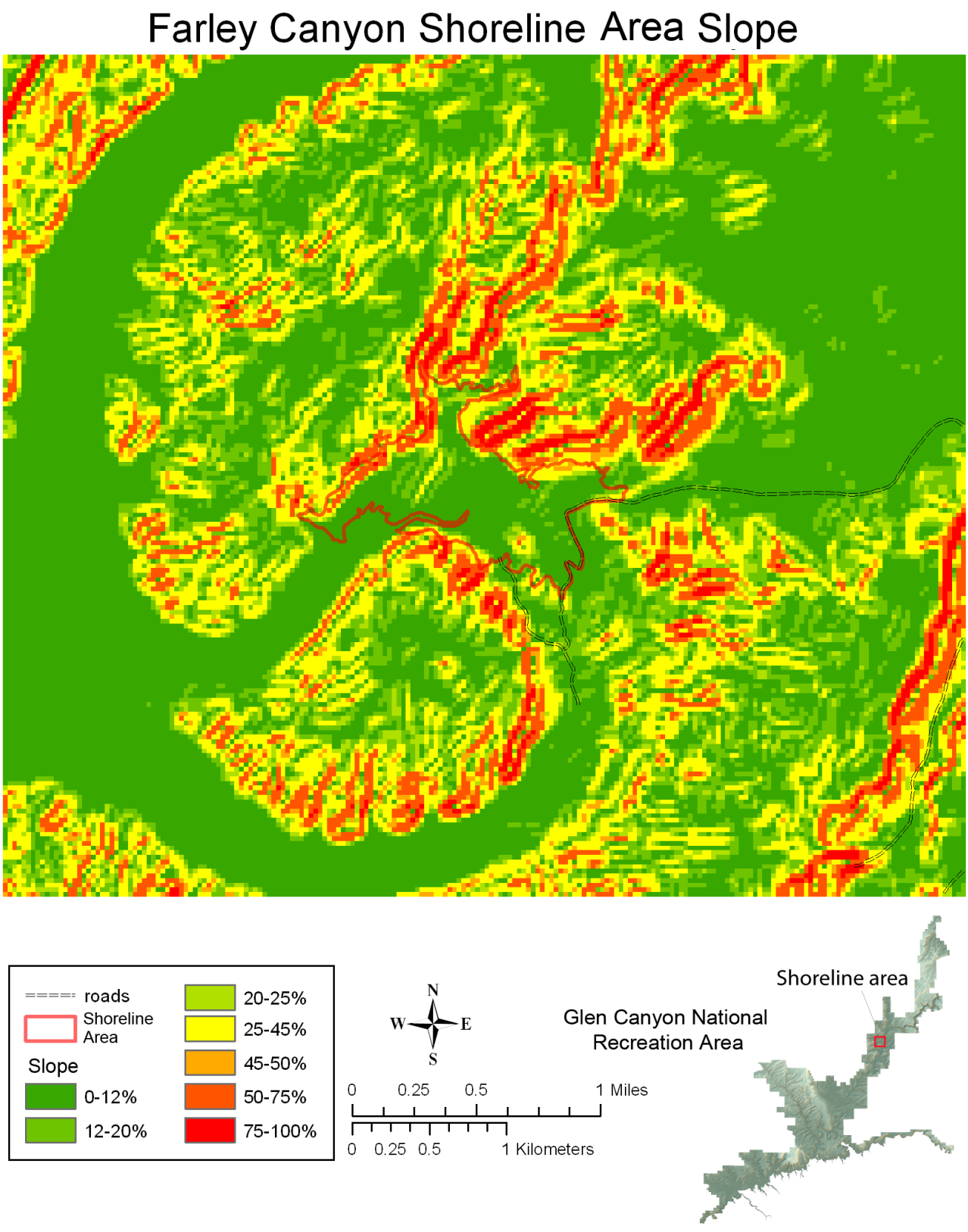

Figure 4.5. The Hite region Farley Canyon shoreline area slope.

Chapter 5.
Hite Region Shoreline(s): White Canyon

Total Area
330.39 acres

Elevation Range amsl:
1,097.28 - 1,130.81 meters (3600 - 3710 feet)

The Hite region encompasses priority shorelines Farley Canyon, White Canyon, Blue Notch, and Red Canyon. This chapter reports specifically on White Canyon, which accounts for 330.39 acres of shoreline. Figure 5.1 depicts the White Canyon shoreline area, 1/2- and 1-mile buffers around the project area, associated known cultural sites within the project area and buffer zones, and the 3,600 feet and 3,700 feet levels of Lake Powell.

Previous Inventories

No cultural resources inventories are known in or around the White Canyon shoreline, as defined for this project.

Known Archaeological Sites

Only one site (GLCA01520) is known within 1-mile of the White Canyon shoreline. The site database lists three structures and general features as present, but provides no additional information as to affiliation or site composition. Original site data should be available in Schroedl (1981a)*.

Environment: Context and Constraints

The White Canyon shoreline lies between 1,097.28 - 1,130.81 meters (3600 - 3710 feet), with the latter just above the full pool level of Lake Powell. With few exceptions, the environmental data, including vegetation, soils, geology, and slope is largely lacking, with each category having been classed as 'water' in the respective datasets. However, by drawing from the surrounding environment, and deriving the relationships of the vicinity cultural resources to that environment, NAU provides a generalized environmental context for the White Canyon priority shoreline, and when possible, makes recommendations as to how to proceed with actual on-the-ground inventory of the shoreline.

Vegetation

The identified primary dominant vegetation zones within the White Canyon shoreline area include blackbrush (0.4 percent) and shadscale (54.1 percent), as presented in Table 5.1 and Figure 5.2).

The dominant species present within these zones include shadscale (*Atriplex confertifolia*) and blackbrush (*Coleogyne ramosissima*), with fourwing saltbush (*Atriplex canescens)* common as a secondary species. The single known vicinity site occurs within the shadscale community.

Table 5.1. Vegetation of the White Canyon shoreline vicinity.

Dominant Species	Acres	%	No. Sites
Not identified	150.5	45.6	0
Blackbrush (*Coleogyne ramosissima*)	1.2	0.4	0
Shadscale *(Atriplex confertifolia)*	178.6	54.1	1
Total	**330.3**	**100**	**1**

Soils

The provided data show three soil types within the vicinity of the Stanton Creek shoreline area (Table 5.2). Rock outcrop-Torriorthents complex soils comprise 7.4 percent of the area, followed by Somorent family-outcrop soils (7.1 percent), and Tsaya-Rock outcrop soils (0.7 percent). As is typical of shoreline locations, however, the majority of the shoreline soil data is simply reported as 'water' because of the Lake Powell inundation (Figure 5.3).

The single known vicinity site is located on Tsaya-Rock outcrop soils.

* Schroedl (1981a) is the short citation corresponding with GCNRA's cultural resources library/database. The full reference is available from GCNRA.

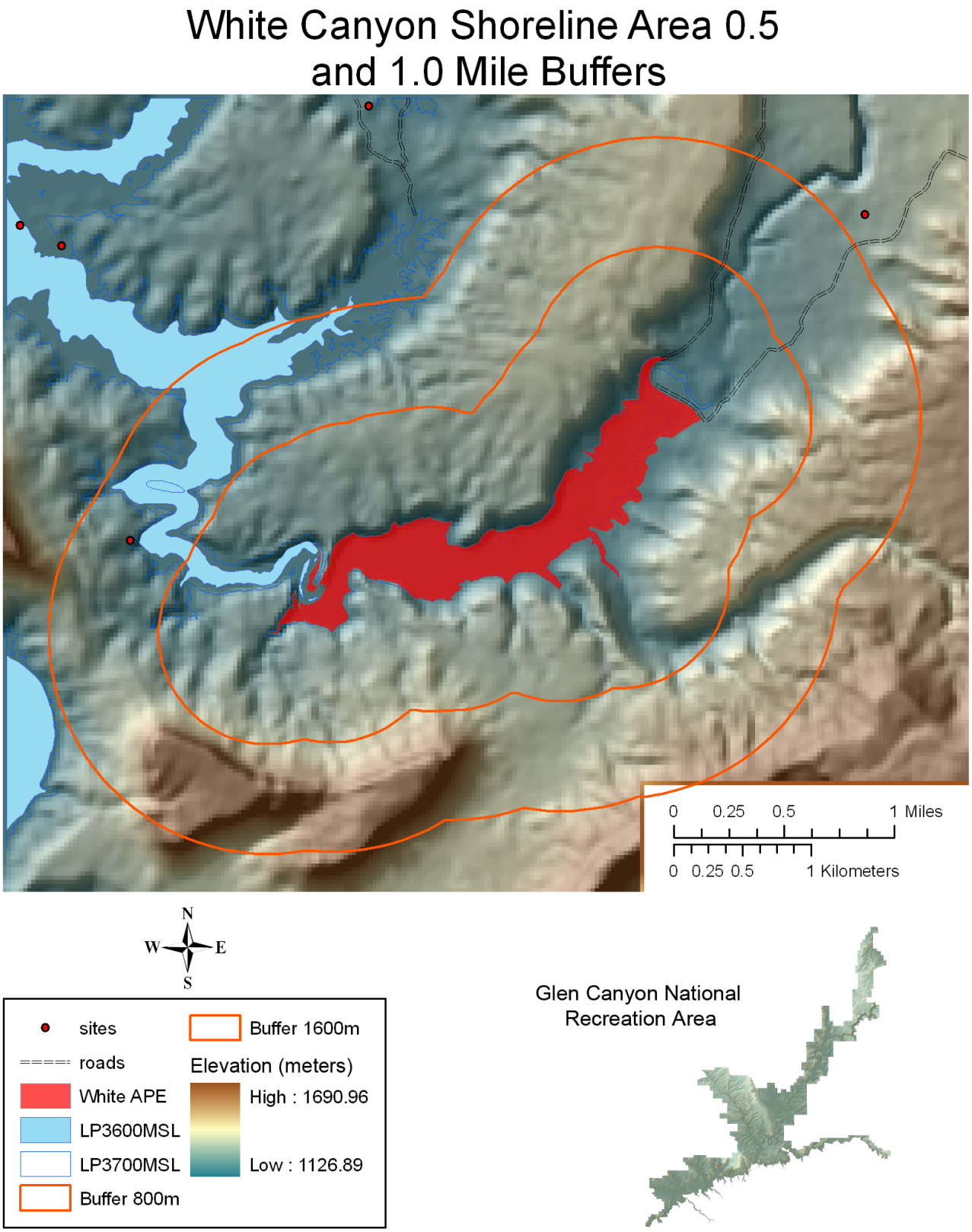

Figure 5.1. The Hite region White Canyon shoreline area.

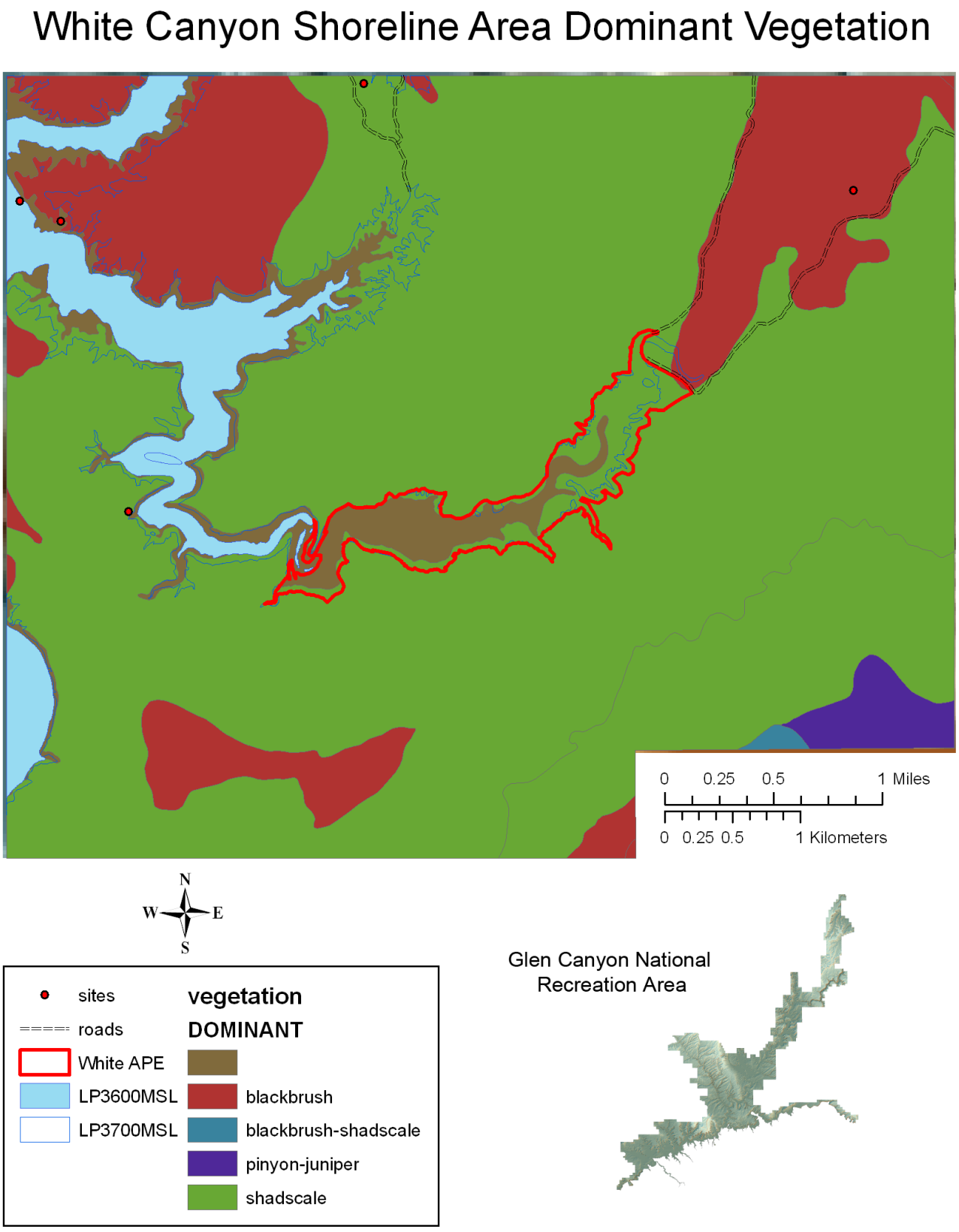

Figure 5.2. The Hite region White Canyon shoreline area vegetation.

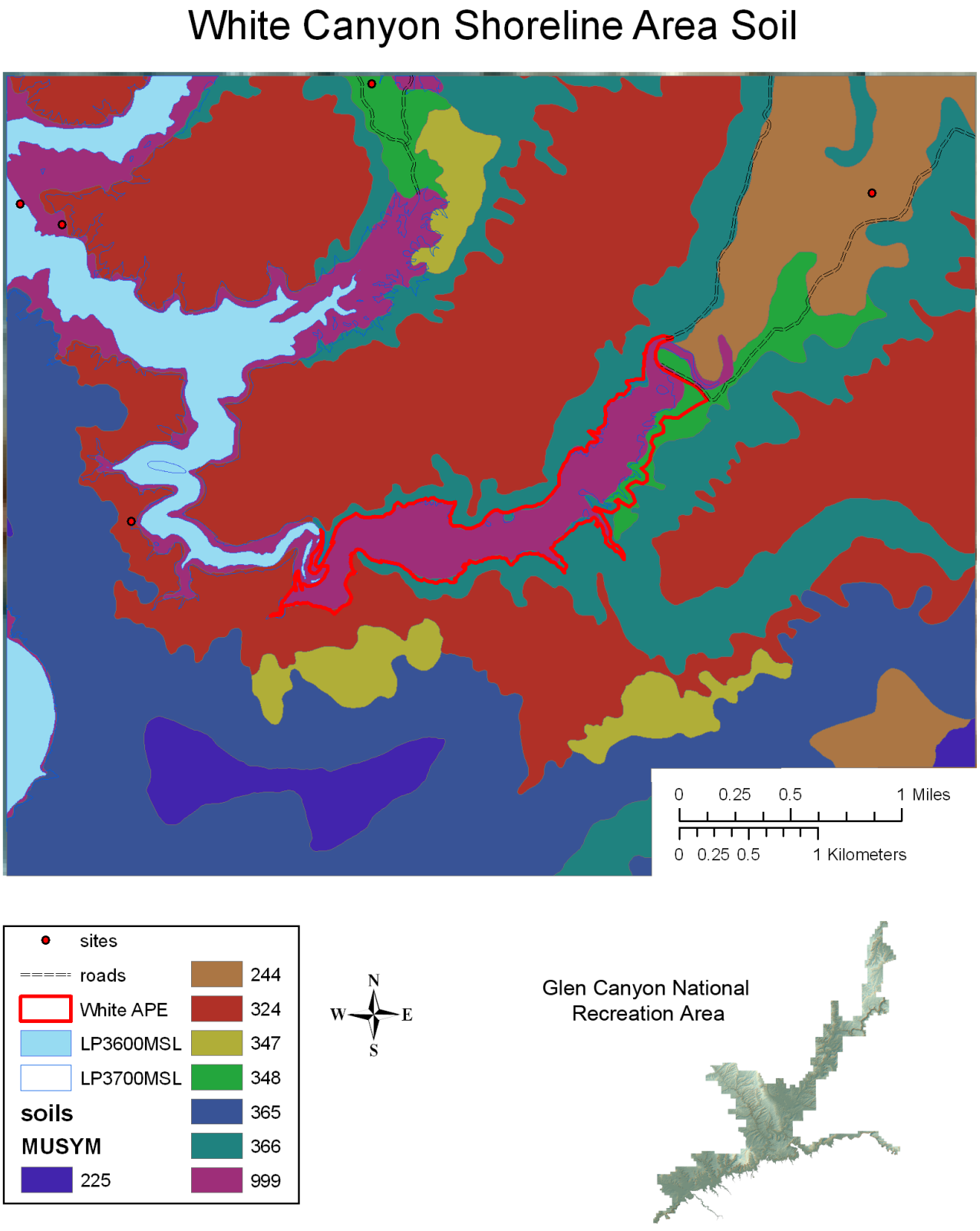

Figure 5.3. The Hite region White Canyon shoreline soils.

Table 5.2. White Canyon soil types.

Soil Type	MUSYM	Acres	%	No. Sites
Rock outcrop-Torriorthents complex	366	24.5	7.4	0
Somorent family-rock outcrop	348	23.6	7.1	0
Tsaya-Rock outcrop	324	2.3	0.7	1
Water	999	279.9	84.7	0
Total	**---**	**330.3**	**100**	**1**

Geology

As was the case for Farley Canyon, the available data for the White Canyon shoreline is far more complete than that for any other shoreline discussed in this document, and illustrates the variable geological formations underlying the Hite region. The geological formations of the White Canyon shoreline include alluvial river terrace gravel deposits, alluvial and eolian deposits, lacustrine deposits, Orange Rock Shale, and White Rim Sandstone (Figure 5.4; Table 5.3).

The single known vicinity site is located atop the upper member of the Moenkopi Formation, a geological context that does not extend into the proposed project area.

Table 5.3. White Canyon shoreline area geology.

Geology	Symbol	Acres	%	No. Sites
Alluvial and eolian deposits	Qae	19.78	6.40	0
Alluvial terrace gravel deposits	Qat	63.86	20.65	0
Lacustrine deposits	Ql	25.54	8.26	0
Organ Rock Shale	Po	189.35	61.22	2
Upper Member Moenkopi Formation	Trmu	4.46	1.44	1
White Rim Sandstone	Pwr	6.31	2.04	0
Total	**---**	**309.3**	**100**	**3**

Slope

The slope data is lacking for the majority of the project shoreline. In this case, the lack of data appears to be the result of the DEM being drafted when the lake levels were at or near full pool (Figure 5.5). Escarpments along the northern and southern boundaries of the shoreline area increase substantially in slope. However, the areas of steep slope account for a small portion of the areas and do not affect the sampling strategy. The escarpments do pose natural boundaries in determining survey area, transect orientation, and access into the shoreline areas, as discussed below.

Survey Design and Recommendations

NAU's recommendation is for 100 percent survey of the White Canyon shoreline, with no alternatives provided herein. The reason for this decision is two-fold - first, the size of the White Canyon shoreline is relatively small (330.39 acres), and second, access requires vehicle travel first on Highway 95 and then CR 656 and/or CR 657, which is costly because of the northern location of the shoreline within GCNRA boundaries and the potentially primitive nature of the roads.

Ground-visibility is expected to be excellent, with large portions of the ground bare of vegetation, when vegetation is indeed present. Access from the east suggests east-west transects would provide the easiest transect orientation for vehicle accessibility. Natural boundaries and a latitudinal long axis suggests north-south transect orientation. Based on these criteria, NAU suggests east-west transects for the east and west portions of the shoreline area, and north-south transects for the central portion of the project area. Additional recommendations based on GCNRA's prioritization of the shorelines is included in the final chapter of this document.

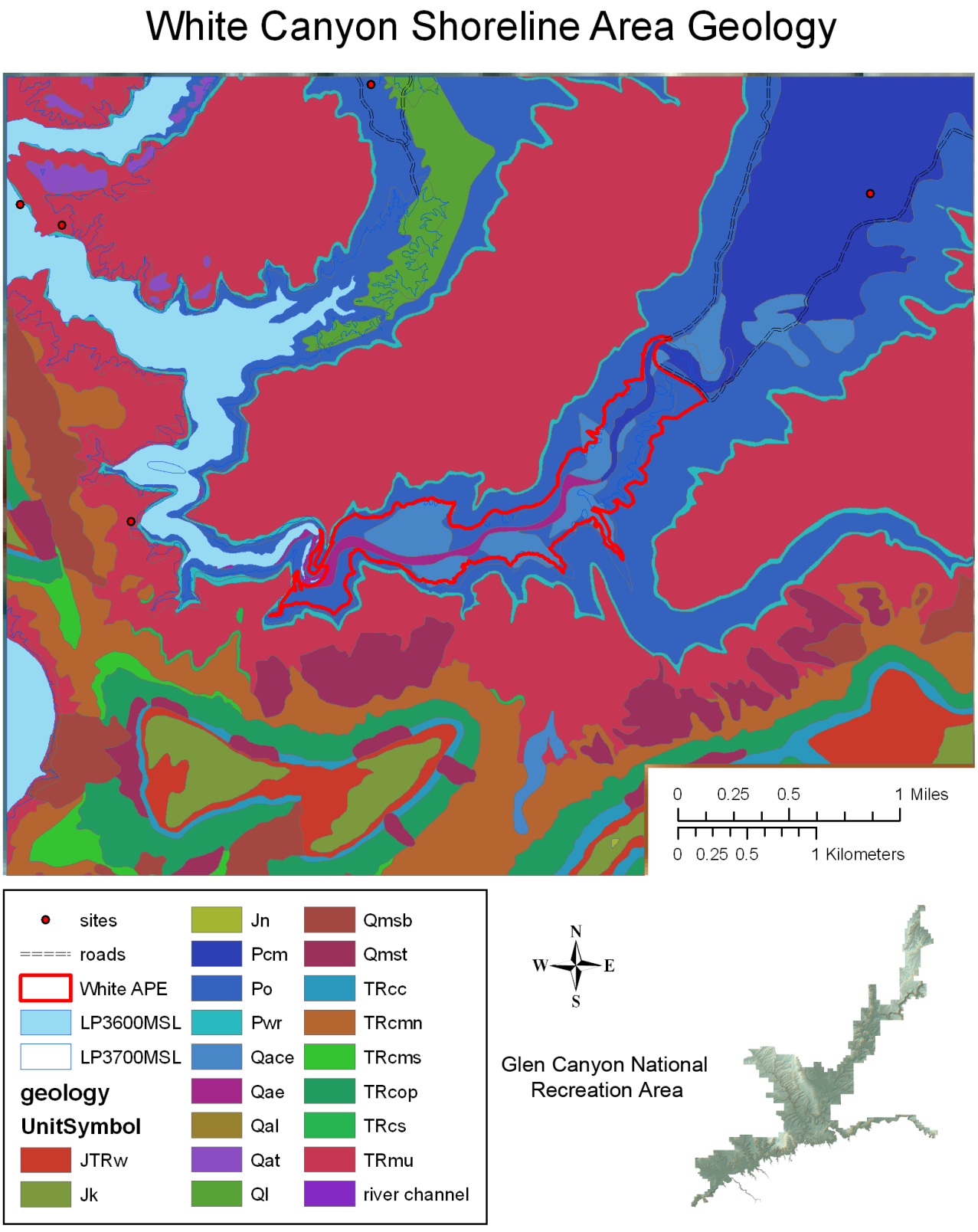

Figure 5.4. The Hite region White Canyon shoreline geology.

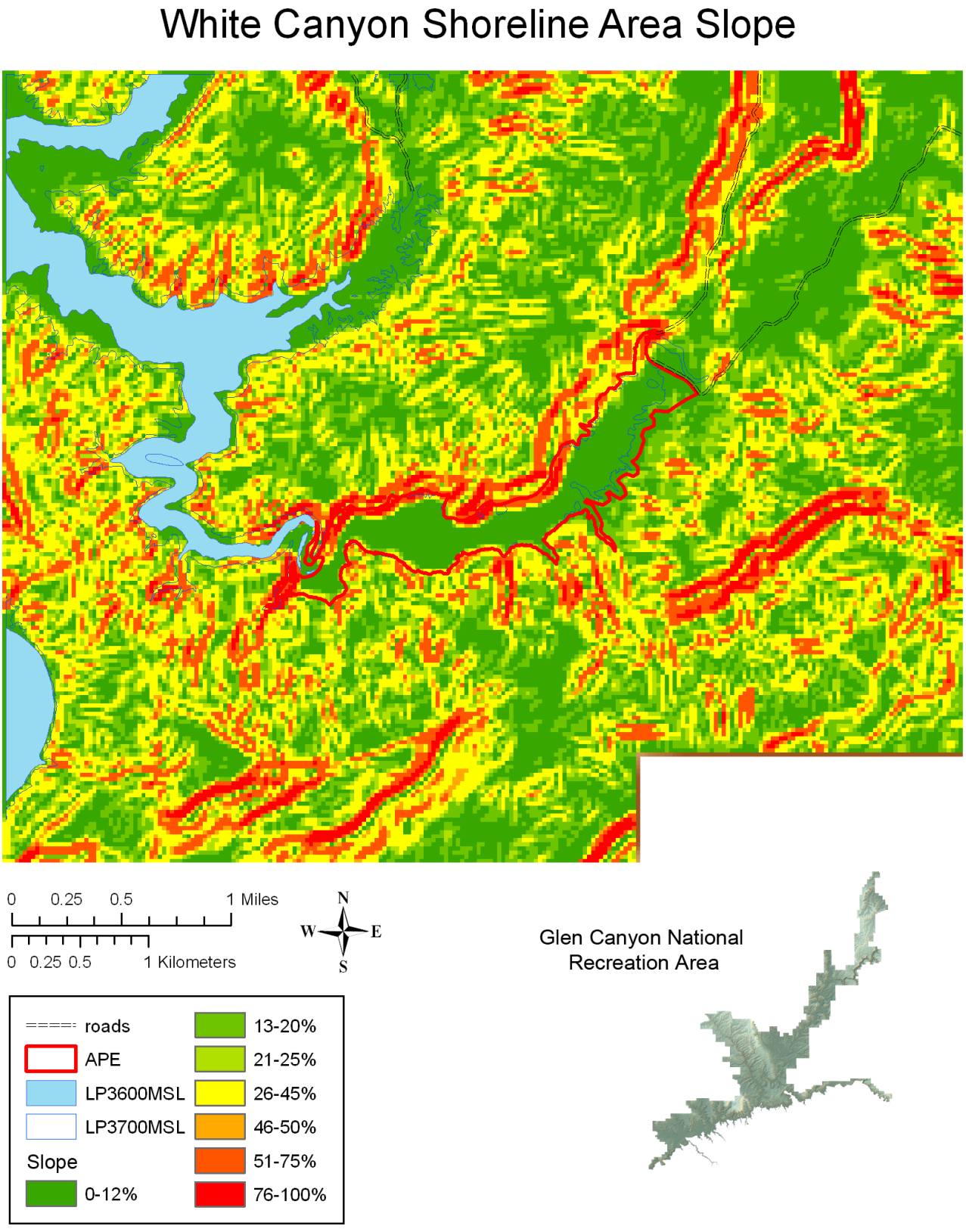

Figure 5.5. The Hite region White Canyon shoreline slope.

Chapter 6.
Hite Region Shoreline(s):
Blue Notch and Red Canyon

Total Area
628.98 acres
(Blue Notch = 327.33; Red Canyon = 301.65)

Elevation Range amsl:
1,097.28 - 1,130.81 meters (3600 - 3710 feet)

The Hite region encompasses priority shorelines Farley Canyon, White Canyon, Blue Notch, and Red Canyon. This chapter reports specifically on Blue Notch and Red Canyon, which together account for 628.98 acres of shoreline. Figure 6.1 depicts the Blue Notch and Red Canyon shoreline areas, 1/2- and 1-mile buffers around the project area, associated known cultural sites within the project area and buffer zones, and the 3,600 feet and 3,700 feet levels of Lake Powell.

Previous Inventories

No cultural resources inventories are known in or around the White Canyon shoreline, as defined for this project.

Known Archaeological Sites

Two sites are known within 1-mile of the combined project areas. One site (GLCA01228) was a Mesa Verde (PII-III) structural site excavated in 1958-1959. The second site (GLCA01276) was a PIII Ancestral Puebloan structural site with possible Hopi affiliation excavated in 1959. Both sites are destroyed and inundated.

Environment: Context and Constraints

The Blue Notch and Red Canyon shorelines lies between 1,097.28 - 1,130.81 meters (3600 - 3710 feet), with the latter just above the full pool level of Lake Powell. With few exceptions, the environmental data, including vegetation, soils, geology, and slope is largely lacking, with each category having been classed as 'water' in the respective datasets. However, by drawing from the surrounding environment, and deriving the relationships of the vicinity cultural resources to that environment, NAU provides a generalized environmental context for the Blue Notch and Red Canyon priority shorelines, and when possible, makes recommendations as to how to proceed with actual on-the-ground inventory of the shorelines.

Vegetation

The identified primary dominant vegetation zones within the Blue Notch and Red Canyon shoreline areas include blackbrush and shadscale, as presented in Tables 6.1-6.2 and Figure 6.2.

The dominant species present within the combined shorelines include blackbrush (*Coleogyne ramosissima*), shadscale (*Atriplex confertifolia*) and fourwing saltbush (*Atriplex canescens).* Fremont cottonwood (*Populus fremontii*) is also present as a secondary species.

Both vicinity sites are in areas inundated by Lake Powell, and vegetation is unknown for those areas at this time. Note that one site (GLCA01276) is within 1-mile of both shorelines and therefore counted twice in the tables below.

Table 6.1. Vegetation of the Blue Notch shoreline vicinity.

Dominant Species	Acres	%	No. Sites
Not identified	123	37.6	2
Blackbrush (*Coleogyne ramosissima*)	204.3	62.4	0
Total	**327.3**	**100**	**2**

Table 6.2. Vegetation of the Red Canyon shoreline vicinity.

Dominant Species	Acres	%	No. Sites
Not identified	125.09	39.32	0
Blackbrush (*Coleogyne ramosissima*)	65.65	20.63	0
Blackbrush-shadscale (*Coleogyne ramosissima - Atriplex confertifolia*)	114.18	35.89	0
Fourwing saltbush (*Atriplex canescens*)	13.21	4.15	0
Total	**318.13**	**99.99**	**1**

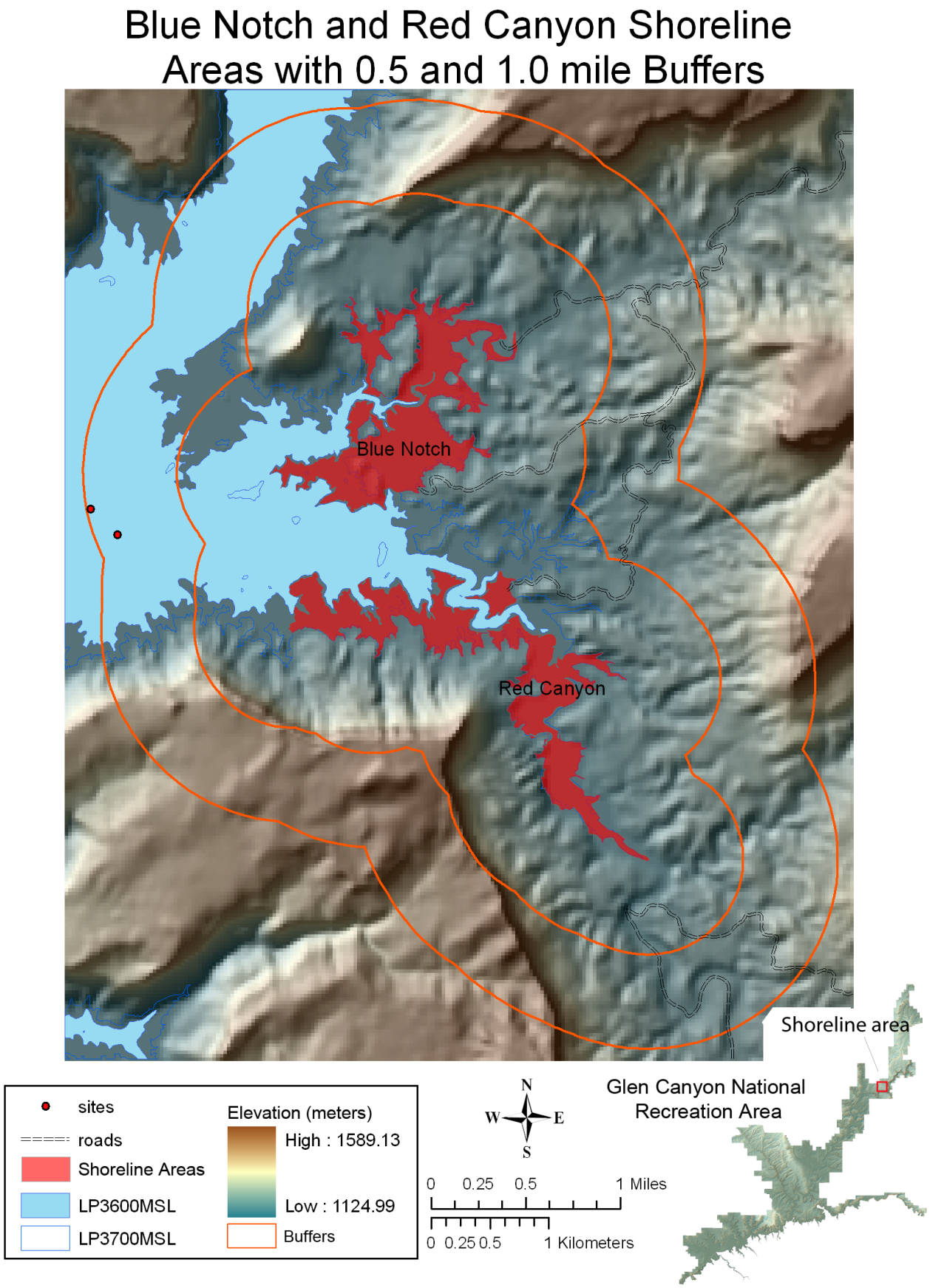

Figure 6.1. The Hite region Blue Notch and Red Canyon shoreline areas.

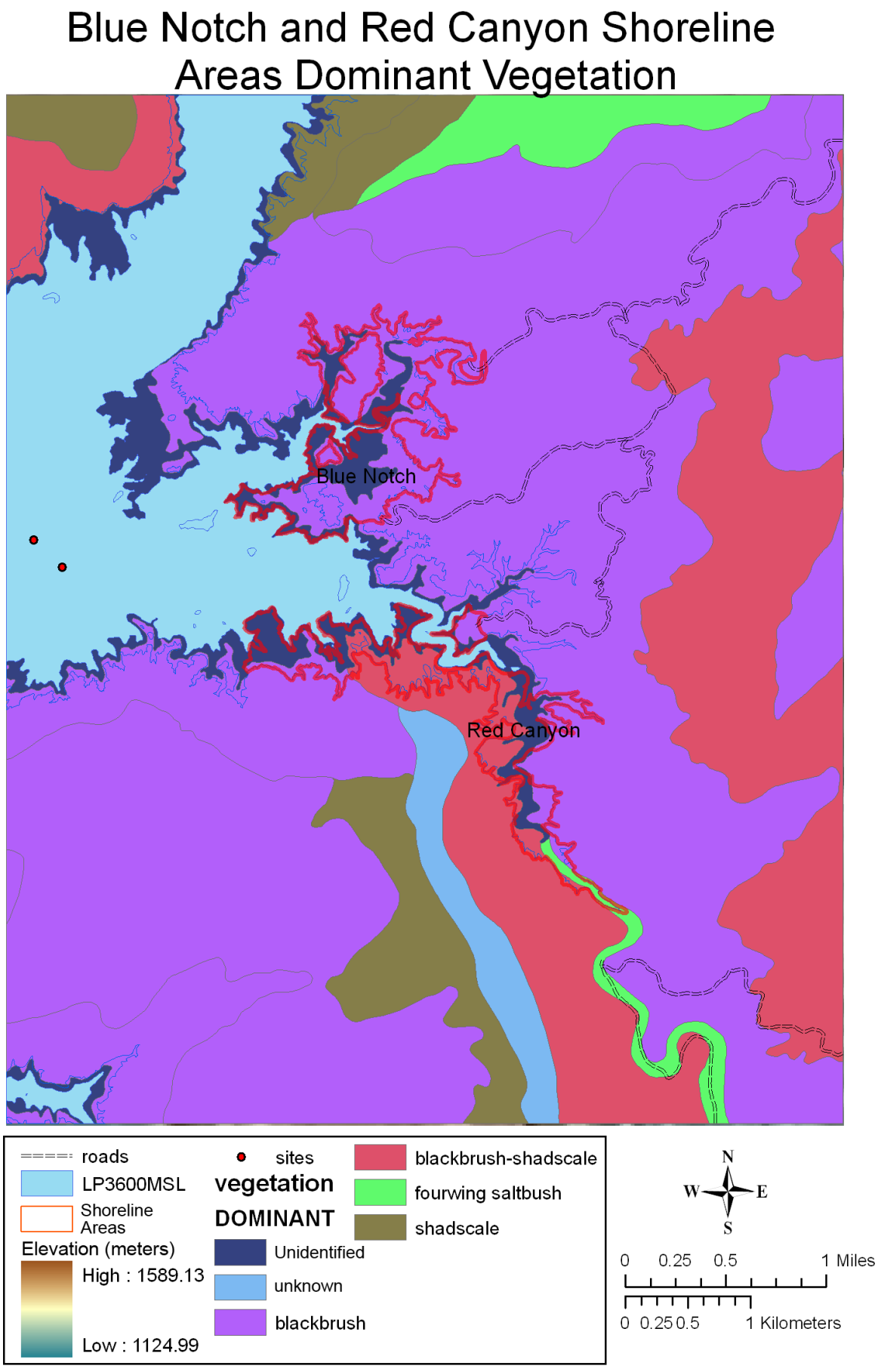

Figure 6.2. The Hite region Blue Notch and Red Canyon shorelines vegetation.

Soils

The provided data show three soil types within the vicinity of the Blue Notch and Red Canyon shoreline areas (Figure 6.3). Somorent family-Rock outcrop soils account for 2.6 percent of Blue Notch and 2.4 percent of Red Canyon. Typic Torriorthents-Badland soils account for 12.4 percent of Blue Notch and 73.2 percent of Red Canyon. Myton gravel and sandy loam is also present in Red Canyon at 0.3 percent. Tables 6.3 and 6.4 present the soils data for the Blue Notch and Red Canyon shorelines, respectively.

No soils data is available for either of the known vicinity sites, which are located west of the proposed project areas in an inundated region of GCNRA. Note that one site (GLCA01276) is within 1-mile of both shorelines and therefore counted twice in the tables below.

Table 6.3. Blue Notch soil types**.**

Soil Type	MUSYM	Acres	%	No. Sites
Somorent family-Rock outcrop	348	8.4	2.6	0
Typic Torriorthents-Badland	356	40.7	12.4	0
Water	999	278.2	85.0	2
Total	**---**	**327.3**	**100**	**2**

Table 6.4. Red Canyon soil types.

Soil Type	MUSYM	Acres	%	No. Sites
Somorent family-Rock outcrop	348	7.5	2.4	0
Typic Torriorthents-Badland	365	23.3	73.2	0
Myton, gravel sandy loam	347	0.9	0.3	0
Water	999	286.4	90.0	1
Total	**---**	**318.1**	**100**	**1**

Geology

As was the case for the other Hite region shorelines, the available data for the Blue Notch and Red Canyon shoreline is far more complete than that for any other shoreline discussed in this document, and illustrates the variable geological formations underlying the Hite region. The geological formations of the combined Blue Notch-Red Canyon shoreline include alluvial, colluvial, and eolian deposits, alluvial terrace gravels, landslide and talus deposits, mass-movement slump blocks, Monitor Butte formation, Shinarump Conglomerate, Tufa, and the upper member of the Moenkopi Formation (Figure 6.4; Table 6.5-6.6).

Of the two known vicinity sites, the Mesa Verdean structural site is situated on the alluvial terrace gravel deposits, and the Monitor Butte formation underlies the Ancestral Puebloan structural site (GLCA01276). Note that GLCA01276 is within 1-mile of both shorelines and therefore counted twice in the tables below.

Table 6.5 Blue Notch shoreline area geology.

Geology	Symbol	Acres	%	No. Sites
Alluvial, colluvial, and eolian deposits	Qace	2.8	0.9	0
Alluvial terrace gravel deposits	Qat	37.7	11.5	1
Alluvial and eolian deposits	Qae	30.2	9.2	0
Monitor Butte	TRcmn	80.6	24.6	1
Shinarump Conglomerate	TRcs	16.2	5.0	0
Upper Member Moenkopi Formation	TRmu	159.7	48.8	0
Total	**---**	**327.2**	**100**	**2**

Table 6.6. Red Canyon shoreline area geology.

Geology	Symbol	Acres	%	No. Sites
Alluvial, colluvial, and eolian deposits	Qace	29.7	9.3	0
Alluvial terrace gravel deposits	Qat	30.5	9.6	1
Landslide and talus deposits	Qmst	15.5	4.9	0
Mass-movement slump blocks	Qmsb	10.1	3.2	0
Monitor Butte	TRcmn	9.8	3.1	0
Shinarump Conglomerate	TRcs	35.8	11.3	0
Tufa	Qst	6.3	2.0	0
Upper Member Moenkopi Formation	TRmu	152.4	47.9	0
Total	**---**	**318.2**	**100**	**1**

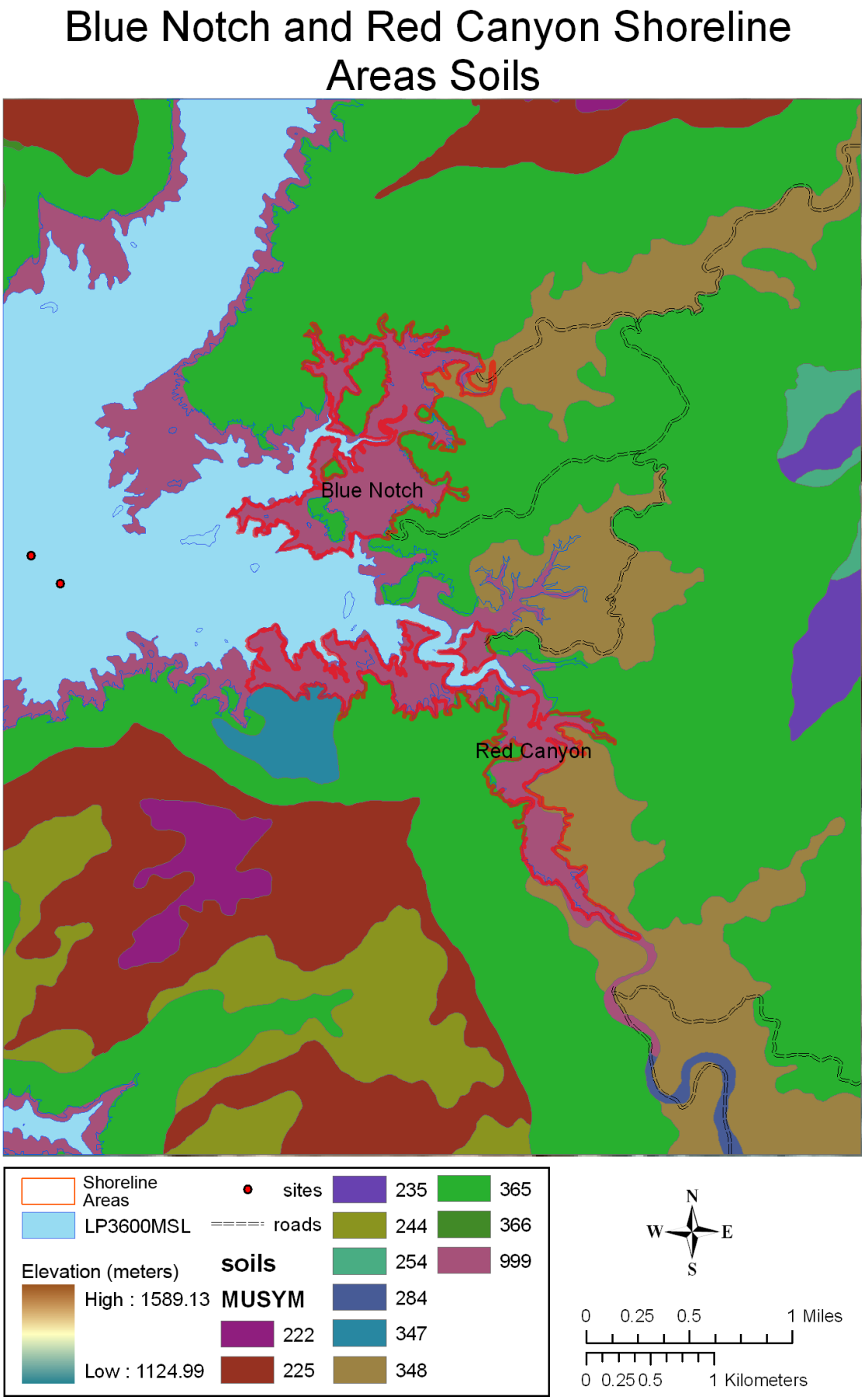

Figure 6.3. The Hite region Blue Notch and Red Canyon shorelines soils.

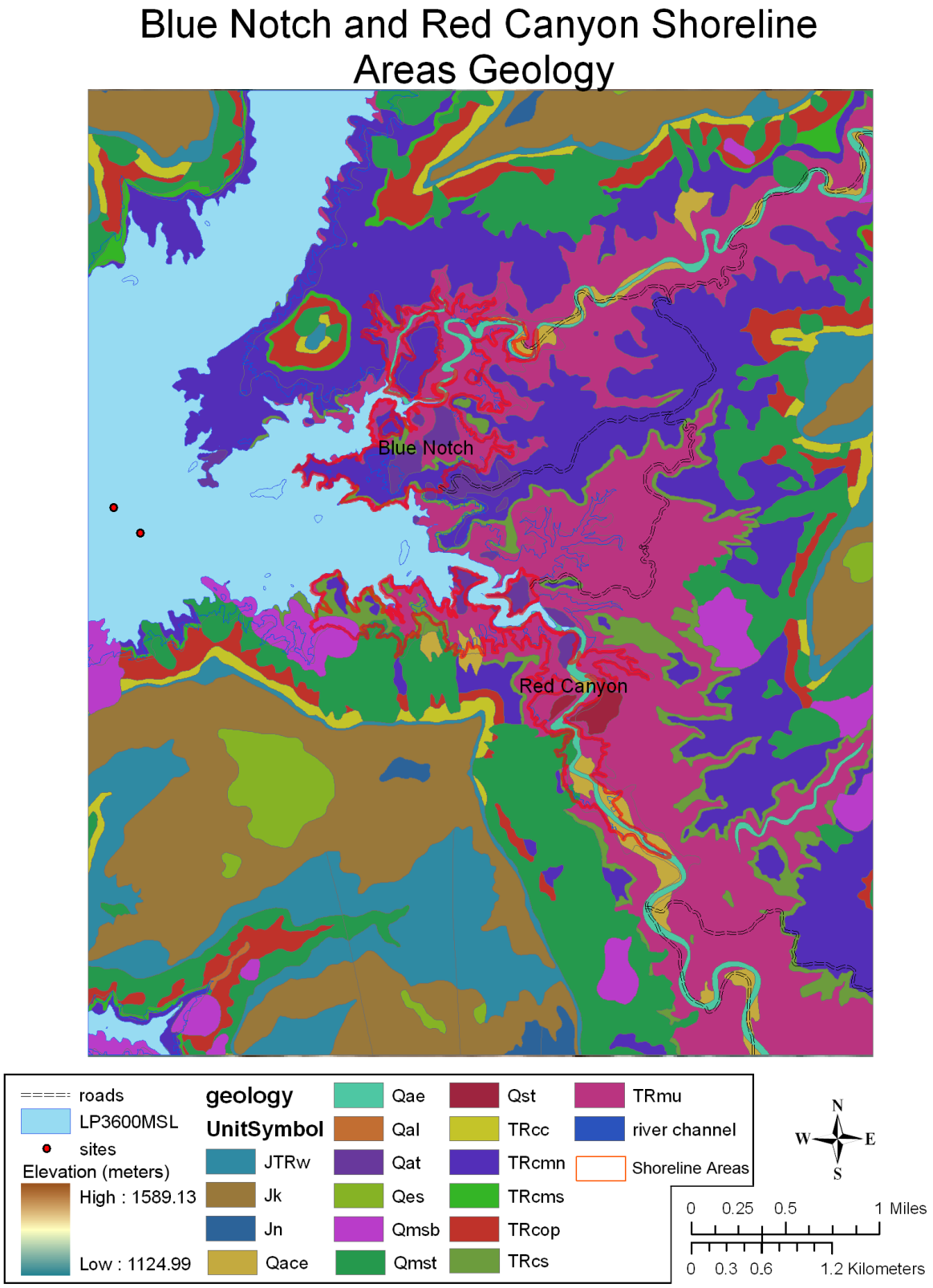

Figure 6.4. The Hite region Blue Notch and Red Canyon shorelines geology.

Slope

The slope data is lacking for the majority of the Blue Notch-Red Canyon shorelines. In this case, the lack of data appears to be the result of the DEM being drafted when the lake levels were at or near full pool (Figure 6.5). Both shorelines are well defined by moderate to steep escarpments and canyon walls. A few small rises with slopes steeper than 20 percent are positioned within the southern portion of Blue Notch. However, the areas of steeper slope account for a small portion of the areas and do not affect the sampling strategy. The escarpments do pose natural boundaries in determining survey area, transect orientation, and access into the shoreline areas, as discussed below.

Survey Design and Recommendations

NAU's recommendation is for 100 percent survey of the both the Blue Notch and Red Canyon shorelines, with no alternatives provided herein. The reason for this decision is two-fold - first, the size of the each shoreline is relatively small (Blue Notch = 327.33; Red Canyon = 301.65), and second, access requires vehicle travel first on Highway 95 and then CR 651, or from Highway 276 and then CR 650, which is costly because of the northern location of the shoreline within GCNRA boundaries and the potentially primitive nature of the roads.

Ground-visibility is expected to be excellent, with large portions of the ground bare of vegetation, when vegetation is indeed present. Access from the east suggests east-west transects would provide the easiest transect orientation for vehicle accessibility. Natural boundaries and a latitudinal long axis suggests north-south transect orientation. Based on these criteria, NAU suggests north-south transects when possible, and transects following the natural contours of the shorelines when north-south oriented transects are not feasible. Additional recommendations based on GCNRA's prioritization of the shorelines is included in the final chapter of this document.

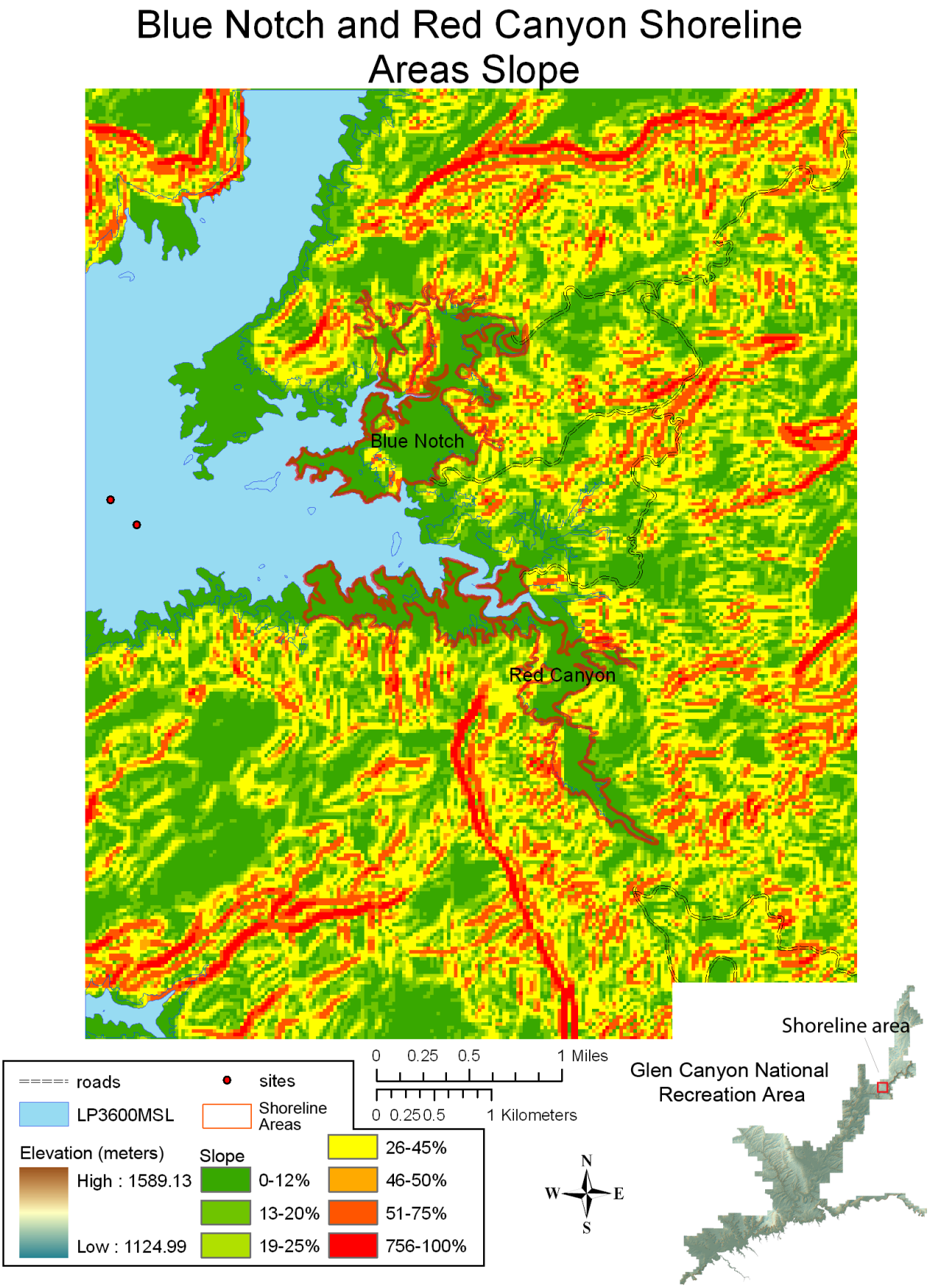

Figure 6.5. The Hite region Blue Notch and Red Canyon shorelines slope.

Chapter 7.
Wahweap Region Shoreline(s): Warm Creek and Crosby Canyon

Total Area
2,859.16 acres

Elevation Range amsl:
1,097.28 - 1,127.76 meters (3600 - 3700 feet)

The Wahweap region encompasses priority shorelines Warm Creek and Crosby Canyon, which combined, total 2,859.16 acres. Warm Creek provides the major waterway into the shoreline area, and ephemeral water occurs in Crosby Canyon. Figure 7.1 depicts the combined Warm Creek-Crosby Canyon shoreline, 1/2- and 1-mile buffers around the project area, associated known cultural resources inventories and sites within the project area and buffer zones, and the 3,600 feet and 3,700 feet levels of Lake Powell.

Previous Inventories

Two previous cultural resources inventories are known within the Wahweap region shorelines (Table 7.1). Both inventories occurred in 1993 along the northwest portion of combined Warm Creek-Crosby Canyon shoreline, accounting for 12.89 acres (0.45 percent) of the total., with no archaeological sites identified within the project areas.

Table 7.1. Summary of previous cultural resources inventories within the Warm Creek-Crosby Canyon shoreline area.

Survey Reference[1]	Purpose	Acres[2]	Intensity	No. Sites
Kincaid 1993b	Parking; telegraph line	6.15	10-m spacing	0
Kincaid 1993c	Movie townsite	6.74	10-m spacing	0

[1] Short citations correspond to GCNRA's cultural resources library/ database. Full references are available from GCNRA.
[2] Listed acreage accounts for areas surveyed within the shoreline areas, and does not provide full project acreage for inventories extending outside the current project areas.

Known Archaeological Sites

Twelve known cultural sites are located in and around the combined Warm Creek-Crosby Canyon shoreline area (Table 7.2).

Table 7.2. Known archaeological sites in and around the Warm Creek-Crosby Canyon shoreline area.

ASMIS No.	Type[1]	Affil.[2]	In[3]	1/2m [4]	1m[5]
GLCA00635	AS	U	X		
GLCA00700	F	U	X		
GLCA00636	AS	U		X	
GLCA00637	AS	U		X	
GLCA00983	AS	U		X	
GLCA00985	AS	U		X	
GLCA00987	AS	U		X	
GLCA00988	AS	U		X	
GLCA00989	AS	A		X	
GLCA00991	AS	U		X	
GLCA00638	AS	U			X
GLCA00639	U	U			X

[1] U = Unknown, F = Feature site, AS = Artifact scatter
[2] U = Unknown, A = Archaic
[3] Within the current shoreline boundary
[4] Within 1/2 mile (800 meters) of the current shoreline boundary
[5] Withing 1 mile (1600 meters) of the current shoreline boundary

Of the 12 sites in and around, the Warm Creek-Crosby Canyon shoreline, 11 (91.67 percent) are currently lacking affiliation data. The remaining site is identified as being Archaic in age. This site and nine others are artifact scatters. Of the remaining sites, one (GLCA00700) has a possible hearth feature, and other has a currently unknown site composition

Environment: Context and Constraints

Like all the priority shorelines, the combined Warm Creek-Crosby Canyon shoreline lies between 1,097.28 - 1,127.76 meters (3600 - 3700 feet), with the latter being

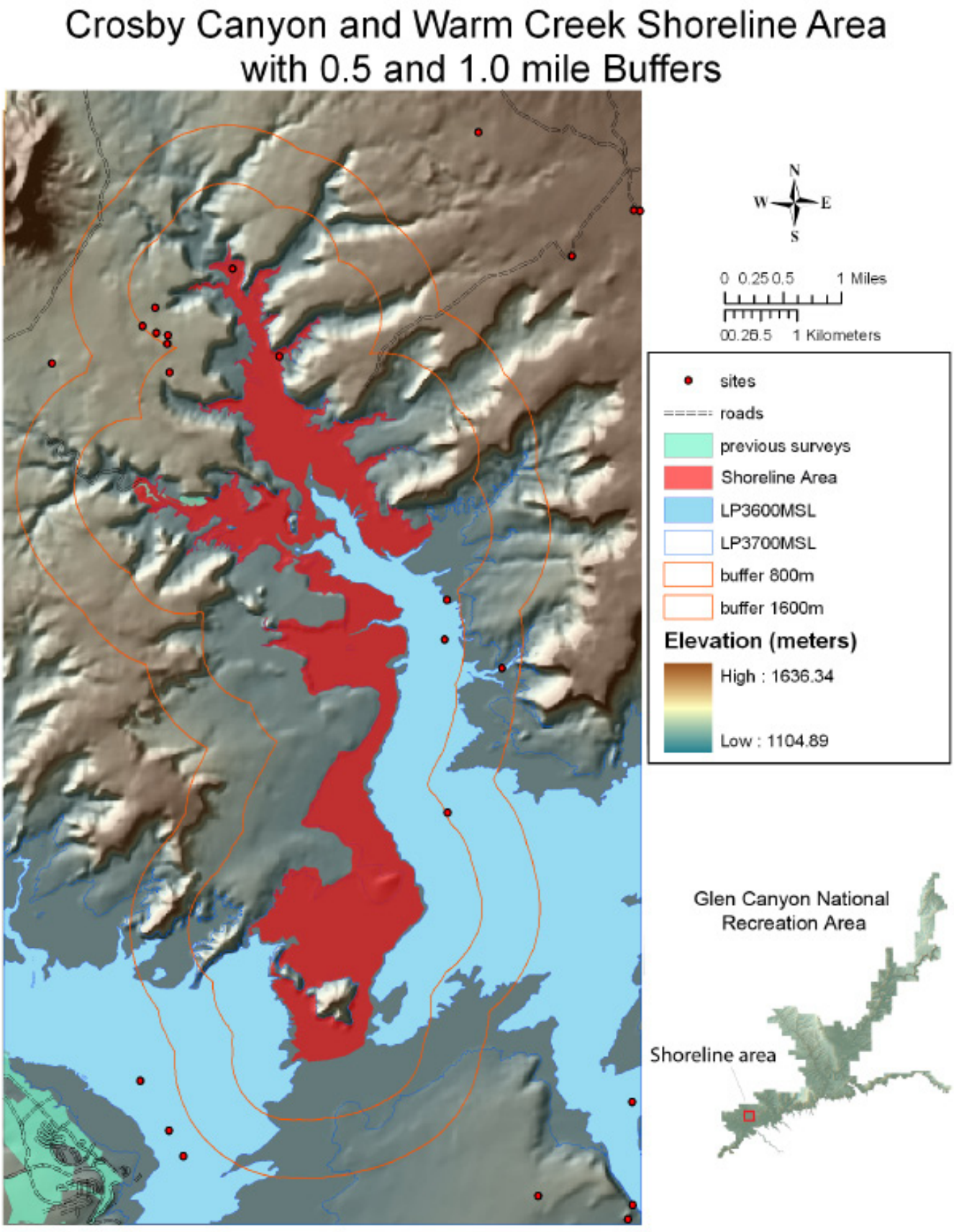

Figure 7.1. The Wahweap region Warm Creek and Crosby Canyon shoreline location with vicinity sites and surveys depicted.

the full pool level of Lake Powell. Because of this zoning, with few exceptions, the environmental data, including vegetation, soils, geology, and slope is entirely lacking, with each category having been classed as 'water' in the respective datasets. However, by drawing from the surrounding environment, and deriving the relationships of the vicinity cultural resources to that environment, NAU provides a generalized environmental context for the Wahweap region priority shorelines, and when possible, makes recommendations as to how to proceed with actual on-the-ground inventory of the Warm Creek and Crosby Canyon shoreline areas.

Vegetation

The identified primary dominant vegetation zones within the Warm Creek and Crosby Canyon shoreline areas include fourwing saltbush (5.4 percent) and shadscale (9.2 percent), with the majority of the vegetation (85.5 percent) being unidentified due to the inundation of Lake Powell (Table 7.3; Figure 7.2).

The dominant species present within these zones include fourwing saltbush (*Atriplex canescens)* and shadscale (*Atriplex confertifolia*), with blackbrush (*Coleogyne ramosissima*) a common secondary species.

A total of 12 sites are known in and around the Warm Creek-Crosby Canyon priority shorelines areas. Five of these sites are located in areas for which prehistoric/modern vegetation composition is unknown because of the Lake Powell inundation. One site (GCLA00700), which contains a possible hearth feature, is located in the fourwing saltbush community, and the remainder of known vicinity sites (n = 6), are located in the shadscale community. The two sites located within the actual proposed survey area include GCLA00700, discussed above, and GLCA00635, an artifact scatter of unknown affiliation, composition, or vegetative context.

Table 7.3. Vegetation of the Wahweap region shoreline vicinity.

Dominant Species	Acres	%	No. Sites
Not identified	2443.7	85.5	5
Fourwing saltbush (Atriplex canescens)	153.2	5.4	1
Shadscale *(Atriplex confertifolia)*	262.3	9.2	6
Total	**2859.2**	**100**	**12**

Soils

The data indicate that the Warm Creek and Crosby Canyon shoreline areas occur on Torriorthents complex, Pagina-Denazar complex, Farb-Pagina complex, and Juanalo family-Rock outcrop complex soils (Table 7.4), with shadscale plant communities typically occurring on the Torriorthents and Farb-Pagina complexs. As is typical of shoreline locations, however, the majority of the shoreline soil data is simply reported as 'water' because of the Lake Powell inundation (Figure 7.3).

Table 7.4. Crosby Canyon and Warm Creek soil types.

Soil Type	MUSYM	Acres	%	No. Sites
Rock outcrop-Torriorthents complex	366	57.6	2.0	0
Pagina-Denazar complex	222	99.5	3.5	0
Farb-Pagina-Rock outcrop	224	27.4	1.0	5
Juanalo family-Rock outcrop complex	144	0.0	0.0	1
Water	999	2674.7	93.5	6
Total	**---**	**2859.2**	**100**	**12**

In the Warm Creek and Crosby Canyon priority shoreline project area and vicinity, sites are located on Farb-Pagina Rock outcrop soils (n = 5) and Juanalo family-Rock outcrop soils (n = 1), with the remainder (n = 6) of the known vicinity sites located in areas classed as 'water' in the available databases. The sites located on the Farb-Pagina Rock outcrop soils are all artifact scatters, of which one (GLCA00989) is thought to be Archaic in age because of the presence of a Gypsum-style projectile point. The single site located on Juanalo family-Rock outcrop soils is an artifact scatter (GLCA00983) of unknown age or affiliation.

Geology

The data indicate that multiple geological formations comprise the Crosby Canyon and Warm Creek shoreline areas, including Alluvium, Romana Sandstone, Entrada Sandstone, Eolian and alluvial sand deposits, Alluvial gravel, and unidentified formations inundated by Lake Powell. The vast majority of the shoreline areas geology is labeled as 'water' in the available database, as is common to the shorelines areas in general (Figure 7.4).

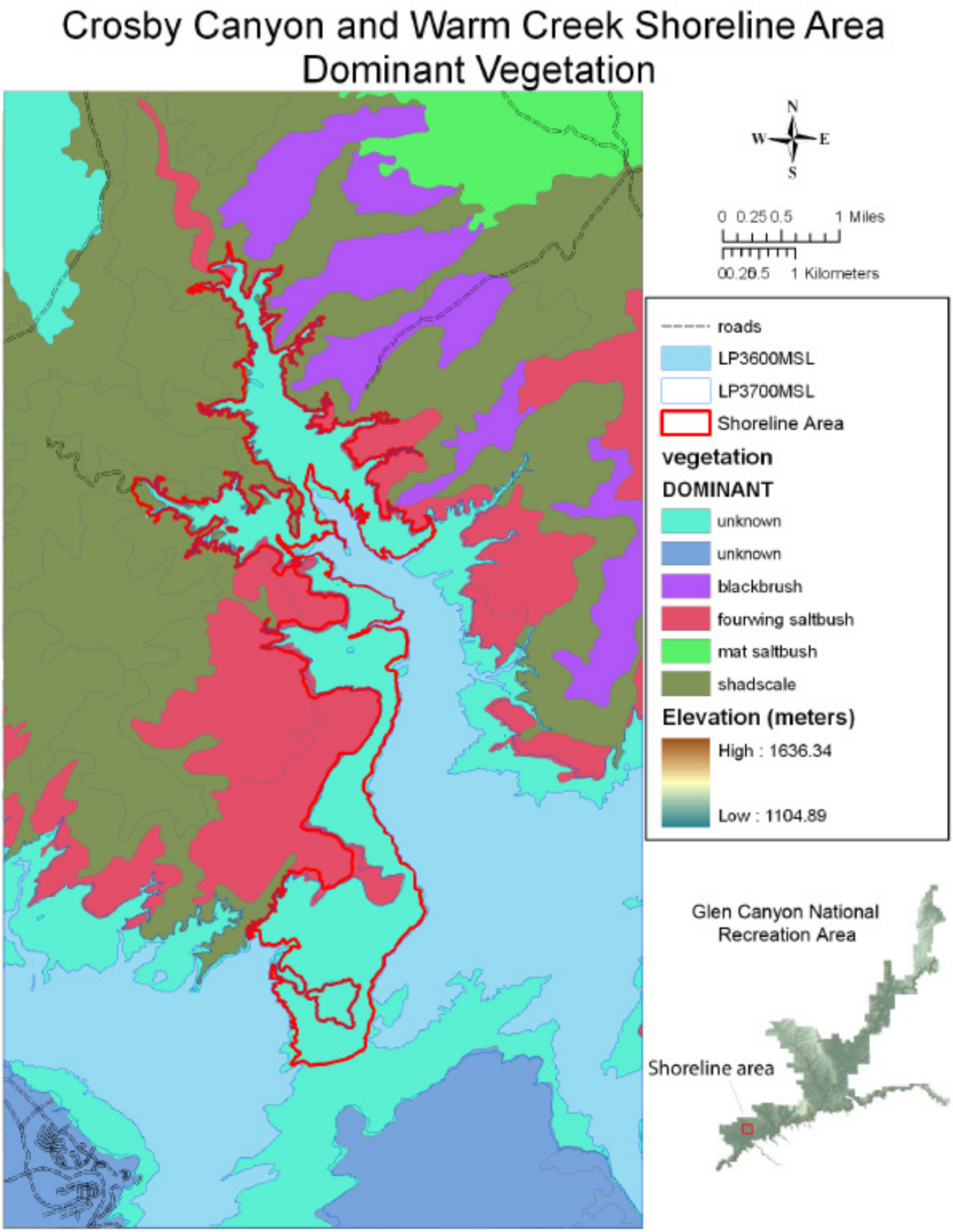

Figure 7.2. The Wahweap region Warm Creek and Crosby Canyon shoreline location vegetation.

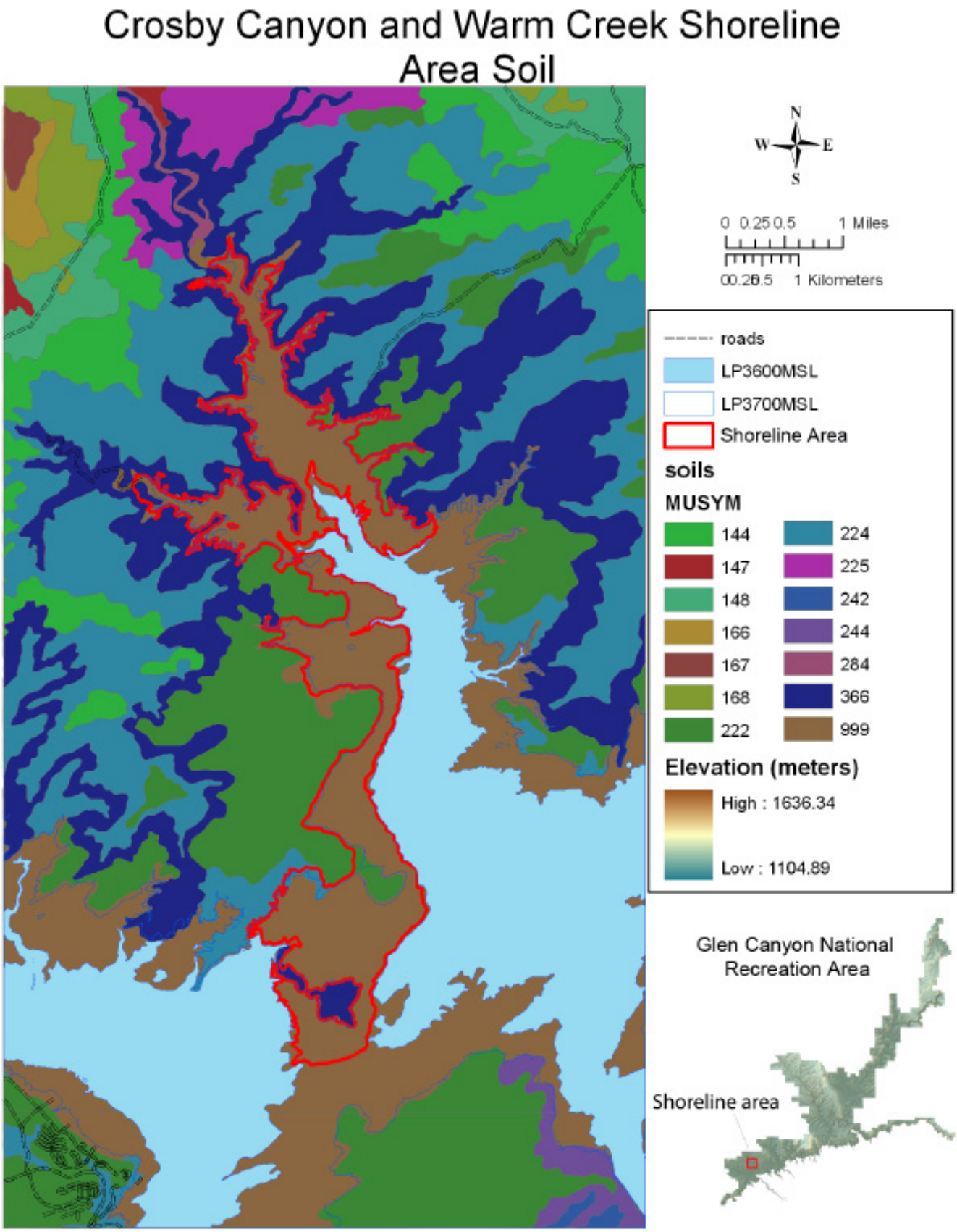

Figure 7.3. The Wahweap region Warm Creek and Crosby Canyon shoreline location soils.

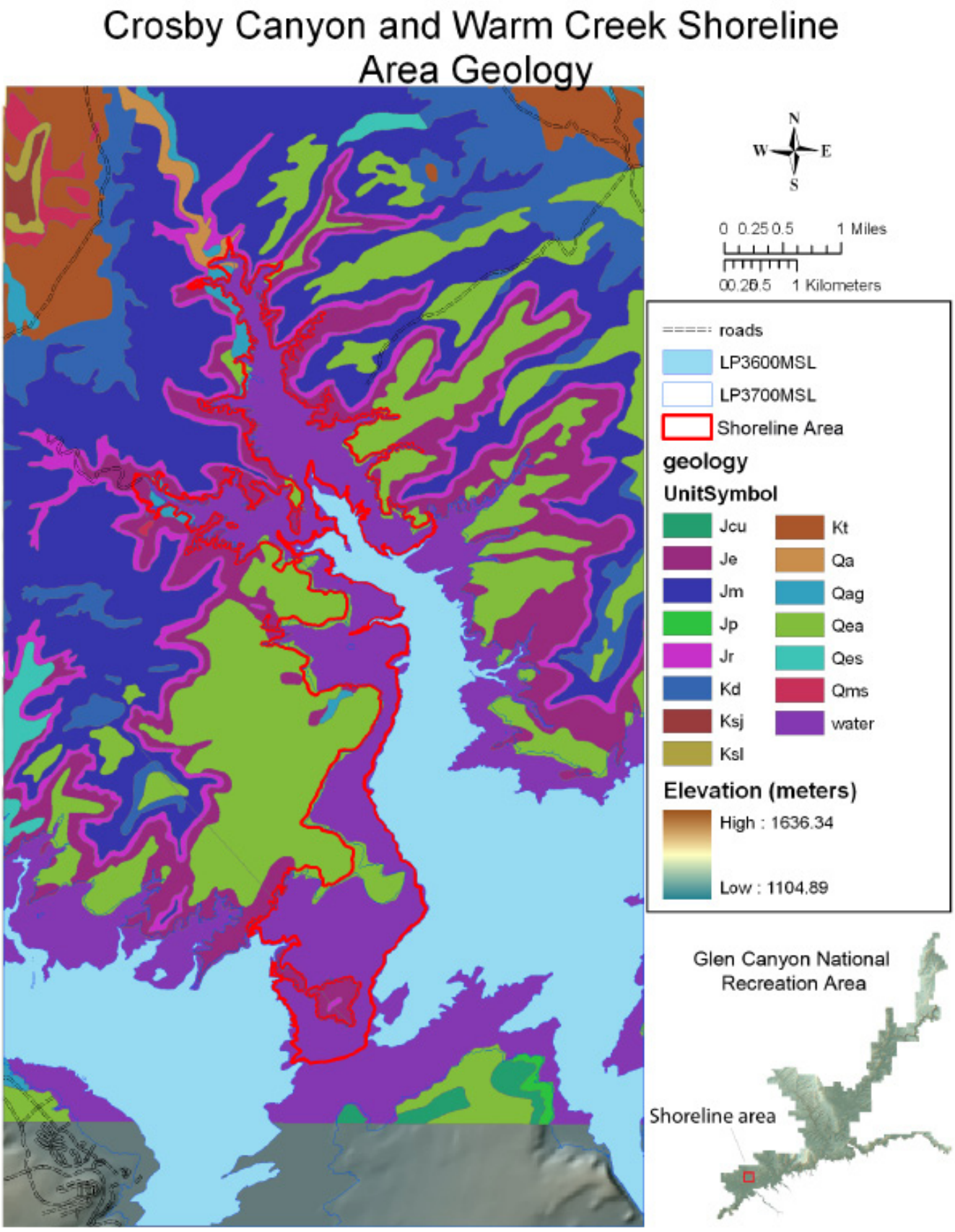

Figure 7.4. The Wahweap region Warm Creek and Crosby Canyon shoreline location geology.

The geological context is known for seven of the 12 vicinity sites in the Warm Creek-Crosby Canyon shoreline area (Table 7.5). One site (GCLA00700) is located on alluvium and contains a possible hearth. The other sites with known geology (n = 5) are all artifact scatters located on the Morrison Formation. Only one of these sites (GLCA00989) has an assigned affiliation, and is suspected of being Archaic in age.

Table 7.5. Crosby Canyon and Warm Creek shoreline area geology.

Geology	Symbol	Acres	%	No. Sites
Alluvium	Qa	8.7	0.3	1
Romana Sandstone	Jr	0.7	<0.0	0
Entrada Sandstone	Je	143.9	5.0	0
Morrison Formation	Jm	0.0	0.0	6
Eolian and alluvial sand deposits	Qea	257.9	9.0	0
Alluvial gravel	Qag	29.5	1.0	0
water	---	2419.3	84.6	5
Total	**---**	**2860**	**100**	**12**

Slope

As with the other environmental categories for the Warm Creek-Crosby Canyon areas, the slope data is lacking for the majority of the project shoreline. In this case, the lack of data appears to be the result of the DEM being drafted when the lake levels were at or near full pool (Figure 7.5). Discontinuous escarpments along the western boundaries of the shoreline area increase substantially with slope, serving as natural boundaries to the project area. These boundaries, as well as the orientation of the lake border in the Warm Creek-Crosby Canyon area aid in the formulation of a survey approach and strategy for completing cultural resources inventories in the Wahweap priority shorelines areas, as discussed in the subsequent section.

Survey Design and Recommendations

NAU's immediate recommendation is for 100 percent survey of the Warm Creek-Crosby Canyon shoreline. The natural boundaries of the proposed survey area are not conducive to broken-block surveys, and the general lack of environmental data and/or variation does not allow for viable stratified sampling of the shorelines.

However, in the event that GCNRA opts to sample the Wahweap region shorelines, NAU suggests focusing on those shoreline areas accessible by pre-existing roadways, as the primary impetus for cultural resources survey in these areas is unauthorized ORV use.

At present, the Wahweap region shorelines can by accessed by CR 230 and CR 265. CR 230 branches off of State Highway 89 west of the project area and leads directly into the mouth of Crosby Canyon. CR 265 provides access to the Warm Creek (east) side of the proposed project area from the northeast. Although boat access via the a launch from the Wahweap Marina is also a possibly, NAU suggests if sampling is employed, access be by vehicle so as to better simulate ORV access, and to provide adaptive flexibility to the sampling strategy employed based on field observations of actual disturbance and damage along the shorelines.

By employing a natural topographical break to seperate the southern extent of the Crosby Canyon shoreline from the combined northern extent of combined and road-accessible areas of Crosby Canyon and Warm Creek, NAU suggests the region depicted in Figure 7.6 be prioritized in sampling of the Wahweap region shorelines, if sampling is pursued. This region accounts for 1,166.60 acres (40.80 percent) of the total proposed shoreline area, allows revisits to the two sites currently known within the Warm Creek-Crosby Canyon priority shorelines area, and encompasses those areas likely to have the highest ORV-derived impacts.

Lower sampling fractions, as listed below, are also possible, but difficult to assign without field-visits to identify high-impact ORV areas:

2 percent: 57.18 acres
5 percent: 142.96 acres
11 percent: 314.51 acres
16 percent: 457.47 acres
20 percent: 571.83 acres

The natural topography and longitudinal long access of the shoreline areas dictate east-west oriented transects, and in all instances, ground-visibility is expected to be excellent, with large portions of the ground bare of vegetation, when vegetation is indeed present. NAU recommends full 100 percent inventory of the Wahweap region shorelines, or if sampling is necessary, a 40 percent inventory covering the northern areas directly accessible to vehicular traffic. Additional recommendations based on GCNRA's prioritization of the shorelines is included in the final chapter of this document.

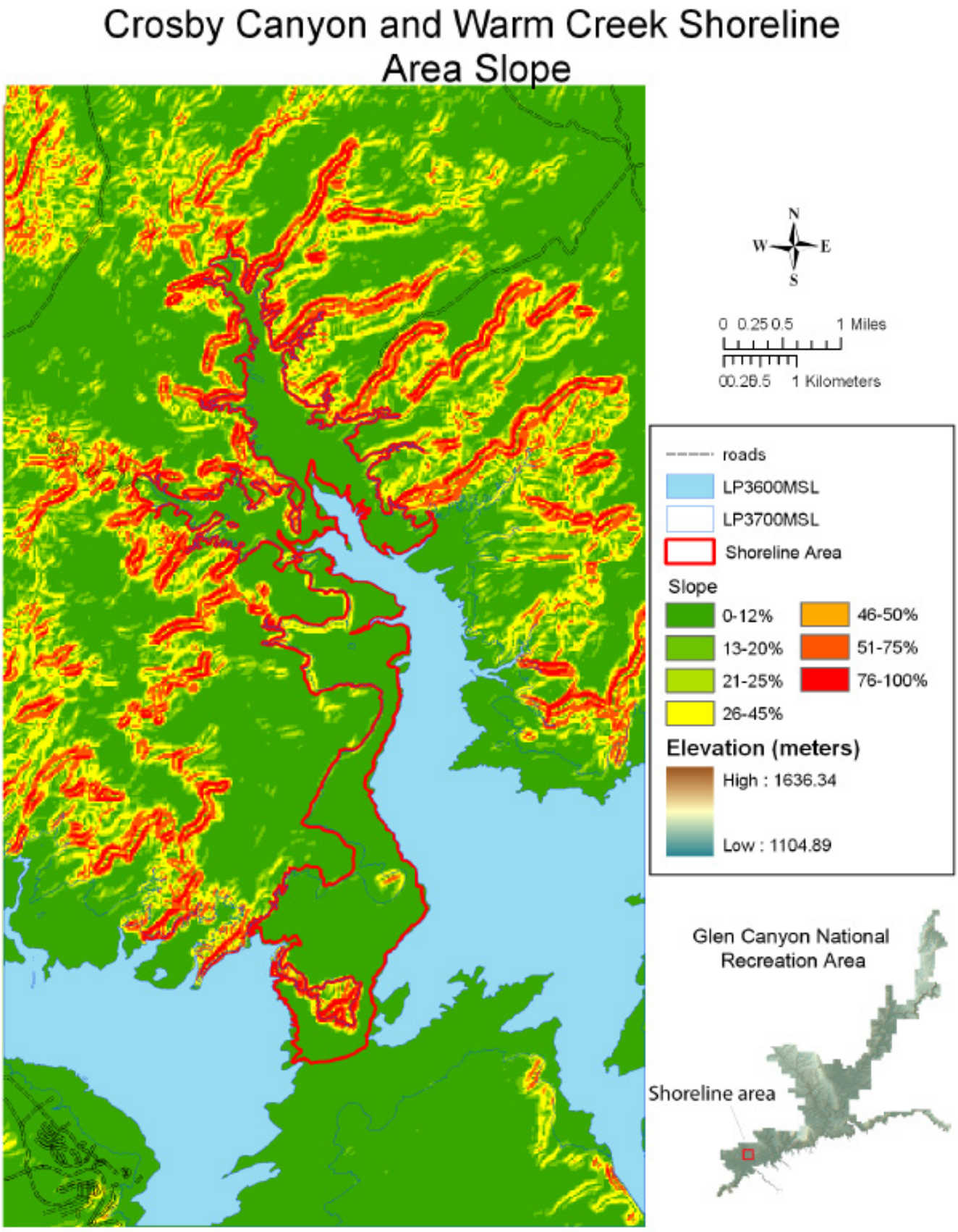

Figure 7.5. The Wahweap region Warm Creek and Crosby Canyon shoreline location slope.

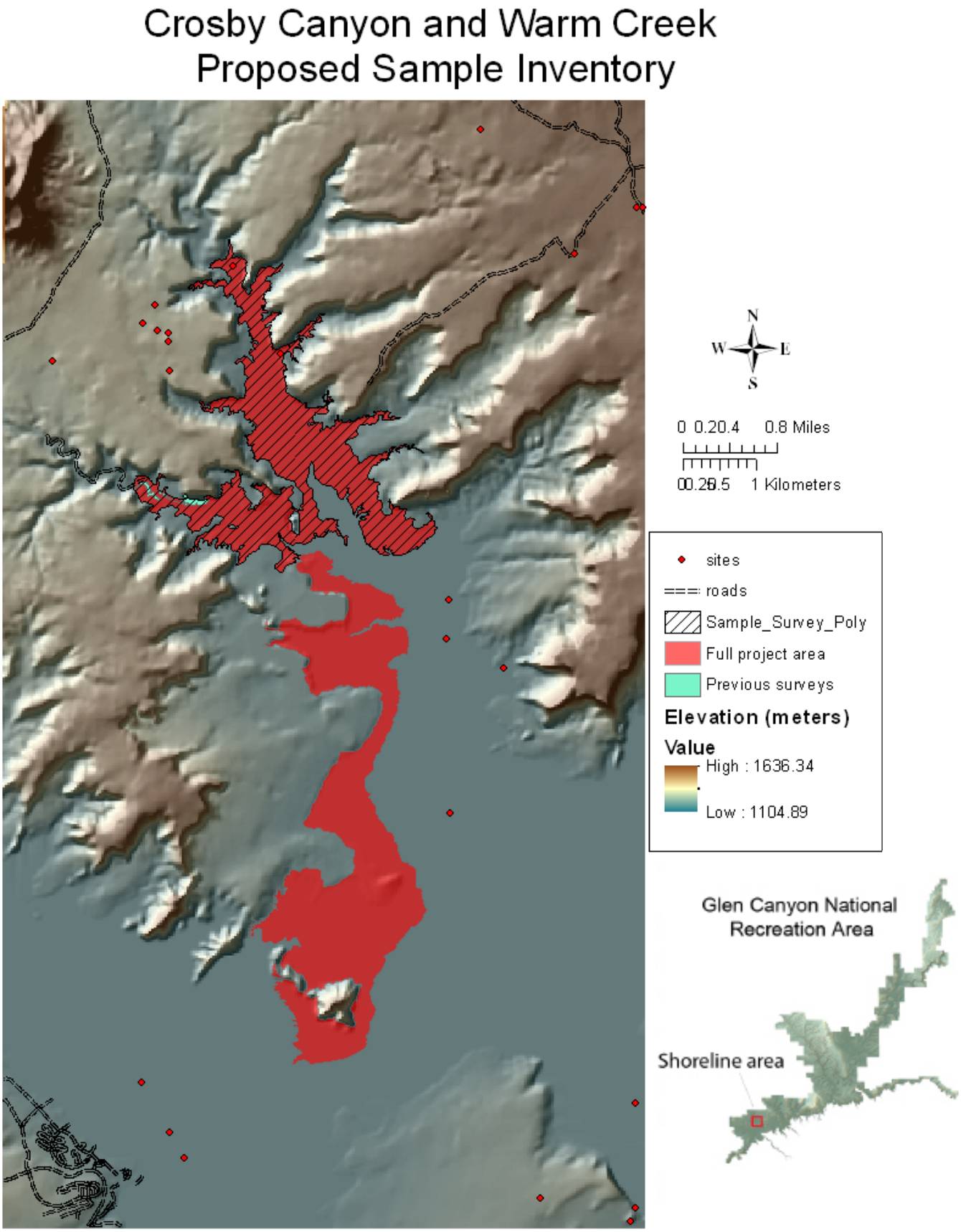

Figure 7.6. The Wahweap region Warm Creek and Crosby Canyon sampling proposal.

Chapter 8.
Summary and Recommendations

Shorelines:
Stanton Creek, Farley Canyon, White Canyon, Blue Notch, Crosby Canyon, Warm Creek, and Red Canyon

Total Area: 5,438.61 acres

Since the establishment of ORV shoreline areas in 1988 (when Lake Powell was at full-pool), decreasing lake levels have stranded the designated areas by as much as a mile from the current lakeshores (Baker 2010:1-2). As the water levels have receded, GCNRA allowed users to "chase the water" and take advantage of the recreational opportunities intended by the establishment of the original areas. However, in chasing the shoreline, many visitors proceed beyond the designated areas and into terrain for which cultural resources are either undocumented or known to be in danger. The dangers posed to such sites include intentional vandalism and unintentional damage resulting from vehicular traffic over sites, trailing, and camping. In recognition of and response to the potential dangers to cultural resources resulting from increased access to areas previously removed from recreational pursuits, GCNRA prioritized the existing accessible shorelines for cultural resources inventory.

GCNRA's ranking of the accessible shorelines was determined primarily by levels of visitor activity (Appendix A), with modifications to the priority list resulting from continued closures to several of the areas, including Bullfrog North and South, Warm Creek, and Crosby Canyon because of low water levels. The finalized priority locations, therefore include, in order from highest priority to lowest: Stanton Creek, Farley Canyon, White Canyon, and Blue Notch, followed by Crosby Canyon and Warm Creek (when water levels rise), Dirty Devil, Red Canyon, Bullfrog North and South (when water levels rise), Piute Canyon, Neskahi, and Copper Canyon.

This document deals directly with the highest priority locations, including Stanton Creek, Farley Canyon, White Canyon, Blue Notch, Crosby Canyon and Warm Creek (priorities 1 - 6), and also includes Red Canyon (priority 8) because of its proximity to Blue Notch. Dirty Devil (priority 7) was discarded from the current investigations because of small size (approximately 40 acres) and lack of proximity to other priority areas.

In total the priority shoreline areas included in this document comprise 5,438.61 acres of shoreline within three regions of GCNRA, including Bullfrog, Hite, and Wahweap, and account for those accessible shorelines for which visitor activity is the highest in GCNRA. The remainder of this chapter summarizes known cultural resources and previous inventories for the combined priority shorelines, and provides survey strategies and recommendations for the project as a whole.

Previous Inventories

As might be expected for shoreline areas inundated more than 20 years ago, very little of the accessible shorelines have been previously inventoried. At present, only five surveys are known in or around (within 1-mile) of any of the priority shoreline areas (Table 8.1), accounting for 12.89 acres of actual proposed project shorelines, and 306.82 acres of land within 1-mile of the accessible shorelines included in the current priority list. Moreover, the most recent of these projects was that of Neal and Wenker (1997), which was a vicinity project near the Stanton Creek shoreline. Given, therefore, that all known inventories in or around the proposed project areas occurred more than 10 years ago, pre-inventoried areas within the accessible shorelines should be reinventoried as a part of this project.

Vicinity Sites: Attributes and Patterns

Known archaeological sites are also few and far between in and around (within 1-mile) the proposed priority shorelines discussed in this document, with only 34

Table 8.1. Summary of previous cultural resources inventories within 1 mile of the priority shoreline areas.

Shoreline Vicinity	Survey Reference[1]	Acres Surveyed[2]	Purpose	Intensity	Location[3]	No. Sites
Stanton Creek	Kincaid 1986j	1.06	Halls Crossing toilet	Inspection	1-mile	0
	Neal and Wenker 1997	299.5	Bullfrog Basin and Halls Crossing Developed Areas	15-m spacing	1-mile	5
	Vetter 1985	6.26	Access Road	10-m spacing	1-mile	0
Farley Canyon	n/a	n/a	n/a	n/a	n/a	n/a
White Canyon	n/a	n/a	n/a	n/a	n/a	n/a
Blue Notch, Red Canyon	n/a	n/a	n/a	n/a	n/a	n/a
Crosby Canyon, Warm Creek	Kincaid 1993b	6.15	Parking, telegraph line	10-m spacing	In	0
	Kincaid 1993c	6.74	Movie townsite	10-m spacing	In	0

[1] Short citations correspond to GCNRA's cultural resources library/database. Full references are available from GCNRA.
[2] Listed acreage accounts for areas surveyed within the shoreline areas, and does not provide full project acreage for inventories extending outside the current project areas.
[3] Location in relation to current project areas.

currently in the GCNRA cultural database. Of these 34, only three are actually located in accessible shoreline zones, with the remainder located either within 1/2-mile (n = 14) or 1-mile (n = 17).

Known vicinity sites span the Archaic to Formative eras, and include Archaic (n=1), Ancestral Puebloan (n=2), Formative (n=1), and Mesa Verde (n=1) sites. Unknown cultural affiliation, however, characterizes the vast majority of the sites (n=29). Generalized site types gleaned from the database include artifact scatters (single or mixed artifact classes); sites with features (hearths, agricultural features, bedrock features, or pits), and structural sites (sites with architectural components). The site-type distribution is as expected, with artifact scatters the predominant site type known for the shoreline vicinity (Table 8.2).

Table 8.2. Summary of site types

Site Type	Count	Percentage
Structural	4	11.76
Feature	3	8.82
Artifact Scatter	18	52.94
Isolated Pot	1	2.94
Unknown	8	8.82
Total	**34**	**99.99**

Finally, it is notable that 14 (41.18 percent) of the vicinity sites are listed as destroyed (primarily as a result of inundation), and an additional two were excavated in 1958-1959.

Table 8.3 provides the currently known attribute data for all shoreline-vicinity sites discussed in the text.

Cultural Context and Research Questions

The minimal number of sites and known attribute data, as well as general lack of previous inventory data and environmental information prevents any viable characterization of the cultural resources within or around the specific project areas. Moreover, the cultural data available for the vicinity sites does not report any site-specific ORV effects. Therefore, the cultural context and research questions presented in detail in Smiley (2010) for the larger grazing components of GCNRA - shore units of which extend to the full pool level of associated shorelines - and summarized in Table 8.4 are applicable and relevant to the current project, with the additional expectation that ORV- and inundation-related disturbances also be recorded and incorporated into the final survey results and synthesis.

Table 8.3. Summary of previous cultural resources inventories within 1 mile of the priority shoreline areas.

Priority Rank	Shoreline Area[1]	ASMIS No.	State Site No.	Cult. Affil.[1]	Site Type[2]	NRHP Status[3]	Cond.[4]	Location[5]	References[6]
1	Stanton Creek	GLCA00706	42KA00513	U	S	NA	D	1/2-mile	Fowler 1959b
		GLCA00733	42KA00622	U	AS	NA	D	1-mile	Lister 1959a
		GLCA00734	42KA00623	U	AS	NA	D	1-mile	
		GLCA00751	42KA01481	U	U	NA	D	1-mile	Kay 1974
		GLCA00751	42KA03374	F	F	NE	P	1/2-mile	Geib 1989a
		GLCA01037	42KA03375	U	F	E	P	1/2-mile	
		GLCA01233	42SA00369	U	AS	NA	D	1-mile	Fowler 1959b; Sharrock 1964
		GLCA01477	42SA03944	U	U	NA	D	1-mile	Kay 1974
		GLCA01478	42SA03945	U	U	NA	D	1-mile	
		GLCA01480	42SA03946	U	U	NA	D	1-mile	
		GLCA01479	42SA03947	U	U	NA	U	1-mile	
		GLCA01671	42SA23082	U	AS	NE	G	1-mile	Neal and Wenker 1997
		GLCA01672	42SA23083	U	AS	NE	G	1-mile	
		GLCA01674	42SA23085	U	AS	NE	G	1-mile	
		GLCA01677	45SA23088	U	AS	E	G	1-mile	
		GLCA01678	42SA23089	U	AS	E	F	1-mile	
2	Farley Canyon	GLCA01490	42SA03957	U	U	NA	U	1/2-mile	Kay 1974
		GLCA01491	42SA03958	U	U	NA	U	1/2-mile	Kay 1974
		GLCA01602	42SA20779	AP	Iso. Pot	NA	P	1/2-mile	Wolley and Osborn 1991
3	White Canyon	GLCA01520	42SA07202	U	S	NA	D	1-mile	Schroedl 1981a
4	Blue Notch	GLCA01228	42SA00364	MV	S	NA	E	1-mile	Fowler 1959b
4 and 8	Blue Notch and Red Canyon	GLCA01276	42SA00413	AP	S	NA	E	1-mile	Fowler 1959a; Lipe et al. 1960; Cutler 1966
5 and 6	Crosby Creek and Warm Canyon	GLCA00635	42KA00251	U	AS	NA	D	In	Lister 1959a
		GLCA00636	42KA00252	U	AS	NA	D	1/2-mile	
		GLCA00637	42KA00253	U	AS	NA	D	1/2-mile	Lister 1958a; Lister 1959a
		GLCA00638	42KA00254	U	AS	NA	D	1/2-mile	Lister 1958a; Lister 1959a; Gunnerson 1959b
		GLCA00639	42KA00255	U	U	NA	D	1-mile	Lister 1958a; Lister 1959a
		GLCA00700	42KA00496	U	F	NA	U	In	Suhm 1959; Geib 1989b
		GLCA00983	42KA03219	U	AS	E	F	1/2-mile	Geib 1989b
		GLCA00985	42KA03221	U	AS	E	F	1/2-mile	
		GLCA00987	42KA03223	U	AS	E	F	1/2-mile	
		GLCA00988	42KA03224	U	AS	E	F	1/2-mile	
		GLCA00989	42KA03225	A	AS	NE	F	1/2-mile	
		GLCA00991	42KA03227	U	AS	E	F	1/2-mile	

[1] U = Unknown, F = Formative, AP = Ancestral Puebloan, MV = Mesa Verde, A = Archaic.
[2] S = Structural, AS = Artifact scatter, F = Feature, U = Unknown.
[3] NA = Not assessed/Unknown, NE = Not eligible, E = Eligible.
[4] D = Destroyed, P = Poor, U = Unknown, G = Good, F = Fair.
[5] Location in relation to current project areas.
[6] Short citations correspond to GCNRA's cultural resources library/database. Full references are available from GCNRA.

Table 8.4. Summary of proposed research questions, adapted from Smiley (2010).

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?
Early Agriculture	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)?

Table 8.4 (continued). Summary of proposed research questions, adapted from Smiley (2010).

Research Domain/ General Period	Cultural Periods	Research Question
	Basketmaker II	**Subsistence (continued):** (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 Agricultural (continued)	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.
	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?
	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 II	(1) Is the previously identified community settlement system for Pueblo III found throughout GCNRA?

Table 8.4 (continued). Summary of proposed research questions, adapted from Smiley (2010).

Research Domain/ General Period	Cultural Periods	Research Question
		(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?
Formative Cultures (continued)	Ancestral Puebloan—Pueblo III (continued)	(6) Are special function, limited activity, and resource exploitation sites found in the midlands and uplands?
		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? `
Proto-Historic	Navajo/Paiute	(4) Can any of the rock art found be attributed to these populations?

Survey Options

The priority allotments detailed in this document total 5,438.61 acres. However, Crosby Canyon and Warm Creek (priorities 5 and 6) have been closed through the GCNRA Superintendent's Compendium since 2003 because of low water conditions (Baker 2010), and are unlikely to reopen in the foreseeable future. Therefore, both Warm Creek and Crosby Canyon have been removed from consideration by GCNRA (Rosemary Sucec, personal communication, 8/19/2010) as priority shorelines, and can therefore be removed from further consideration in the survey options presented herein, which brings the total priority acreage down to 2,579.45 acres.

Red Canyon, although included in the preceding chapters because of geographic proximity to the other Hite region priority shorelines, is actually ranked as priority 8 in GCNRA's prioritization of the accessible shorelines, and can therefore also be removed from consideration in this section, which brings the priority acreage down further, to a total to 2,277.8 acres.

The confined elevation zone and location of the areas along the shorelines restricts the vegetation and soil types, geology, and slope. Therefore, the shoreline areas do not afford a stratified sampling strategy. Moreover, the relatively small proposed areas of the majority of the shorelines (specifically those in the Hite region, which average around 300 acres or less) in logistically distant parts of GCNRA would result in higher cost accrued if sampling is employed over simple 100 percent inventories of those regions.

Therefore, NAU provides the following as survey options for the remaining GCNRA shorelines, based on acreage, accessibility, and known funding sources:

Survey Option A:
Full inventory of Stanton Creek (priority 1)
Total acreage: 1,342.30

Survey Option B:
Inventory of Stanton Creek Survey Option 1 (road-focus inventory) at 586.30 acres
and
Inventory of Farley Canyon (priority 2; 277.78 acres)
and
Inventory of White Canyon (priority 3; 330.39 acres)
Total acreage: 1,194.47

Survey Option C:
Inventory of Stanton Creek Survey Option 2 (actual shoreline inventory) at 688.15 acres
and
Inventory of Farley Canyon (priority 2; 277.78 acres)
and
Inventory of White Canyon (priority 3; 330.39 acres)
Total acreage: 1,296.32

All proposed options are reasonably within the budget parameters of the NAU/GCNRA Colorado Plateau Cooperative Ecosystems Studies Unit (CPCESU) Agreement No. H1200-09-0005 for actual on-the-ground inventory of the priority shoreline areas. In the event that inventories in excess of the GCNRA-selected survey option prove possible (e.g., no sites are identified), then GCNRA should select the areas of additional survey.

However, should additional inventory prove possible, NAU suggests additional areas correspond to the original survey options selected. For example, if Survey Option B is selected, any additional survey should either cover additional area in Stanton Creek, or partially inventory the final priority allotment (not included in the current survey options because of current capability estimates) - Blue Notch, and likewise for Survey Option C.

Summary

This document presents a research design for archaeological inventory of seven priority shoreline areas in GCNRA. Three shorelines have ultimately been removed from the project, leaving four priority shorelines (2,277.8 acres), for which NAU has presented three viable survey options within the parameters of known funding, logistics, and so forth. Any selected option will aid GCNRA in satisfying their archaeological obligations under Section 106 of the NRHP, as amended, and will inform future decisions in ORV-related management at GCNRA. However, in all instances, NAU recommends complete survey of the priority shorelines, with the understanding that in order to accomplish this, GCNRA will need to apply a phased approach, and that the selected survey option will serve as the first step in completing full Class III inventories of shorelines accessible and open to ORVs in the NRA.

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APPENDIX A

Original prioritized list of shoreline areas provided to NAU by Brian Sweatland.

Order	Site Name	Geographic Location	Approximate Acreage 3,600 (3,640) elevation	Recommended Approach
1	Stanton Creek	Bullfrog	1,100 (915)	Vehicle
2	Farley Canyon	Hite	218 (169)	Vehicle
3	White Canyon	Hite	(400)	Vehicle
4	Blue Notch	Hite	260 (220)	Vehicle or Boat
5	Crosby Canyon	Wahweap	315 at 3,670	Vehicle or Boat
6	Warm Creek	Wahweap	226 at 3,670	Vehicle
7	Dirty Devil	Hite	40 at all elevations	Vehicle
8	Red Canyon	Hite	unknown	Boat
9	Bullfrog North and South	Bullfrog	580 at 3,670	Vehicle
10	Piute Canyon	San Juan	466 (466)	Boat
11	Neskahi	San Juan	260 (169)	Boat
12	Copper Canyon	San Juan	unknown	Vehicle

Total estimated acreage to be inventories is at least 3,865 acres, plus whatever acreage comes to at Copper Canyon and Red Notch. A range of up to 5,000 acres at low lake levels is a reliable estimate for sampling.

The order is determined by levels of visitor activity, and whether or not a site is open to public use.

Presently, Crosby Canyon, Warm Creek, and Bullfrog North and South are closed. These sites will remain closed until lake elevations return to at least 3,670-feet. White Canyon is unusable until lake elevations return to 3,650-feet.

Acreages are approximations based on topographic details, bathometric data, reasonably foreseeable lake levels, records of the historic use zones at 3,700 feet, and recent site visits. Acreages are based on potential open space for recreational use: if a site like Crosby will not open until lake levels reach 3,670-feet, the estimated acreage is based on the space available for recreation from 3,670-feet to full pool elevation.

Site visits have revealed that at full pool (3,700), site impacts were isolated. As lake elevations decreased, site impacts spread along the then-available lakeshore. In all instances, however, very little impacts were observed above the 3,700-foot elevation.

Recommended approach is based on site visits.

I have not conducted a site visit to Copper Canyon, and have no data to support an estimate of acreage in that location.