D1. Project Goals: Peopling the Wilderness

The distribution of human populations across the earth’s surface is neither spatially nor temporally static and this is perhaps nowhere more evident, yet least understood than in high elevation, alpine settings. This proposal seeks funding for an archaeological research and education program in a very poorly known montane setting within northwestern Wyoming’s Greater Yellowstone Ecosystem (Brussard 1991; Knight 1994; Meagher and Houston 1998; Patten 1991; Power 1991; Figure 1). Specifically, funds are requested for additional surface documentation and limited testing of a high elevation (3100 m) locality (temporary designation FF001) discovered as part of a program of backcountry archaeological survey project along the upper Greybull River including lands administered as part of the Shoshone National Forest and the Washakie Wilderness. Although the site targeted is outside the Wilderness boundary, its investigation will add considerably to both basic archaeological research goals and to suggestions for management policy for sites within designated Wilderness settings.

Today, the upper Greybull is one of the most remote areas in the continental United States. In part, it is this sense of isolation that plays a central role in the management and perception of Wilderness areas and the surrounding National Forest lands. However, it is clear from the research conducted thus far that limited human presence is a quite recent pattern contingent upon the last two centuries’ documentary history. Researching long-term human uses and impacts in such “pristine” environments has the potential to both increase our archaeological knowledge base and provide concrete examples of the ubiquitous nature of human-landscape interactions. Humans have been part of nearly all of North America’s landscapes for over 10 millennia (Binnema 2001; Wooley 2002). One of the broader impacts of our project is to bring this perception of long-term human participation in landscape formation and niche construction (Laland et al. 1999, 2004; Odling-Smee et al. 2003) into clearer focus for both policy makers and the general public. It has been our observation that archaeological sites located in Wilderness areas currently fall into a conceptual and managerial never-never land – ironically, these sites provide unambiguous evidence of the interaction of humans and landscapes in areas that are often viewed as being significant today, in large part due to the lack of human presence (Gross et al 1997; McCool and Cole 2000). In this sense, we hope that while operating on a drainage basin scale and focusing attention on specific information from a single site, we can help to create a closer set of connections between past human-landscape interactions and issues related to sustainable futures with the complementary goal of fostering communication among local and regional stakeholders, managerial stakeholders, and the scientific community (Berke and Folke 1998a, 1998b, 2004; Gorke 1999; Holling 2000; 2001; Holling, Gunderson, and Peterson 2002; Scheyvens 1999).

While there are demonstrable significant research potentials in legally protected Forest and Wilderness settings, there are also policy and societal mandates that require that Wilderness activities produce minimal impacts, which we’ve applied to our preliminary survey work on both Wilderness and other Forest Service lands. Therefore, although we’ve conducted in-field data collection on over 40,000 pieces of prehistoric chipped stone, the only collections made during our 4-year research project have been a sample of obsidian artifacts for non-destructive XRF sourcing analysis, which will be returned to their find-spots once analysis is completed. As the high density of archaeological materials became apparent during our pilot study, several conclusions developed: 1) while contemporary human use of the Wilderness area is limited, prehistoric use was not; 2) given the mandate to maintain Wilderness in an “untrammeled” state (which promotes archaeological non-collection policy) coupled with the increased documentation of the richness of the region’s archaeological record leads to an awareness that the record is in immediate danger. As modeled below, a combination of biotic, abiotic, and anthropogenic processes act to modify an archaeological record. In most cases, however, arguably the most immediate and severe

Figure 1. Project area in NW Wyoming, the Greater Yellowstone Ecosystem, the Greybull River drainage, and location of site FF001.
dangers to the record are anthropogenic in nature. The project outlined here is an attempt to research the archaeological record, but also to investigate adaptive management approaches and public involvement (Westley, et al. 2002) in protecting and preserving the archaeological record as a significant component of a Wilderness landscape. Combining education and research goals has the potential for developing a productive, synergetic, collaborative effort that effectively addresses both NSF’s intellectual merit and broader impacts criteria.

Given this coalescence of social goals and natural science methods, the Colorado State University’s archaeological pilot research projects in the GYE helps us redefine archaeology as not only the “quintessential interdisciplinary field” (Schiffer 1988:463) but also an important applied field of ecological study and educational enrichment. The funding sought here will be used to further develop an integrated, multi-scale research and education program focused on the upper reaches of the Greybull River drainage system within the Greater Yellowstone ecosystem (GYE) of northwestern Wyoming. The primary objectives of this larger project, of which the current funding request is one component, are:

1) To build a regional perspective on human paleoeconomy in which multiple, tightly coupled data sets can be created within the constraints of limited funding and personnel. Achieving this goal will provide cost-effective science that yields solid baseline datasets, foundations for monitoring landscape change (Cole and Landres 1996; Theobald et al. 2005), and the potential to span many of the gaps that need to be closed between social and natural sciences in order to provide a unified approach to conservation of biological, heritage, and physical resources.

2) To develop a better understanding of long-term human impacts within a unique landscape largely unmodified by anthropogenic changes over the last two centuries, many relating to exurban development (Hansen et al. 2005). Although the area has yet to receive heavy Euro-American use, all indications are that recreational visitation and associated alteration of the archaeological landscape are on the verge of expanding rapidly. Success at this goal will aid in modeling options for ecosystem sustainability by creating better ways to monitor change and by increasing local stakeholder awareness of the relevance of heritage resource protection to overall environmental health.

3) To implement a coordinated program of K-12, local, regional, and national education and outreach in order to fulfill our research goals but also to meet professional responsibilities to advocate for the appreciation, conservation, and protection of archaeological resources as important, irreplaceable components of this ecosystem. If successful, this will lead to a greater sense of local stewardship of the diverse sets of processes related to landscape systems, which in turn might lead to a more sustainable future for not only archaeological resources, but also for other components of the landscape. Such stewardship enhances the potential for archaeological resources to be considered in discussion of ecosystem sustainability.

While growing out of the basic tenets of anthropological archaeology, we are of the opinion that for both empirical and pragmatic reasons, it is time to move away from anthropocentric research concerns to research that sees the human dimension as one of many, but not the exclusive, factor to consider in virtually all studies of ecosystem processes.

Most contemporary ecological studies can be faulted for excluding human agency from their design or concern. Contemporary anthropological studies can be faulted for exalting human agency as the ultimate relevant causative force. In this research program, which we call the Greybull River Sustainable Landscape Ecology (GRSLE) project (http://www.greybull.org), we...
seek a middle ground between reductionist disregard of humans as part of ecosystem processes and anthropocentric
disdain for ecosystem processes as fundamental concerns for multiple levels of cultural understanding.

D2. Landscape Taphonomy: Concepts and Methods

Landscape evolution is often investigated in terms of the interactions of biological and physical processes
(Pazzaglia 2004). However, most landscape processes are experiencing accelerating rates of anthropogenic impacts
and humans have played a significant role in almost all major global ecosystems (Redman 1991). Any functional
definition of landscape must include a human/cultural component. Operationalizing this tripartite definition
(cultural, biological, physical) requires integrated research designed to incorporate aspects of both social and natural
science. It also requires the ability to work at multiple spatial and temporal scales. Our archaeological research
program focuses on developing and implementing a concept of Landscape Taphonomy in which landscape is defined
as resulting from a complex, evolving, and integrated set of cultural, biological, climatologically, chemical and
geological processes. In this realm, archaeology provides an appropriate body of concepts and techniques for
placing human actions into analytical domains amenable for integration with other components of landscape
formation. Using the classic definition of taphonomy as investigation of biosphere processes transitioning into
records preserved within the lithosphere, archaeology also is in an appropriate disciplinary space to provide
methodological and analytical tools for bridging studies of contemporary landscape processes to long-term
perspectives (Figure 2).

This model guides development of the GRSLE project in several ways:

• Landscapes are complex formational mosaics that cannot be seen exclusively as cultural, biological, or
  physical entities.
• Non-trivial landscape research, regardless of its ultimate goals – whether archaeology, geological, or
  biological – must incorporate aspects of each of the major contributory realms.
• Landscape properties are constantly in flux at multiple spatial and temporal scales and require continuous
  monitoring.
• Methods for researching landscapes must be collaboratively developed with significant inputs from
disciplines based in the social, biological, and physical sciences.
• Multi-spatial and temporal scales of landscape processes are productively modeled from a perspective
  incorporating adaptive cycles.

Combining these perspectives, landscape taphonomy provides baseline datasets, monitor landscape change,
and span many of the gaps between social and natural sciences. This helps build a unified approach to biological,
heritage, and physical resources. This is best described as human ecology (Butzer 1980, 1982), since its ultimate goal
is to investigate long-term ecosystem processes in relationship to human actions, impacts, and responses. Our
project builds on Butzer’s landscape perspective in terms of specific integrated sampling methods. This approach is
essential to realize the suggestions that long-term preservation of resources must be based on an iterative process of
problem identification, response design and implementation, followed by monitoring, assessment, and response re-
design. We envision GRSLE archaeological ecology as a valuable contribution to this adaptive management process
(Berkes and Folke 1998a) at several levels. First, as providers of baseline data; second, as providing expertise in
multidisciplinary project design and implementation, and finally by setting the stage for long-term bundled
monitoring programs (see section D2.4). Although the proximate goals of this project are the investigation of
archaeology of a small segment of the drainage system, one of the ultimate broader impacts of GRSLE may be to
provide a realistic evaluation of adaptive management feasibility across Federal (USDA Forest Service, and USDI
BLM), State, and private landholdings.

A landscape framework of traditional survey archaeology, which focuses almost exclusively on documenting
evidence of human agents, is an ineffective means for comprehensive documentation of the multiple scales of
cultural, biological, and physical properties. As Hobbs (2003:223) has noted, “mismatch between scales of
investigation and scales of management is problematic because observations of many phenomena depend on the
scale at which those observations are made.” Issues of scale and scaling-up (Atkinson 1997; Burger 2002; Grace et
al. 1997; Marshall et al. 1997; Peterson and Parker 1998; Schneider 1994, 1998) are seldom directly addressed in the
design and implementation of archaeological survey programs. The modified-Whittaker (M-W) sampling design
(Barnett and Stohlgren 2003; Burger 2002; Burger and Todd 2006; Burger et al. 2004; Chong et al. 2001; Kalkahan
and Stohlgren 2000; Stohlgren, Binkley et al. 1995; Stohlgren, Falkner, and Schell 1995; Stohlgren et al. 1997a,
1997b; Shmida 1984) provides an adequate initial basis of understanding small-scale processes, as well as the ability
to integrate multiple datasets collected from single sample plots into larger-scale pictures. This sampling framework
uses limited spatial area to maximize sampling and integrate data extracted. As of yet, there have been no studies to
develop a cohesive sampling unit with which to understand the evolution of landscapes, but only by actively
evaluating alternative methods can such an understanding be found. The scaled samples of the modified-Whittaker create comparable datasets with which landscape assessment, monitoring, and management can be more productively and less contentiously undertaken. While clearly appropriate for making the small scale, fine-grained observations, we need to embed the M-W frame (see section D2.5) within a series of larger spatial observation units that more closely approximate scales of human landuse. One aspect of this project is to further experiment with this use of nested sample design in archaeology.

While the documentation of archaeological evidence is a main objective of GRSLE, understanding range conditions, invasive plant distribution, fire history, geomorphology, and recreational use intensity are also relevant avenues for fully understanding the niche space of the contemporary archaeological record and of prehistoric landuse potentials. Liu (2001:3) states that, “it is crucial to integrate ecology with other social sciences” in an effort to understand the human behaviors as well as human attitudes that contribute to ecosystems under human pressures. We contend that it is of equal importance that archaeology actively integrates a broader array of ecological perspectives – particularly human behaviors and their resultant archaeological traces as being tightly coupled with a diverse set of other ecosystem processes. Any one dimension is a byproduct of the whole suite of other dimensions constraining the surroundings, and the archaeological record is certainly responsive to this multiplicity of factors, both in terms of the behaviors that created and the events that preserved it.

The project outlined here can make an archaeological contribution to “a critical component of adaptive management [that] is missing in land-use planning – monitoring and evaluation” (Theobald et al. 2005:1912). The more “healthy” the biological or physical properties of an area, the more likely that recreational users will be attracted to it, potentially to the detriment of the biological, physical, and of central relevance to this proposal, archaeological dimensions. Thus we argue that if appropriate baseline studies have been undertaken, studies that monitor conditions along a limited set of dimensions may inform about the state of other linked conditions. For example, if recreationalists are drawn to an area initially because of excellent trout fishing, but also engage in artifact collection, studies of benthic macro-invertebrates may well provide information on both stream ecology and on threats to stream-side archaeological materials (Schoville et al. 2003). As exurban development continues in the Greater Yellowstone Ecosystem (Dale et al. 2005; Hansen et al. 2005) there is a greater need for baseline data acquisition and development of effective monitoring protocols. This project contributes to both.

A major problem with models like Figure 2 is that while capable of illustrating big-picture interactions, they do not provide obvious clues as to how to proceed in investigating the circles, boxes and arrows. Figure 2 is long on concept, short on method. The problem of operationalizing archaeological landscape research at multiple spatial and temporal scales can be further modeled as having four active components: 1) tightly coupled process research, 2) clearly linked paleoecological datasets, 3) bridging data and 4) bundled research strategies. Effective research has to simultaneously cycle through top-down (conceptual, theoretical, and analytical) and bottom-up (methodological, operational, and documentary) investigatory practice (Yellen 1996). The GRSLE project is an attempt at putting this iterative research perspective into practice. We start with a conceptual framework of landscape taphonomy (Figure 2), then propose a methodological framework for exploring the concept, and eventually turn to concerns for how to integrate the conceptual and methodological perspectives into a multi-scale field research project.

D2.1 Coupling. In order to understand the operation of prehistoric systems, a basic understanding of coupled interactions within dynamic, contemporary systems is an appropriate starting point. Quite simply, coupled systems studies provide basic information on contemporary ecological interactions that directly influence artifact visibility, preservation, and spatial integrity. As described in section D4.1.3, this project will specifically be examining interactions among vegetation, burrowing rodents, soil properties, freeze-thaw cycles and snow melt, grazing/trampling, as these influence contemporary surface archaeological artifact visibility and impact the interpretive potential of shallowly buried subsurface materials (Surovell et al 2005). 

D2.2 Linking. As both a conceptual and pragmatic distinction, although coupled systems can be observed, documented, and modeled in contemporary setting, the complexity of such coupled processes make them somewhat less accessible in paleoecological studies. Therefore, we need to document diachronic patterning linked to proxy measures to make inferences about past systems. Linked pattern studies are a common mode of investigation in paleoecological and archaeological research. The study of coupled site formation processes will be used to develop more reliable inferences about linking surface artifact data from the GRSLE survey to prehistoric human systems.

D2.3 Bridging. Unless connected, coupled systems research and linked pattern studies can create two methodologically disjunctive bodies of information, and contributing little to the broader, cross-disciplinary understanding. In order to mitigate this possibility, we propose a number of empirical bridges to span the temporal gap between the complexity of the present and the opacity of the past. While there are a number of potential bridging data sets (e.g., pollen profiles, dendroecology, or spleotherm series), we use geomorphological to provide first planks to address issues of multi-generational scales of landscape change along the Greybull river. Once the
baseline datasets outlined in this proposal are available, we envision the subsequent methodological and conceptual development of expanded bridging research to be one of the potential intellectual and broader impacts of this project.

**D2.4 Bundling.** The potential costs of large-scale multi-disciplinary investigations to study coupling and provide linkages can easily reach astronomical levels. Although limiting scope is one oft-applied tactic, we feel that the resulting reductionist models may be much too simplistic to be of utility in describing the present, interpreting the past, or providing adequate data for planning for future conditions. We propose to alleviate the difficulties of compromising between comprehensiveness and cost by grouping, or bundling, a number of dataset collection protocols within a single sampling framework. The Modified-Whitaker sampling units are initially more costly in terms of field time to set up and document. However, once a plot is established, the “cost” of documenting and field sampling the plants, the archaeology, the herbivore pellets, the predator scat, the soils, and the plot specific locational and weather attributes do not add appreciable amounts to the field costs (Figure 3). In this illustration, each data class is indicated by A-F. If only one or two data sets are collected, a nested sample frame is relatively expensive; however as more data sets are collected, the overall cost remains relatively stable. Bundled sampling increase data output while containing overall project costs. On the other hand, if each of these studies were to be implemented using different sampling strategies, different field teams, and a variety of spatial scales, the costs would continue to escalate geometrically. We also assert that when a variety of data sets are documented across a number of spatial scales, the overall information return for understanding coupled processes will, in fact, be greater than that which could be achieved with an equal or even greater number of more autonomous data collection protocols. The ability to examine changing properties of multiple spatial scales opens the door to asking questions about the web of complexity shown in Figure 2. Specific applications are described in sections D4.1.2-D4.1.4.

An aspect of this project that merits mention is the experimental approach we are taking to better integrate multi-scalar and trans-disciplinary approaches into archaeological investigation. As such, we are, in part, requesting funding for concept development and field evaluation as part of a program to develop a substantive body of information about an area for which we currently have minimal archaeological data.

**D2.5 Modified-Whittaker sampling plots: A tool for Coupling and Linking.**

Implementing field methods to evaluate indicator condition is a different operation than conducting fieldwork to locate artifacts. In previous studies (Burger 2002; Burger et al. 2004; Burger and Todd 2006), we’ve described nested sampling plots used in ecological studies as an approach to investigating multi-scale spatial properties of archaeological artifact distributions. While still convinced of the utility of these small-scale plots as building blocks for beginning to recognize larger-scale artifact/area relationships, we also see these plots as providing a reliable way to begin a program to monitor archaeological landscape properties. For the 2006 project, we intend to locate several such plots within a 1 km² area, positioned so as to capture high and low-density surface artifact scatters. This will allow not only a refined view of artifact recovery rates and assemblage properties; it will also build a framework within which to capture data relevant for subsequent monitoring.
As illustrated in Figure 4, these plots consist of ten 1m² subplots (1-10), two 10 m² plots (A, B), one 100 m² plot (C), all nested within a 1000 m² K-plot. To document artifact recovery at different survey intensity values, we first survey the K plot with crew members spaced at slightly less than one meter apart moving across the plot at a constant rate of about 2.5 km/hr (a slow, careful walking pace). Artifacts (both prehistoric and historic/recent) located during this survey are mapped, documented, marked with a sharpie dot, and replaced at the spot where they were found. A separate crew then returns to the plot and conducts a higher intensity survey, crawling with shoulders touching (1-10, A, B, and C plots [total of 130 m²] only) and again documenting and mapping the artifacts, noting which are marked with sharpie dots (‘recaptured’ artifacts) and which are newly discovered. While the crawl surveys typically find more, and sometimes considerably more, artifacts than closely spaced walking transects, the goal of the sample is not to discover more items per se, but to calibrate the results of surface documentation using coarser-grained sampling. The modified-Whittaker plot allows us to assess “what we may have missed” (Burger et al. 2004).

This approach also allows us to systematically record information of fundamental relevance for documenting other non-archaeological properties of the surveyed landscape. In conjunction with archaeological documentation additional attributes to monitor other biophysical site surface visibility and formational processes are also recorded (see section D4.1.3). Examples of these sample plots to assess artifact visibility are given in section D3. While by no means comprehensive, this group of attributes, in addition to other spatial variables (such as distance from plot to trails, streams, and timber) will provide information to assess surface archaeological content and to provide baseline data for indicators of anthropogenic, biotic, and abiotic site condition.

D3. GRSLE Archaeological Research

Archaeological research in Wyoming’s Big Horn Basin has produced information on a variety of regionally significant sites such as Mummy Cave (Hughes 1988, 1998; 2003; Husted and Edgar 2002; McCracken et al. 1978; Wedel et al. 1968), Horner (Frison and Todd 1987), Colby (Frison and Todd 1986, 2001), Lookingbill (Kornfeld et al. 1998), Medicine Lodge Creek (Frison 1976), Hanson (Frison and Bradley 1980) and Dead Indian Creek (Frison and Walker 1984). Archaeological surveys within the central basin, prompted largely by oil and gas development, has resulted in the discovery of nearly 10,000 archaeological sites, most within the interior Basin and lower elevation foothills. Largely through the efforts of Frison and crews from the University of Wyoming, the Bighorn Mountains to the east of the Basin are also relatively well known. In contrast, very little work has been done outside of Yellowstone and Teton Parks in the Absaroka Mountains to the west of the Basin.

Beginning in 2002, we have conducted nearly 150 field-days of research along the upper reaches of the Greybull River (Figure 5) as part of the GRSLE project. These pilot studies were designed to: 1) evaluate the archaeological potential of the area and to develop appropriate field methods; 2) investigate some non-conventional sampling strategies; and, 3) learn the logistics for working in remote, mountainous settings. This has allowed us to try a variety of options for dealing with issues such as electrical power for charging PDAs, EDM batteries, and laptop computers (deep cycle marine batteries with solar panels), working and living in grizzly bear habitat (bear resistant food storage containers, camp layout, crew safety training, etc.), and in-field data collection (using PDAs and GPS units). We have explicitly tried to take care of most
Table 1. Summary of 2002-2005 Block Surveys on the Upper Greybull, Wyoming. In addition, about 200 ha of trail corridor survey has also been completed.

<table>
<thead>
<tr>
<th>SURVEY BLOCK</th>
<th>MEAN ELEVATION (m)</th>
<th>AREA (ha)</th>
<th>CHIPPED STONE</th>
<th>ART/HA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Creek Flats</td>
<td>2875</td>
<td>185</td>
<td>17887</td>
<td>97</td>
</tr>
<tr>
<td>Haymaker Flats</td>
<td>2580</td>
<td>310</td>
<td>10686</td>
<td>34</td>
</tr>
<tr>
<td>Dollar Mountain</td>
<td>3250</td>
<td>90</td>
<td>2609</td>
<td>29</td>
</tr>
<tr>
<td>Upper Francs Fork</td>
<td>3075</td>
<td>50</td>
<td>2629</td>
<td>33</td>
</tr>
<tr>
<td>Pinney Creek</td>
<td>2540</td>
<td>90</td>
<td>1178</td>
<td>13</td>
</tr>
<tr>
<td>Meadow Creek Basin</td>
<td>3100</td>
<td>90</td>
<td>1069</td>
<td>12</td>
</tr>
<tr>
<td>Gold Reef</td>
<td>3200</td>
<td>115</td>
<td>234</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>930</td>
<td>36292</td>
<td>39</td>
<td></td>
</tr>
</tbody>
</table>

century mining region at Gold Reef [Mueller et al. 2003]); 4) block surveys of open, relatively open settings. Survey spacing varies from 5 m to under one meter. In most cases, as artifacts are discovered, they are flagged, and coded by multiple two-person teams. As many as five such teams using PDA, calipers, and GPS units to record individual coordinates and descriptive and metric attributes on all pieces of chipped stone may be working on a single site at any one time. Diagnostic pieces are photographed and many have had latex molds taken of them (Todd and Burnett 2003).

Nearly 100 km of 20 m transects have been surveyed along a series of forest trails (200 ha). Larger block surveys have been undertaken and add another 930 ha to the survey coverage (Table 1). The research proposed here will expand on the Upper Francs Fork coverage (Table 1). The rugged topography often makes block surveys much less practical than linear trail transect, which usually traverse the most passable terrain, often follow drainages, and cross most open meadows. Since trail routes are dictated largely by topography, current trails are usually also the most probable access routes in the past and hence a reasonable starting point for gaining a large-scale overview of the region’s archaeology. These preliminary surveys have resulted in the documentation of over 40,000 pieces of chipped stone, and nearly 173 archaeological sites (over 30 other sites have been discovered, but have yet to be fully documented and are not included in the quantitative project summary information presented here). Prior to our work, only 3 prehistoric sites were recorded in this portion of the Shoshone National Forest and given the lack of any empirical data to the contrary, the notion of a “natural landscape” that has not been influenced by human actions could be maintained. Recognition of the archaeological complexity of human-landscape interactions, even in these remote Wilderness settings presents unassailable evidence that discussions of “empty” wilderness need to be modified to include models of spatially and temporally diverse human presence. Viewed across extended temporal and spatial scales, it becomes clear that models of human-landscape interactions expressed as a binary, presence or absence, perspective are overly simplistic.

Over the last four years, we’ve begun to document the rich, complex archaeological landscapes along the upper Greybull watershed. Our concerns have turned to how best to attempt to both preserve the archaeological component of the Wilderness, while at the same time working to find innovative ways to help enhance its research potential have guided us to consider interrelationships among archaeological preservation and local economic and environmental sustainability. Obviously, the legal mandate for managing heritage resources in the Wilderness places primary responsibility with the USDA Forest Service. However, we are of the opinion that as the potential for archaeological impacts are identified as part of an academic research program such as that outlined here, there is also an ethical responsibly that falls upon the research community to assist in such management. Therefore, in addition to our basic research concerns about prehistoric landscapes, we also see one of the necessary components of this project to be a concern with the longer-term sustainability of future Wilderness landscapes of which the archaeological record in an integral part.

We began our pilot studies with several very basic field research questions that reflected the absence of background information on archaeology of the Washakie Wilderness. The most fundamental question – is there evidence of significant prehistoric use of the area – has most assuredly been answered in the affirmative. Beginning our first field season, we expected a low density, sparse-scatters archaeological record. This expectation led to plans to survey a 35 km section of the Greybull River trail from the drainage headwaters to
the Wilderness boundary. After having spent 20 field days, recording over 10,000 pieces of chipped stone, and covering less than 5 km of the trail, it became abundantly clear that while light-scatters may be a common pattern, dense patches are also to be expected. By the end of our fourth field season, we have begun to answer several other questions about spatial and temporal variation in archaeological materials. At present two MA theses based on the GR5LE project have been completed (Burnett 2005; Reitze 2004), four more are scheduled for completion during the spring semester 2006, and three more have completed one field season’s data collection. Summaries of these and other research related to the project are available at www.greybull.org.

Obsidian XRF sourcing data from 128 artifacts collected during the 2004-2005 season indicates that the majority (79%) are derived from the Obsidian Cliff source in Yellowstone (Bohn and Todd 2005), but there are suggestions that there may be temporal differences (between Late Archaic and Late Prehistoric) in obsidian source selection and abundance in stone tool technologies, that prompt us to continue evaluating these and other apparent patterns in raw material acquisition through time. Artifacts have been recorded between 2200 and 3450 m, with artifact elevations clustering at 2500, 2800, 3100, and 3300 m. Average elevations of sites with temporally diagnostic artifacts (only one chronometric date, for a Late Prehistoric hearth feature is currently available), suggest more common use of lower elevations by Late Archaic and Late Prehistoric groups (average elevations 2759 m and 2748 m respectively) than that of Early Archaic (2970 m), Middle Archaic (2853 m), and Paleoindian (2823 m) groups. The majority of sites are relatively small, with the average assemblage size being 231 pieces of chipped stone, although about 65% of the sites have less than 100 pieces and eight sites have more than 1000 pieces. Seventy percent of the materials documented are unmodified debitage (N=28542) and the average item size is relatively small (14.8 mm; Figure 6).

Preliminary studies of evidences of changes suggest that a complex interaction of fire history and climate change have influenced the relationship between site placement and timber. Several sites that are today several hundred meters above tree line have high percentages of heat crazed and pot-lidded artifacts (>10%), and are uniformly distributed across the site’s surface, reminiscent of those at lower elevations with evidence of having been damaged by forest fires within the last 500 years. There are hints of dynamic interactions between climate, fire history, and human use of mountains (Reasoner and Jodry 2000). Pedologic and paleobotanical evidence in the Absarokas suggests elevated timber lines during the middle Holocene (Reider et al. 1988).

A series of modified-Whittaker plots (see Section D2.5) have been documented in several of the survey areas. In the Haymaker Flats survey area (Table 1), five plots were recorded to assess the impact of invasive plant species on the area as a proxy of the degree that the historic human activities may have altered other aspects of the landscape, such as artifact collection. Two botanists tabulated species richness, diversity, percentage ground cover (by species), litter cover, vegetation height (by species), and scat counts (mostly elk). Sample plots were then surveyed and documented by two independent archaeological crews. The first covers the full K plot (20x50m) at ~70 cm transect spacing and records all artifactual material and indicates that a piece has been coded by marking it with a Sharpie dot. As a second level of observational intensity, we then may have a second crew resurvey the 1m² plots (Figure 4;1-10), the 10 m² A and B plots, and the 100 m² C plot (Figure 4) using a finer grained coverage to provide information on how different observational scales influence our surface documentation. This second coverage, with crews crawling on hands-and-knees, and touching shoulders approaches 100% coverage of an area. As reported elsewhere (Burger et al. 2004), these different scales of survey coverage can produce significant differences in

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1 Crew spacing is determined by each crew member touching the shoulder of the adjacent crew member. The average distance between variable-arm-length teams of this spacing is 70 cm.
chronology from excavations. Objectives include both basic and applied archaeological research. At the basic level, more sophisticated questions without more complete survey, and without additional information on subsistence and patterns in elevation zone use, lithic raw material selection, and site placement and reuse we are unable to address the larger, high elevation sites documented – site FF0012.

Also need site specific data. Based on a number of criteria outlined below, we proposed a testing program at one of significant research questions that can potentially be addressed with our archaeological survey, most can not be fully documented of prehistoric sites will add considerably to our understanding of montane adaptations in general (Aldenderfer 1998), as well as contribute to questions on: 1) interactions between Plains and Foothills-Mountain groups on the northwestern Plains (e.g., Bender and Wright 1988; Black 1991; Frison 1976; Frison et al. 1986; Frison and Gray 1980; Husted 1969, 1995, 2002; Husted and Edgar 2002; A. Johnson 2002; Kornfeld and Frison 2000; Kornfeld et al. 1998; McCracken et al. 1978; Pithlado 1998, 2004; Stiger 2000; Wedel et al. 1968); 2) interactions among prehistoric groups inhabiting the Plains, Plateau, Great Basins (Frison 1991; Janetski 2002); 3) interactions of human groups and western montane landscapes during the Holocene (Bender 1983; Benedict 1978, 1981, 1992a, 1992b; Benedict and Olson 1978; Camon 1996; Frison 1976, 1991; Hughes 1988, 1998, 2003; Reeves 1973, 1974; Sanders 2002; Shortt 2002; Wright 1982, 1984); 4) investigation of the interplay between humans and other components of multi-scale adaptive cycles (Gunderson and Holling 2002; Holling 1996, 2002; Holling and Gunderson 2002) and 5) researching how the ecological legacies (Barton et al. 2004; Odling-Smee et al. 2003; Phillips 1997, 2001; Redman 1999a, 1999b, 2002) of past human/landscape interactions provide a framework for understanding contemporary ecological pattern, process, and adaptive management strategies (Berkes and Folke 1998a, 1998b, 2004; Holling, Gunderson, and Ludwig 2002; Redman and Kinzig 2003; Wesley et al. 2002).

On the applied side, the project will operate at two levels. First, it will contribute baseline data and field methodologies for monitoring archaeological site condition (particularly in terms of anthropogenic impacts) in an area that has yet to suffer extensive damage from artifact collection or other impacts related to recreational or commercial use. This component of the projects seeks to develop a series of indicators (Bamberger et al. 2004; Havstad and Herrick 2003; Niemi and McDonald 2003; Noon 2004) to evaluate changes in archaeological site condition. Second, the project will apply archaeological techniques to expand the conceptual and methodological toolkit of recreational ecology (e.g., Cole 1978, 1981a, 1981b, 1988, 1989a, 1989b, 1992, 1993, 1994, 1995a, 1995b, 1995c, 2001; Cole and Bayfield 1993; Cole and Landres 1996; Cole and Monz 2002, 2003, 2004; Font 2000; Hall and Farrell 2001; Liddle 1997; Reid and Marion 2005; Zabinski et al. 2002). Therefore, while there are a series of significant research questions that can potentially be addressed with our archaeological survey, most can not be fully formulated until a better understanding of the fundamental spatial and temporal patterns of human landuse is available, and for a finer grained understanding about the formational dynamics of those patterns. It is this latter aspect that is a primary goal of this funding request. Additional survey coverage (funds requested from non-NSF sources) will help fill in the spatial gaps in coverage, but in order to more fully interpret these surface data sets, we also need site specific data. Based on a number of criteria outlined below, we proposed a testing program at one of the larger, high elevation sites documented – site FF0012.

This site was discovered in 2005, and although Smithsonian numbers for the sites found this year have been requested from the Wyoming SHPO office, these are not yet available and the site is referred to here by its temporary field designation.

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2 This site was discovered in 2005, and although Smithsonian numbers for the sites found this year have been requested from the Wyoming SHPO office, these are not yet available and the site is referred to here by its temporary field designation.
Figure 8. Site FF001, 2005 in-field coding. Note small, snow-melt fed pond and hummocky terrain (probably linked to slumping of local hill slopes).

D4. Site FF001: Coupled Field Research -- Formational Dynamics and Longitudinal Study

Of the sites recorded to date, only five have more than 2000 pieces of chipped stone tabulated from the surface documentation. Site FF001 (Figure 8) is one of these larger assemblages with a total of 2471 piece having been recorded in July, 2005. These include 23 projectile points ranging from Late Paleoindian to Late Prehistoric in age (Figure 9) and 21 other bifacial performs as well as cores, scrapers, and a series of other formal and expedient tools. At an elevation of 3100 m and covering over 6 ha, this site is spatially one of the largest encountered in our four year’s survey, is one of the highest elevation sites recorded in the project, and contains one of the most diverse lithic assemblages (in terms of both chronological indicators and artifact categories). Raw materials include over 70% non-local sources (e.g., not from the local Absaroka Eocene volcano-clastics; Breckenridge 1974; Dunrud 1962; Love 1939). Most recorded items are fairly small (average 15.6 mm, maximum 115 mm) and unmodified debitage accounts for fully 73% of the documented assemblage. The distribution of all documented items is shown in Figure 9 with two scales of buffers. The outer buffer (black) is set at 30 m and is used to define the site boundaries. Second, a series of 5 m buffers (blue) suggest internal clustering of artifacts, which may, with additional evaluation be indicative of different occupational events. Nearly 5% of the chipped stone exhibits crazing or potlidding indicative of burning. The site is currently above timber line, but given fluctuations in the past (Meyer et al. 1995; Meyer and Wells 1997; Romme 1982; Romme and Despain 1989; Whitlock and Bartlein 2004), it is possible that this burning may be the result of past forest fires. However, spatial patterning of the burned pieces of chipped stone exhibits a tendency toward clustering within a few areas rather than uniform scatter across the site surface, which is suggestive of potential hearth locations. The site is on a rolling surface dotted with a series of alpine ponds fed by seasonal snow melt. Several of the larger ponds appear to hold water through out the summer. The east facing slope is somewhat sheltered from the high winds that often scour the ridge tops and more exposed settings and fine-grained sediments seem to have accumulated and soil development is indicated by exposures in several erosional cuts. The alpine ponds form in the bottoms of depressions that can be as much as 2-5 m below the surrounding surfaces (Figure 8) and seem to provide excellent sediment traps. Spring melt waters coupled with abundant loose sediments from pocket gopher burrows both on the ground surface and within snow drifts provide a ready source of annual deposition into these lower lying areas. One of the reasons we’ve selected FF001 for additional investigation is this potential for greater regular depositional inputs than most other sites in the area. This depositional potential, coupled with the projectile point evidence of nearly 8 millennia of repeated use suggests that this is a good candidate for yielding datable materials from a range of time periods.

However, the site’s depositional history is no doubt complex. First, pocket gophers as well as badgers seem to be very active in areas of the site with appropriate sediment depths and soil moisture properties. The potential for bioturbation from this burrowing as well as from trampling by grazing animals around the muddy pond margins is high. Second, some of the higher portions of the site exhibit some patterned ground and cryoturbation has no doubt played a role in the soil mantle formation. Small-scale sediment slumping and soil creep are suggested on some of the steeper slopes and the entire surface on which the site is situated may be in part the result of multi-scale mass wasting earthflow events (e.g., Parise 2003), which may be the origin of the hummocky terrain with lobate structure in which the ponds form.

The artifact assemblage from FF001 is suggestive of a diverse set of activities including tool manufacture (based on the number of early stage bifaces recorded) and rejuvenation (many of the flakes seem to be from tool resharpening with over 700 of those observed on the surface being under 10 mm in maximum length). Projectile points include Paleoindian points that appear to be more similar to classic Plains forms than to Mountain/Foothills...
forms (Figure 9: ADB-1 and ADB-2) as well as a suite of both named and unnamed Archaic and Late Prehistoric variants. It is one of the highest elevation sites documented in the GRSLE project (3100 m) and has one of the highest surface artifact densities in the project area. Possible clustering of burned lithics suggests hearth areas, and there is the possibility of stratigraphic separation of occupational episodes in some of the sediment pockets dispersed across the site area. In all, the site has a high potential for contributing a better understanding of the little known mountain archaeology of the region and providing insights into a wider range of montane landuse questions.

However, in order to meet such potential and before any large scale excavation would be warranted, further information on the site’s context and formational complexity is required. It is toward these ends that much of the field work of the current request for funding are directed.

D4.1 Field Methods.

A field camp will be established about 600 m from site FF001. The site itself is about 2 km from the nearest 4 wheel-drive accessible two-track road. Since the total amount of communal field gear (cook tents, bear resistant food storage containers, batteries, EDMs and tripods, food, etc) used for this project typically weighs between 1100-1500 kg per field session, an outfitter and pack horses will be employed to transport the majority of field equipment to and from the field camp location. Crew members will be responsible for transporting their personal camp gear (tents, sleeping bags, clothing, etc). The majority of the crew will be Colorado State University
undergraduate students who have had at least 10 field days training in project-specific field protocols before the FF001 project begins. In terms of educational benefits, student participation in the GRSLE project has led to a phenomenal rate of undergraduate and graduate student presentation at professional meetings (for example, of the 13 students enrolled in the summer 2005 class, 11 [85%] have been authors or co-authors on conference papers -- http://www.greybull.org/plains05.htm). Stipends are requested for three local K-12 teachers (from the Big Horn Basin, with preference for School District 16 [Meeteetse]) to participate in the field program to learn basic archaeological approaches, and to work on incorporating archaeological examples into their lesson plans. The PI has previously had success with a similar program of K-12 teacher participation in a field class setting (http://www.humanpaleo.org/Bimson02.htm).

D4.1.1: Control Network

**Objective:** develop high-resolution site control points for documentation and monitoring using both sub-meter GPS and EDM total stations. **Outcomes:** This will provide baseline provenience control for immediate work and long-term monitoring of the site. **Methods:** The first phase of the field work will be to establish a local geodetic control network using five static, tripod mounted GPS receivers (Thales Navigation Locus units) that will be initially positioned within 1 km of the site with each receiver collecting GPS data for a minimum of 18 hours. Once the local control points are established, three of the static receivers will be relocated at appropriate nearby USGS geodetic control points, again for a minimum residence time of 18 hours. Postprocessing of these data allow establishment of control nodes with 3-D coordinate accuracy of at least 5mm or less. The local control network can then be used for establish mapping points for our two Sokkia total station EDM’s, which will be used in conjunction with Thales MobileMapper GPS units for mapping artifacts and landscape features. Site area control points will be marked with stamped aluminum caps on rebar rods. Each crew member will be equipped with a recreational GPS/radio unit (Garmin Rino) that will be used for field communication and marking and relocating areas of interest. Artifact mapping will be done using EDM’s or for dispersed items where precise spatial relationships will not be as critical, with either sub-meter Trimble GeoXT (with ArcPad) or MobileMapper GPS units. This system has been the basis of some of our artifact recording since 2002, and the in-field protocols are at this point are well established and demonstrably feasible.

D4.1.2: 100 ha Block Survey

**Objective:** Provide background surface survey data to compare to FF001 cluster and stratify local setting for finer-grained survey, documentation, and monitoring. **Outcomes:** This allows investigation of archaeological spatial patterning at several scales (Wandsnider 1998; Wandsnider and Camili 1992; Wells 2001) and provides additional contextual information for site specific data from FF001. **Methods:** Summer 2005 fieldwork in the FF001 area focused on the single dense artifact cluster shown in the center of Figure 9. However, while walking to and from the site, other artifact scatterings were observed, their locations marked but not intensively surveyed and documented. The second phase of proposed work in the site area will be to conduct a survey of a 1 km² block centered on the FF001 cluster. As with our other block surveys, this area will be first covered at 5 m crew spacing (8-10 person survey crew) walked at a pace of 2.5 km/hour. Crew members at each end of the survey line will be responsible for maintaining transect direction and rate of coverage using Thales MobileMapper units. Each crew member will also have WAAS enabled recreational GPS unit and the tracklogs of each crew member’s GPS will be recorded to document specific survey transect locations. Each artifact encountered will be marked with pin flags, while maintaining constant rate of travel (i.e., in order to assure uniform survey coverage, crew will not stop and/or spend any additional time searching for other artifacts near a find spot). As each 500x500 m quadrant survey is completed at the 5 m spacing, all areas within 30 m of a flagged artifact will be resurveyed at a 70 cm transect spacing, again flagging each additional item. Finally, a recording crew, comprised of two-person teams will begin in-field documentation of all flagged artifacts. As recording proceeds, additional artifacts are usually encountered and these are flagged and recorded as well. Each recording team will be equipped with sub-meter accuracy GPS units, and all artifacts will be recorded using either these or an EDM total station. All artifact locations will be recorded in WGS84 UTM coordinates. As with other components of this project, this will be a largely non-collection survey and in addition to locational information, documentation teams will record artifact type and

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3 The project already has a Trimble GeoXT GPS unit with ArcPad 6, but can increase site documentation speed and accuracy using the less expensive, equally accurate Thales units budgeted in this proposal.

4 Each discovery context in differentiated by using different colors of pin flags, and “flag color” is one of the attributes documented for each item. This allows us to examine the surface record from different observational scales: 5m (yellow flag), 70 cm (red pin flag), and seated, non-systematic discovery while coding (blue flag).
completeness, raw material type, artifact color, dorsal scar counts, platform attributes, heat modifications, and basic length, width, and thickness measurements on all pieces of chipped stone. All coded items will be clearly marked with a Sharpie dot on their upper surface to assure that artifacts that have already been recorded can be distinguished from newly discovered artifacts during a second level of survey intensity (see section D4.1.3). Additional measurements are made on diagnostic projectile points, and digital photographs are taken of all projectile points and formal tools. Data are coded into PDAs as Excel files or Pocket CE data catalog systems on Trimble and Thales GPS units. Data are stored on SD cards, which are backed up onto PCs at least once a day. Tracklogs, and basic GPS data sets, GIS shapefile data, and photos are also downloaded and backed up daily. Electric power is provided by 3 deep cycle marine batteries that are recharged with solar panels. Archaeologically, these survey data will allow us to develop a better understanding of artifact patterning at a scale between that of the individual site and the larger regional coverage. Smaller sample plots nested within this 100 ha plot will facilitate linking observations across multiple spatial scales.

D4.1.3: Nested Sample Plot documentation

Objectives: Develop tightly coupled observations on biophysical processes that influence surface archaeological visibility and site formational dynamics, provide a second observational scale of archaeological documentation to assess the results of 100 ha block survey, and record aspects of the surface record that can be used as baseline data for longitudinal study of site condition. Outcomes: Provides an innovative approach to linking observations between surface archaeological record to both the subsurface record and to key aspects of the biophysical formational processes acting on the artifact assemblage. This also seeks to refine methods of documentation conducive to a quantitative approach for monitoring archaeological site condition. Methods: As survey and documentation of the 100 ha plot is completed, selection of locations for the placement of ten modified-Whittaker sample plots will be completed. The 100 ha survey block will be stratified into areas having either <40 artifacts/ha or ≥40 artifacts/ha. This distinction between “low density” and “high density” sampling strata is based on the average density of artifact per hectare documented in a variety of settings across the upper Greybull (Table 1). Sixty percent of the sample plots will be arrayed across the high density areas and the remaining four modified-Whittakers will be positioned in the low density areas of the block survey area. Corners of each 20x50 m sample plot (Figure 4) will be shot in with the EDM and marked with durable markers. Before any additional archaeological documentation is conducted in the sample plots, the following attributes will be recorded in each 200x50 cm subplot (Figure 4:1-10): plant species identification, ground cover (by species), and vegetation height (by species), percentage bare ground, number of game animal and domestic animal scat (the site area is part of a summer grazing allotment for cattle) and percentage of plot covered with scat, percentage surface area stone covered, the percentage of each of the 10 largest stones covered in lichen, percentage covered with backdirt from rodent burrow, volume of loose sediment from rodent burrows (this will be recorded as part of archaeological documentation, after all visible surface artifacts are recorded, the loose sediments will be collected and screened through 1/8” mesh dry screen), and approximate sediment depth (an Oakfield soil probe will be used to estimate sediment depth). With the exception of rodent mound information and surface stone ground cover and lichen cover, each of these sub-plot attributes has previously been documented on some of the other sample plots recorded on the Greybull.

In order to interpret the site’s and region’s surface archaeological patterning, we need to develop a better understanding of the relationships between artifact visibility and other biophysical processes in these alpine settings (e.g., Benedict 1976, 1979; Birkland et al. 2003; Bocak 1986, 1992; Dixon 1991; Engeman et al 1999; Forbis et al. 2004; Fowler et al. 2004; Gabet 2000; Gabet et al. 2003; Hadly 1997, 2003; Heegaard 2002; Inouye 1997; D.L. Johnson 1989, 1990, 2002; Johnson et al. 2005a, 2005b; Knight et al. 1979; Litaor 1996, 2001; Matsuoka 1998, 2005; Mattson 2004; Miller et al. 2001; Ohel 1987; Phillips 2004; Proulx et al. 1995; Rezutek and Cameron 2000; Romanasch et al. 2005a, 2005b; Seabloom et al. 2001; Seaward 2004; Sherrod and Seastedt 2001; Smallwood and Morrison 1999; Stanton et al. 1994; Walsh et al. 2003; Yamada et al. 2000; Yoo et al. 2005). The rationale for including many of these attributes as part of the basic survey is threefold: first, in order to assess the results of surface survey, aspects of archaeological visibility and artifact movement patterns are required. Visibility has both biological (vegetation cover and bioturbation) as well as physical components (erosion, cryoturbation, and soil mantle turbidity) and we have selected a suite of attributes to monitor a diverse set of visibility-linked processes. Second, we envision a component of basic archaeological site documentation that provides baseline data for future monitoring of site condition. However, without information on coupled data of biophysical condition, changes in, for example artifact frequency from one monitoring episode to the next would have little interpretive value. Finally, pedagogically it is essential for students, the general public, and land managers to be given concrete examples of the interrelationships and connectedness of archaeology with other aspects of landscape science.
Once the biophysical data are collected within the sample plots, the second intensity of archaeological survey (crawl survey) will be completed in 130 m² subplots (Figure 4: Plots 1-10, A, B, C) and any newly discovered (not Sharpie dotted) items will be recorded using the same attributes as in the 100 ha survey. Typically, the crawl survey finds 30-60% more artifacts than the 70 cm walking survey. Within the 20x50 m plots, all diagnostic artifacts will be point provenienced with at least sub-cm accuracy in order to allow relocation of items most vulnerable to artifact collection as part of longer-term monitoring program. Loose pocket gopher backdirt (in 200x50 cm plots) will be collected and screened onto plastic tarps to record the number of artifacts currently being mobilized by burrowing. After screening the sediment will be returned to the plot. Artifacts recovered from rodent mound screening will be collected. Taken with the larger scale survey sample, these fine-grained data will provide for analysis of surface spatial patterning at multiple scales and allow for a better informed selection of plots for test excavations.

D4.1.4: Subsurface testing

**Objectives:** Evaluate depth and of sediments and artifacts, provide stratigraphic profiles for geomorphological investigation, and collect materials for radiocarbon dating. **Outcomes:** Adds to basic understanding of regional prehistory, regional paleoenvironment, and applications to archaeological site formation studies. **Methods:** Test excavations will be of two sorts: small test pits (200x50 cm) and slightly larger blocks (2x5 m). Based on results of documentation of 100 m² surface plots (ten 200x50 cm plots within ten modified-Whittaker plots), a sample of 25 will be selected for initial test excavations with most (N=20) positioned in areas with highest potential for yielding subsurface materials (based on topographic settings, artifact frequency on surface and in rodent mounds, and soil probe depths). Five test plots will be positioned in settings with comparable soil probe depths and topographic setting, but with no surface artifacts and at least 30 m from nearest surface artifact cluster. It is likely that in addition to the high density clusters shown in Figure 9 for site FF001, several other artifact clusters will have been encountered within the 100 ha and sampled with modified-Whittaker plots. Therefore it is unlikely that all 20 test units will be placed within the boundaries of site FF001 as currently defined, which means that this phase of testing will impact less than .05% of the known site. Unless clearly visible natural stratigraphic breaks are observed, initial testing will be by arbitrary 5 cm levels excavated within 50x50 cm units. Hand excavation, with trowels will be used in all test units and unless bedrock is encountered, each will be taken to a depth of at least 1 m. All sediment will be screened through 1/8” mesh, with all clasts (whether artifactual or not) captured in the screens collected for further documentation. Samples for potential radiocarbon dating will be collected and attention will be given to issues of assessing charcoal sources (Benedict 2002; Gardner and Whitlock 2001; Whitlock and Bartlein 2004; Whitlock and Millspaugh 1996). Depending on depth and artifactual content, a sample of sediments may be removed from the site and transported to waterscreening facility in the nearest town (Meeteetse). No water screening will be attempted in the site area to avoid adding sediments to the alpine hydrologic system. A total station EDM will be used to provide point provenience data for all excavated items found in situ greater than 2 cm in maximum length (and for all sediment, charcoal, etc. samples), and all appropriate point provenienced items will also have orientations and inclinations of the long axis recorded (appropriate items will have a clearly defined major long axis).

Based on results of these small unit text excavations, and with surface indications again considered, five slightly larger excavation units 2x5 m (Figure 4: A and B plots) will be excavated and screened using the same methods as the smaller plots. Whereas the 200x50 cm plots are used to assess subsurface potential, the larger plots will serve to provide a slightly more detailed view of assemblage content in any subsurface components. Altogether, less than 70 m² of site FF001 will be impacted by test excavations (slightly over 0.1% of the site area). While this is an extremely small portion of the site and will provide only a limited view of the archaeological diversity, it will provide essential information to design appropriate larger-scale excavations aimed at providing more detailed interpretations of site specific activities and regional interactions.

D5. Schedule and Personnel

To minimize travel time and the number of pack trips needed, the majority of fieldwork will be conducted during 20-day field sessions. Depending on winter snow depths and spring temperatures, field work can begin as early as late May or as late as mid-June and often must be completed by late September, but snow flurries are to be expected throughout the year. During 2006, field crews will include CSU field school students who have been trained for at least 15 days prior to the FF001 project (5 pre-field training in lithic analysis and coding, use of GPS and mapping equipment, etc. and 10 field days), paid Graduate student supervisors with at least 1 field season’s experience with the project, as well a graduate and undergraduate volunteers. Overall design, supervision, and analysis of the archaeological fieldwork will be under the direction of Todd who has nearly 30 years experience in Plains archaeology, and lifetime familiarity with the study area, having grown up on a near-by ranch. Late in the
field session, once most of the test units have been completed and the full array of potential stratigraphic profiles has
been exposed, geoarchaeologist Dr. Gary Huckleberry will spend 3-4 days on site sampling, describing the sections
and collaborating on additional data collection and geoarchaeological interpretations of the site’s formational history.
Although best known for his more recent work on desert alluvial geomorphology, Huckleberry is well versed in
montane research having conducted his master’s thesis research at high elevation archaeological site in the Absarokas
(Huckleberry 1985; Reider et al. 1988) and is currently collaborating with Robert Kelly on Paleoindian use of
rockshelters in the Big Horn Mountains about 125 east of the GRSLE project area. Interaction with local
stakeholders will occur at several levels. In addition to the on-going, informal contacts, at least one overview
presentation on the project will be given in the local Public Library (this has been an annual event) in addition to
follow-up and possible in-class project collaboration with K-12 teachers. Some of the equipment used for the field
project (Garmin Rino GPS units) will be loaned to School District 16 for use during the 2006-2007 school year and
both Todd and graduate students will be available periodically to serve as resources for local teachers. At least two
MA theses will use data from this project.
Laboratory analysis will be conducted during the 2006-2007 academic year, and will include spatial
analyses and basic soil analyses (e.g., grain-size, pH, and organic matter). The site area will be revisited during the
winter and during the summer 2007 to map features such as snow drift locations (using GPS and recorded as GIS
shapefiles), that will add additional dimensions for understanding the sites formation. In addition, a small sample of
the surface documentation plots will be revisited several times during 2007 and the basic archaeological and
biophysical attributes tabulated to provide a short-term perspective on changes in site condition.

D6. Project Outcomes
Completion of this project at FF001 and its environs will result in a number of benefits to archaeological
research, resource protection, and community science education:

- Archaeological data on the surface assemblage from a large, multi-component high elevation site (FF001) in
  a little know portion of the American Rocky Mountains. The presence of Paleoindian and Early Archaic
  components contribute to modeling mountain-Plains interactions during the early Holocene.
- Intensive survey (5 m transect spacing) of 100 ha centered on the FF001 artifact cluster. This surrounding
  area, similar alpine ponds, seems very likely to exhibit similar densities of artifacts. This survey will expand
  our understanding patterns landscape use and reuse.
- Resurvey of 10000 m² within the 100 ha block (1% resample) at ~70 cm transect spacing and 1300 m² at a
crawl. This will yield three scales at which to examine difference in artifact recovery and assemblage
characteristics. These data add to discussion of archaeological survey methodology.
- Within ten modified-Whittaker plots, collect detailed observations of biophysical properties to allow
  analysis of site formation and artifact visibility variation. These data will also serve as baseline
  information on present condition of the site area and can be used to monitor condition based on replicable,
  quantitative attributes.
- Testing of 70m² of a large, complex site to assess potential for subsurface, stratified materials deposits. The
  potential is high, and locating multiple levels at a 3100 m open site would greatly expand the basic
  information on high elevation use of the Rockies.
- Developing indicators of archaeological condition and encouraging local stewardship through involvement
  of community K-12 programs and information exchange with local groups and management agencies will
  raise awareness of the information potential of the area’s sites.
- Increase awareness among multiple stakeholders of the complexity of human/landscape interactions in
  today’s wilderness settings, and promote a more holistic (Gorke 1999) perspective on human influence on
  even the more remote environments. Create suggestions for backcountry site management policy.
- Promote science and community-based scientific research to enrich rural, economically disadvantaged
  communities and encourage local pride in the area’s heritage and potential though using local examples to
  enhance K-12 classroom settings.
As a group, this set of outcomes provides significant primary archaeological data, while integrating
education, policy, and preservation concerns into a broader framework. Transdisciplinary archaeological field work
adds to our understanding the past, but it can also provide conceptual and methodological bridges for integrating
other social and biophysical sciences into more comprehensive understanding of landscape dynamics. This project
seeks to illustrate the centrality of investigating anthropogenic processes as fundamental and contributory to a
diverse group of community and ecosystem ecological and social research issues.
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