Values-Based Management of Archaeological Resources at a Landscape Scale

Francis P. McManamon, John Doershuk, William D. Lipe, Tom McCulloch, Christopher Polglase, Sarah Schlanger, Lynne Sebastian,and Lynne Sullivan

Historically, there are examples of large public projects in which more broadly conceived approaches have been used to assess the value of archaeological resources in a management area prior to development or for the mitigation of infrastructure project impacts to significant archaeological resources (Altschul 1997). Examples of such management and mitigation approaches include: the Wetherill Mesa program at Mesa Verde National Park (Hayes 1964); the Dolores Archaeological Program in southwestern Colorado (Dolores Archaeological Program 2015); the Theodore Roosevelt Dam Studies (Theodore Roosevelt Dam Studies 2015); the Jamestown Archeological Assessment (Brown and Horning 2006; Colonial National Historical Park 2001); and

ABSTRACT

Public agencies at all levels of government and other organizations that manage archaeological resources often face the problem of many undertakings that collectively impact large numbers of individually significant archaeological resources. Such situations arise when an agency is managing a large area, such as a national forest, land management district, park unit, wildlife refuge, or military installation. These situations also may arise in regard to large-scale development projects, such as energy developments, highways, reservoirs, transmission lines, and other major infrastructure projects that cover substantial areas. Over time, the accumulation of impacts from small-scale projects to individual archaeological resources may degrade landscape or regional-scale cultural phenomena. Typically, these impacts are mitigated at the site level without regard to how the impacts to individual resources affect the broader population of resources. Actions to mitigate impacts rarely are designed to do more than avoid resources or ensure some level of data recovery at single sites. Such mitigation activities are incapable of addressing research question at a landscape or regional scale.

Los organismos públicos de todos los niveles de gobierno y otras organizaciones que administran recursos arqueológicos a menudo se enfrentan al problema de muchas empresas individuales que afectan a un gran número de recursos arqueológicos significativos individualmente. Este tipo de situaciones se presentan cuando una agencia es la gestión de un área grande, como un bosque nacional, distrito de administración, unidad de parque, refugio de vida silvestre, o la instalación militar. También pueden surgir en relación con los proyectos de desarrollo a gran escala, como la evolución de la energía, carreteras, embalses, líneas de transmisión y otros proyectos de infraestructura importantes. Con el tiempo, la acumulación de tales impactos también puede degradar el paisaje o de escala regional los fenómenos culturales. Normalmente, estos efectos se mitigan como acciones individuales sin tener en cuenta cómo los impactos a los recursos individuales afectan a la población en general de los recursos. Acciones para mitigar los impactos rara vez están diseñados para hacer algo más que asegurar un cierto nivel de recuperación de datos en los sitios individuales. Este tipo de actividades de mitigación son incapaces de hacer frente a la pregunta de investigación en un paisaje o escala regional.

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the Lower Verde Valley Archaeological Program in central Arizona (Lower Verde Archaeological Project 2015; Whittlesey et al. 1997).

In this article, we consider how archaeological resources can be managed at a landscape or regional spatial scale in ways that take account of the full range of their values. First, we present information noting the importance of this topic and some efforts already underway to develop and implement such a resource management approach. Then, we describe necessary preconditions for the successful application of such an approach. Readers should note that we are describing an emerging, broad resource management framework, not a rote, formulaic solution.

We define "landscape or region" as a relatively large area, although we do not select a minimum or maximum size. The landscape approach to resource management and valuation that we discuss in this article typically is applied to relatively large areas with cultural, ecological, environmental, and/or historical consistency. Examples include: the San Luis Valley in southern Colorado and northern New Mexico; the American Bottom area of the central Mississippi River near St. Louis; Cape Cod on the New England coast; generally conceived ecological regions such as the Colorado Plateau, the Great Basin, or the Southern Great Plains, all of which include portions of several states. A landscape approach to resource management also may focus on a particular geographical area that is managed by a public agency.

An important feature of values-based landscape-scale management is the range of resource values that can and should be considered. While form and visual value are used to describe and evaluate "cultural landscapes," additional values, such as cultural, educational, historical, and scientific values, also can be incorporated into landscape-scale resource management. In different sections of this article, we consider both the values that archaeological resources may have and how individual resources may be ranked when the relative importance of different values is evaluated. Such rankings are essential to decision-making about management of individual resources or classes of resources. More broadly, adoption of a landscape management orientation in archaeology aligns with growing trends in ecological and environmental sciences.

We use the term "archaeological resources" to emphasize that such a management framework must consider all types of in situ archaeological sites, as well as archaeological collections, including associated paper and digital records. The latter are significant archaeological resources in their own right.

This article is derived from a report prepared by the Task Force on Valuing Archaeological Resources (established in October 2014) for the Board of Directors of the Society for American Archaeology (SAA) (Altschul 2016; SAA Values Task Force 2015; Supplemental Appendix A).

The SAA Board asked the task force to determine whether managing archaeological resources at a landscape spatial scale using a values-based approach was a feasible and positive management approach. The short answer to the question is a qualified "yes."

The feasibility of a management framework depends on how it is devised and implemented. If the necessary conditions and guidelines are met, a values-based, landscape-scale archaeological resource management framework can be applied. Such approaches have great potential to generate useful archaeological data and manage both individual archaeological resources and classes of archaeological resources for effective long-term protection and use.

Our overall perspective and general recommendation, expressed throughout this article, is that archaeological resource management systems, whatever their basis and methodology, should include treatment options that extend beyond avoidance, in situ preservation, or impact mitigation through data recovery. These preservation treatments are important, but alone they do not provide the full social benefit that should be derived from the effort and expense that they require. Management of archaeological resources should include proactive efforts to provide societal benefits that go beyond preservation (Lipe 1996, 2009; Willems 2014). Activities that enable broad access to heritage or educational sites, collections, and information are widely appreciated. The creation of new information about the past and its dissemination through scholarly and publically oriented publications, media treatments, museum displays, and social media also are important aspects of archaeological resource management. A landscape approach will yield greater integration and synthesis of data and clearer translation of detailed information for the public. For many archaeological sites, in situ preservation and the adequate curation of physical collections and digital data simply make it possible for public benefits to be delivered someday, somehow, by someone. Resource management needs to extend beyond this essential, but incomplete, preservation activity.

BACKGROUND

Many federal, local, state, and tribal agencies manage land and so are responsible for the management of archaeological resources. This includes a wide range of agencies, for example, at the federal level, the Bureau of Land Management (BLM), the NPS, the Forest Service (USFS), the Bureau of Reclamation (BOR), the Fish and Wildlife Service (FWS), various Department of Defense (DoD) branches, and more. Other agencies fund or regulate public developments (e.g., the Federal Highway Administration, the Environmental Protection Agency, and the Federal Energy Regulatory Commission) and are responsible for the impact that these undertakings have on archaeological resources (e.g., see Departmental Consulting Archeologist 2010; McManamon 1992, 2000). Many of these agencies are interested in improving the stewardship of archaeological resources by managing them at a larger spatial scale. Organizations that advise and oversee how agencies treat the cultural resources for which they are responsible, for example, the Advisory Council on Historic Preservation (ACHP) and State Historic Preservation Offices (SHPO), share this interest in improving the management of cultural resources, but may not always agree with how agencies determine to do so.

The movement emphasizing resource management at larger spatial scales recently has been driven by leaders in key public agencies. One such example is Secretarial Order Number

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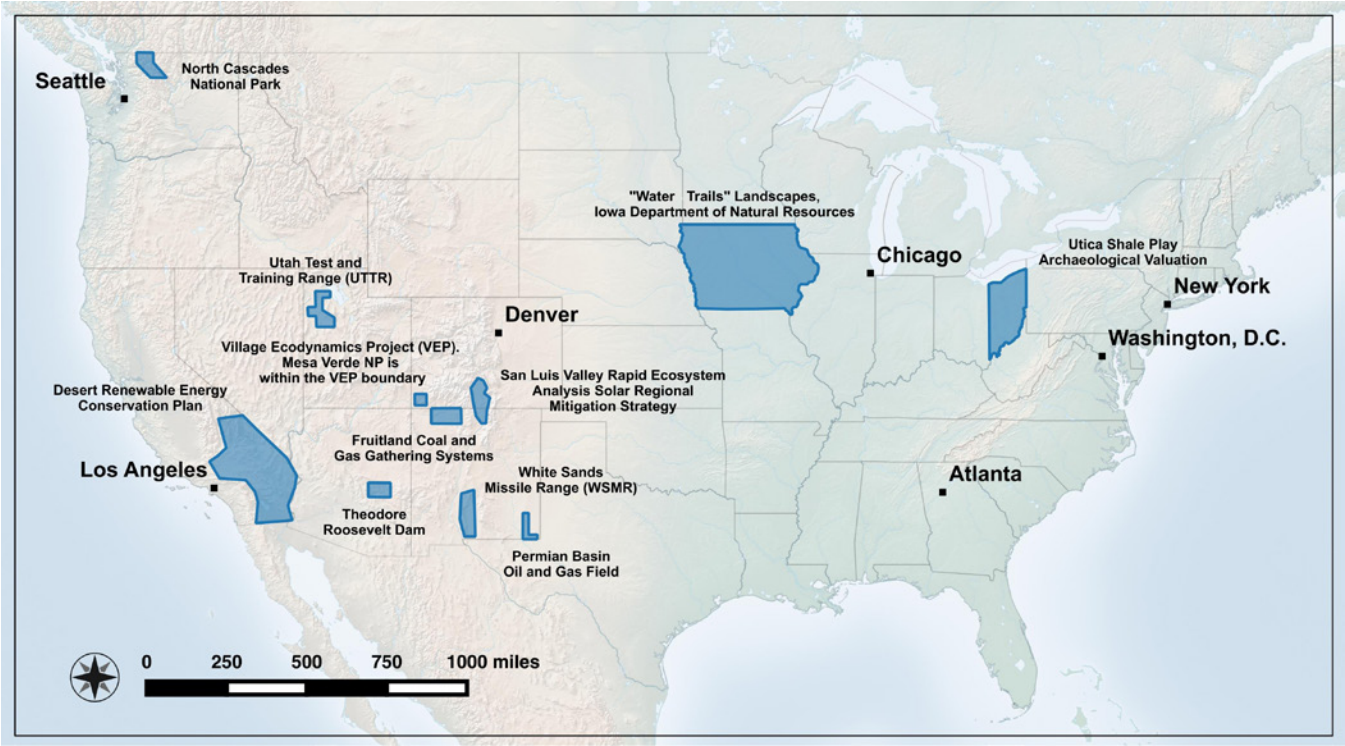

FIGURE 1. National map of the United States showing general locations of projects and programs mentioned in the text (map prepared by Grant Snitker, School of Human Evolution and Social Change, Arizona State University).

3330 by Secretary of the Interior Sally Jewell (2013), *Improving Mitigation Policies and Practices of the Department of the Interior*. The approach summarized in this document involves determining the values of the resources within a larger spatial unit, for example, a river drainage, oil or gas leasehold, military installation, park, forest, or refuge. This larger areal perspective provides the context for determining how impacts to resources affected by an undertaking can be mitigated in relation to the values associated with groups of resources. Such a perspective should enable a land or resource manager to focus more holistically on the preservation or other proper treatment of archaeological resources, rather than on a site-by-site basis.

As agencies develop ways to undertake this approach, they are considering a number of issues. The BLM, for example, is adopting a landscape approach to managing natural and cultural resources to meet challenges for which project-by-project reviews are not sufficient. BLM projects at this scale include: the Desert Renewable Energy Conservation Plan, covering much of eastern southern California (http://www.drecp.org/) and the San Luis Valley Rapid Ecosystem Analysis Solar Regional Mitigation Strategy in southern Colorado and northern New Mexico (http://www.blm.gov/co/st/en/fo/slvfo/solar.html) (Figure 1; Kate Winthrop, personal communication 2015). The BLM approach begins with a regional assessment of resource types and values, which then informs strategies to identify conservation and development areas and to develop impact mitigation strategies. A landscape approach for archaeological resources means identifying the actual resources that occur, the types of cultural resources that are known to occur, and the resources likely to occur; identifying the types of values inherent to them (e.g. educational, historic, interpretive, scientific, or traditional cultural value); assessing risks and vulnerabilities likely to affect these values; setting priorities among the resource values; and developing mitigation strategies appropriate for different types of resources and values.

The NPS is developing a landscape approach to its management of cultural resources that utilizes methods and techniques to facilitate collaboration among archaeologists, historians, tribal representatives, and a variety of other stakeholders. Collaborations are intended to produce information useful for identifying pertinent cultural resources and determining their values in particular landscapes. The values identified or developed by such groups would be used to classify land parcels and cultural resources into high, medium, and low cultural resource sensitivity. These rankings would be used in planning for future development activities and land uses.

The USFS has expressed interest generally in developing landscape or regional-scale approaches to the management of cultural resources along the lines expressed in more detail by BLM and NPS. The ACHP encourages these approaches.

In a comparable vein, Leaders in Energy and Preservation (LEAP), a non-governmental organization, is addressing the challenge of creating voluntary best management practices for archaeological resources affected by relatively unregulated energy projects. This approach is being developed at a landscape scale (e.g., an entire shale oil or gas play) to allow energy companies to manage their impacts on the most important archaeological resources, as determined in consultation with

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archaeologists and other key stakeholders. One key component of the LEAP best-practice framework is the assessment of archaeological site value at the landscape scale. Given all of this focus on landscape-scale and value-based management by public agencies, it is important for the archaeological community to identify management practices that can be implemented in ways that benefit interpretation, preservation, and study of archaeological resources.

IS LANDSCAPE-SCALE MANAGEMENT OF ARCHAEOLOGICAL RESOURCES DESIRABLE?

The management and treatment of archaeological resources on a project-by-project basis typically focuses on identification and evaluation investigations of small impact areas. In some cases, this leads to data recovery mitigation efforts at individual sites or, more typically, portions of sites. These short-term preservation practices may not lead to the best preservation or resource use solutions. Landscape approaches to archaeological resource management are designed to overcome this problem.

A management program that simply avoids in situ archaeological resource sites once they have been discovered also is not an effective or efficient long-term management approach. Avoidance strategies are severely limiting because not knowing the values and relative importance of resources restricts the treatment options available to managers. Decision makers cannot readily determine which resources have educational, interpretive, historical, or scientific values and should be investigated or otherwise managed. Depending on the size of the area, any future use of the land may be substantially constrained. As more sites are discovered and managed by avoiding any impact to them, the areas around the sites cannot be considered as suitable for other uses. For the avoided sites, the assumption of resource significance remains unsubstantiated by actual investigation, evaluation, and documentation. At the same time, the avoided sites may suffer deterioration from conditions that are not detected.

Landscape-scale management is an alternative to management by avoidance or by using case-by-case, "one site at a time" procedures that result in piecemeal decision-making. This broader approach may not require impact mitigation for every resource adversely affected by an undertaking. Past uses of such an approach have been referred to as "programmatic" or "alternative" mitigation. Impacts to resources and mitigation of them are considered at larger-than-single-site spatial scales and for groups or populations of resources. Examples, some of them described in more detail as case studies (and located on Figure 1) in subsequent sections, include:

(a) a model for management based on site significance at the Utah Test and Training Range (Sebastian 2008);

(b) a model for site location and significance at White Sands Missile Range, New Mexico (Heilen et al. 2012);

(c) the impact mitigation program for the modification of Theodore Roosevelt Dam near Phoenix, Arizona (Rice and Lincoln 1998);

(d) the Fruitland Coal Gas Gathering Systems data recovery program (Brown et al. 2014);

(e) the Permian Basin Oil and Gas Field archaeological inventory and data recovery program (Schlanger et al. 2013);

(f) the identification of "cultural resources priority areas" as part of regional planning in southern Arizona and New Mexico (Laurenzi et al. 2013);

(g) the inclusion of drainage basin archaeological and architectural history data in the development of "water trails" by the Iowa Department of Natural Resources, integrating cultural resource management concerns with water quality and other environmental management issues and emerging eco-tourism opportunities (e.g., Haury 2014; Iowa Department of Natural Resources 2015);

(h) the Utica Shale archaeological valuation approach being developed by LEAP for archaeological sites in eastern Ohio. This program, currently being developed, involves consultation among archaeologists, staff from the Ohio State Historic Preservation Office, and representatives of the oil and gas industry; as yet, there is no published description (LEAP 2015).

These large-scale management approaches have been applied in a variety of contemporary contexts. Examples (a) and (b) relate to long-term management programs of archaeological and cultural resources at large military installations. Examples (c), (d), and (e) are programmatic impact mitigation actions for large development projects; and (f) and (g) use archaeological research values and consultation with experts and stakeholders to identify areas of special archaeological potential within a large multi-state region (f) or within-state drainage basin (g). The final example (h) is a developing voluntary archaeological resource management partnership at a landscape scale involving energy industry companies and developers, cultural resource management firms, and other preservationists. The majority of examples mentioned here and included as short case studies in later sections are from the western United States. This distribution is not intended to indicate that such a management approach is possible only in this part of the country or the world; it simply reflects cases and examples most familiar to the authors.

A values-based landscape approach to management or impact mitigation requires two general stages to ensure an effective outcome: high quality background information about the resources at risk and a quantifiable and replicable means of assessing value. First, the characteristics of the archaeological resources, including the collections and records from previously investigated sites must be known sufficiently to establish potential resource values. It will rarely be the case that the area of interest is identified simply by its archaeological characteristics. Most often, the areas for which management or impact mitigation plans will be developed will be defined by the anticipated impacts of modern development projects or contemporary land

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use or resource management planning. The values of archaeological resources in an area will be affected by characteristics of the area. For example, the educational or economic values of a given site might be very high in a context of easy public accessibility; however, such values may be low for remote, hard-to-access resources.

Not every individual archaeological resource within the area needs to be identified and investigated to manage the resources at a landscape scale. However, the size, scale, and characteristics of the population of archaeological resources within the area must be documented well enough that decisions can be made reasonably about the value(s) they are likely to have and to whom these values relate. Previous archaeological investigations of the area may provide a sufficient sample of the resources upon which value ranking and treatment decisions can be based. In addition to the specific data about site characteristics, existing records and collections may be sufficient to inform current resource management decisions, including the use of alternative mitigation, and also have significant research potential for future uses (Sullivan 1992). Or, it may be that the area of interest requires a new archaeological investigation to obtain sufficient information for a values-based evaluation of the population of archaeological resources that exist in it.

The second key aspect of this kind of an approach is the development of procedures that are clearly defined, explicit, logical, and transparent for making decisions about the value(s) associated with specific archaeological resources. There must be agreement about the types of values of the archaeological resources in an area, about how to weigh the values assigned to different classes of resources, and about a procedure regarding how to balance impacts to some resources for the preservation of others. The organizations likely to be involved in these considerations include federal agencies and State and Tribal Historic Preservation Offices. Other organizations and stakeholders also may be involved as consulting parties, e.g., Indian tribes and other descendant communities, professional and avocational archaeologists, local museum staffs, educators, historic preservationists, and outdoor recreationists. In subsequent sections, we describe examples of procedures for identifying appropriate values for archaeological resources and ranking resources for various types of treatment.

REQUIREMENTS FOR MANAGING ARCHAEOLOGICAL RESOURCES AT A LANDSCAPE SCALE

Prior Conditions—Background Information Necessary for Values-Based Management

The kinds and levels of values associated with the archaeological resources vary with the amount of available information, which, in general, will be incomplete. Known resources will be only a sample, usually not a representative one, of what actually exists in or from a management area. Specific application of any management approach needs to take account of these limitations, and appropriate procedures and decision-making steps must be developed accordingly.

Archaeologists are familiar with working with incomplete information and small samples. It is important that management plans consider what are reasonable population estimates and ways of estimating the characteristics of resources in an overall population. For example, Iowa, like other states, maintains an inventory of archaeological site records. New sites are regularly reported by professionals and avocational archaeologists and added to the inventory; existing records are updated. Typical site records include information about cultural affiliation, chronology, location and size, site condition, known threats, and environmental context (e.g., distance to water, soils, and elevation). Such site inventories provide background information for creating a values-based, landscape-scale management approach.

These site data will have been gathered by investigations conducted for different reasons, by various investigators, using different methods, at different times. It can take substantial additional investigation to make these data useful for values-based assessments of resources in landscape-scale areas (e.g., Riley et al. 2011). To be useful, the information available in general site inventory systems may need to be enhanced and made comparable by additional analysis or survey activities. An example of how site inventory data can be developed for landscape- or regional-scale management is the assessment done for the Village Ecodynamics Project (VEP), an 1,800-km^2 study area in southwest Colorado (Figures 1 and 2; see Ortman et al. 2007; Varien et al. 2007). Note that VEP was not a resource management study; however, it provides a useful example of appropriate evaluation and use of site inventory data.

For the VEP, several thousands of survey records were examined to develop comparable data on site chronology, functional site type, and site size (both in terms of site area and for the habitation sites, population). Survey coverage for the various periods represented had to be assessed and estimates made of what the site populations would look like if full survey coverage was available. The result was estimates of average momentary populations (of past inhabitants) for a number of chronological periods. Eventually, the VEP researchers were able to describe settlement systems for each of the chronological periods recognized in the analysis. The piecemeal site survey data contained much useful information when analyzed further to provide population-level data suitable for landscape-scale settlement pattern and demographic analysis.

In the VEP study area, a "site" can be a small, low-density lithic scatter, a single rock art element, or a village that housed several hundred people. This focus allowed for sampling and evaluation of resources at the scale at which people lived. The VEP research team also recognized that for some periods in the study area, the settlement pattern was structured around large "community centers" that formed social nuclei for communities made up largely of dispersed households or small clusters of households. The community centers are hard to miss and there are not very many of them, so nearly all are represented in state survey databases, although the quality of the record varies. Information is much spottier for the hundreds of small dispersed habitation sites that surround the major centers.

The main point of this example is that landscape-scale assessments and subsequent management and treatment options

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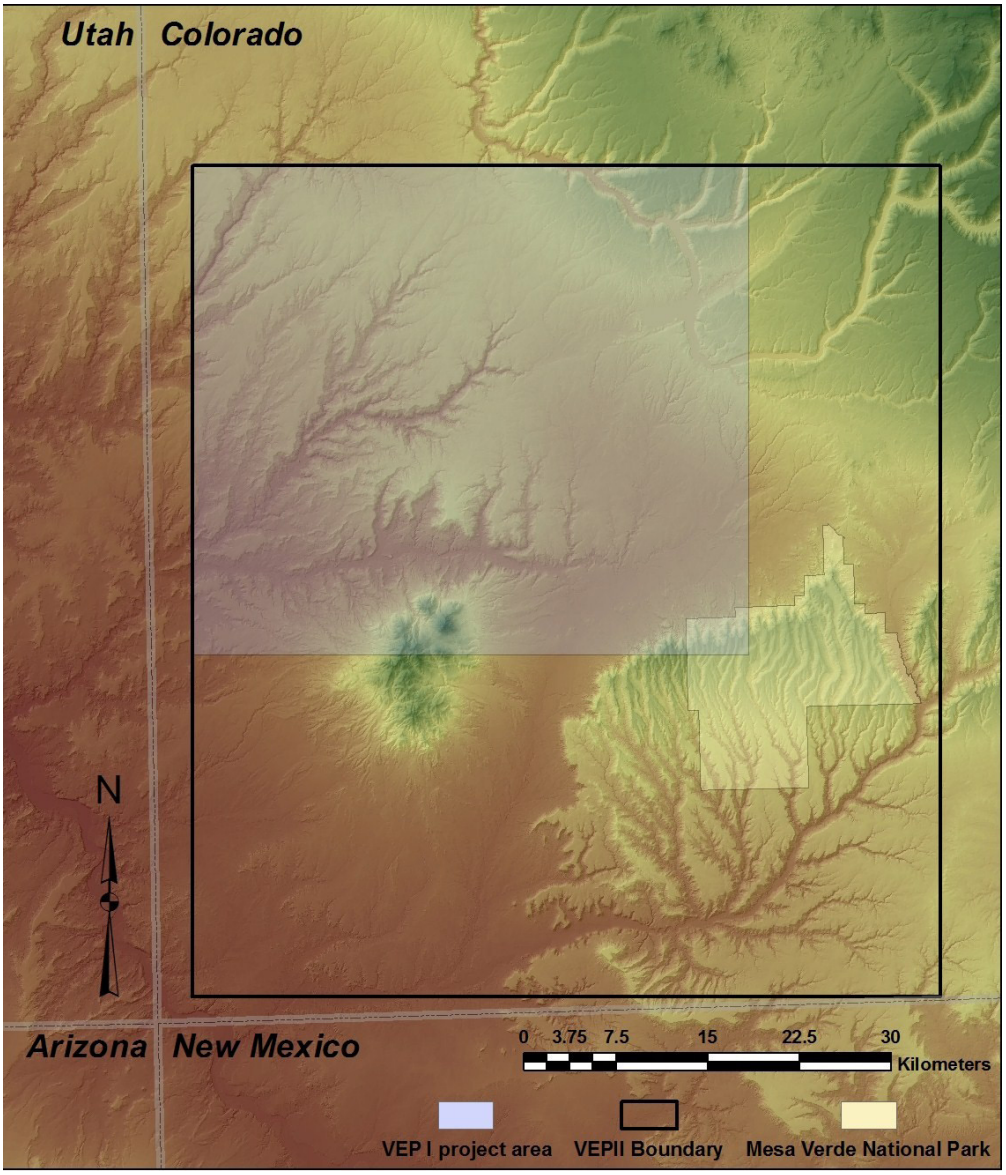

FIGURE 2. General map of the Village Ecodynamics Project study area (Courtesy of Tim Kohler, Department of Anthropology, Washington State University, from VEP website, October 2015).

require considerably more than simply adding up site counts for a particular area. The scale of demographic and settlement pattern characteristics of the VEP study area varied from one time period to the next and from one part of the study area to the next. This would need to be taken into account in designing resource management or impact mitigation programs.

When information about the resources is limited, new investigations may be part of the solution. It may be necessary to combine an explicit sampling approach with more focused site discovery investigations. Probability sampling, for example, will miss or underestimate the frequency of rarely occurring resources. If such resources are specialized or potentially significant, procedures need to be developed to take account of them in management and treatment decision-making. Rare resources may be among the highest valued from different perspectives.

A values-based, landscape-scale evaluation of resources requires high standards for archaeological survey. Information must be detailed and consistent and carefully recorded. The determination of whether or not to collect artifacts or other samples from identified sites needs to be considered carefully (Beck and Jones 1994; Heilen and Altschul 2013; Majewski 2010). If collections are not made, the appropriate information about observed and/or likely site contents and structure must still be documented. Survey crews must be organized to include the appropriate expertise for systematic and accurate in-field analyses and interpretation of site contents, structure, and basic geomorphology.

Landscape-level approaches require a conceptual reorientation that considers settlement systems, communities, and demographic clusters as the appropriate scale for the design and implementation of management or impact mitigation strategies.

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This approach differs from those that regard the "site" as a fundamental entity whose value is self-evident. The objective must be refocused on defining the values attributed to populations or sub-populations of resources within the management area.

Scale and ecological context of the landscape or region to be managed is also important. Coherent landscapes should be considered, but not excessively large or complicated ones. For example, it may or may not be sensible to lump multiple watersheds together. Complex areal delimitations make management of the resources within them more challenging and potentially less effective. The identification and evaluation of archaeological resources also depends on understanding the past environments in which these resources were created. Frameworks for the management of resources need to be sophisticated enough to recognize that a place now arid and sparsely vegetated may once have been a grassland or forest.

The Relative Values of Archaeological Resources at a Landscape-Scale

Values-based, landscape-scale archaeological resource management requires that the values of the resources within the management area be carefully and fully considered. A variety of values are affixed to archaeological resources throughout the world (McManamon et al. 2008).

Lipe (2009) describes six kinds of value that archaeological resources hold: Preservation, Research, Cultural Heritage, Aesthetic, Educational, and Economic. Due to legitimate concerns about the commercialization of objects removed from archaeological sites, it is important to note that the "economic" value Lipe (2009:61) lists relates not to selling artifacts, but to sites that are "attractions that draw crowds and support the development of tourism."

Among the research, cultural heritage, and educational values of archaeological resources is that they are "actual material evidence of the past" that helps to authenticate interpretations about the past; and they can, with proper investigation, provide "credible accounts of what happened in the past" Lipe (2002:20–21, 2009). "Commemorative or associative" and "knowledge" values of archaeological resources, are similar to research, educational, cultural heritage, aesthetic, and preservation values (McManamon 2002). A number of the essays in Little (2002) also focus specifically on the public benefits and values associated with archaeology and archaeological resources. Indian tribes or other organizations representing Native Americans often emphasize that archaeological resources have traditional cultural value to their members.

This wide range of kinds of value should be taken account of as part of management planning and impact mitigation. Federal regulations, the ACHP procedures, as well as planning and management policies and procedures of many state and federal public agencies recognize the benefit of such consideration (e.g., ACHP 2009:2; NPS 2006:19–20). However, routinely and historically, archaeological resources are most often valued for their research potential when evaluated by National Register of Historic Places (NRHP) criteria. Their cultural or historical associations, let alone the other kinds of potential value noted here, are less often recognized formally. Even in the case studies that follow, the most frequent valuation of archaeological resources is done solely in terms of historical or scientific research value.

There are two main points about using the values of archaeological resources in developing landscape-scale management plans. First, there is a wide range of potential values of archaeological resources. Not all of them will apply in every situation, but the full range of potential values should be considered in values-based planning. Second, an effective management framework based on the values of the archaeological resources requires clear, detailed, and transparent evaluation of the actual values of resources. Subsequent to such an evaluation, agency actions must be planned or organized in ways that preserve important values and make appropriate use of resources that are impacted by agency developments and operations. In addition, information about a landscape and sites needs to be regularly reviewed and values assessed as new information becomes available.

The values of archaeological resources are relative measures that are context driven and measurable on a number of levels; some are interrelated, others mutually exclusive. Single perspectives on value, e.g., historical or scientific research potential, heritage tourism, educational value, sacred value (i.e., importance to a descendant community) should not be the sole focus of a valuation effort. Rather, all applicable vectors of value should be considered. The assignment of archaeological value to resources in a landscape cannot be done in a vacuum. It also may be important to consider the nature of the impacts expected from planned or anticipated development activities as part of determining what resources have value and the nature of these values in a landscape.

Modeling and Values-Based Assessment and Ranking of Archaeological Resources

In the previous two sections, we considered how the level of knowledge about the archaeological record of an area affects the development of landscape-scale management and the wide range of values that can be attributed to archaeological resources. Another key aspect in developing landscape-scale, value-based management plans for archaeological resources is how this information is used to describe and rank the relative importance or significance of resources within the area being managed.

We identified a number of examples of landscape-scale approaches to resource management, some involving resource-valuation tools for multiple cultural resource management uses, others developed specifically to guide mitigation of the effects of large scale development programs. In this section, we examine some of these examples. This aspect of developing resource management plans is critical because resource assessment and ranking determines how individual resources or classes of resources are treated in the operation of the management plan.

Two related examples of archaeological resource-valuation tools use quantifiable and categorical data for assessing of the values associated with the archaeological resources and for classifying or ranking the resources within military installations. The first example is a pilot project undertaken to assess the feasibility of developing a computer-based "significance model" that could

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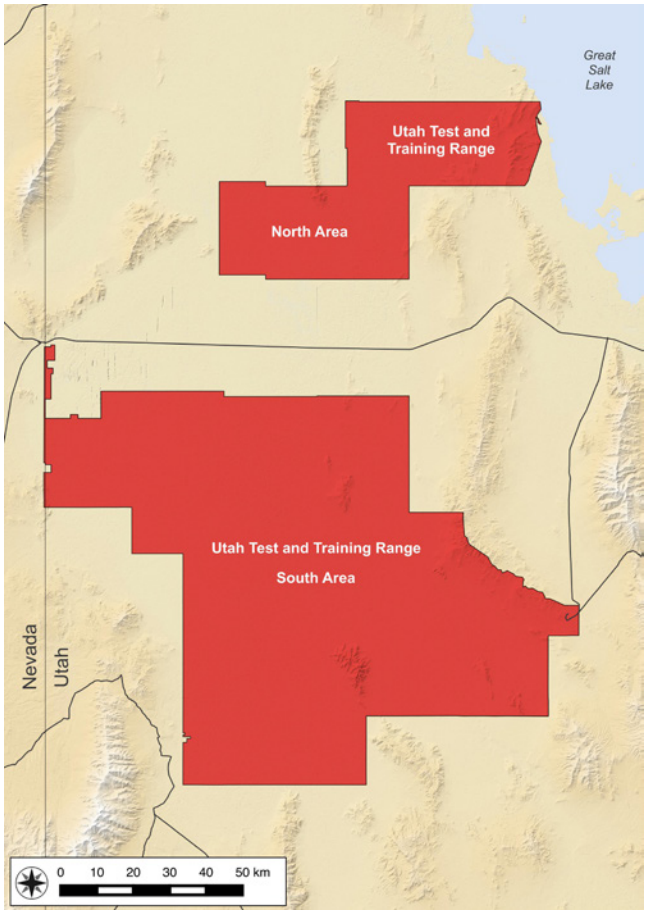

FIGURE 3. General map of the Utah Test and Training Range in Northwestern Utah (map prepared by Grant Snitker, School of Human Evolution and Social Change, Arizona State University).

systematically assign unevaluated archaeological sites to categories that would determine how the sites would be managed, what kinds of protection from effects would be appropriate, and what the approach to mitigation might be if a site were to be adversely affected. This pilot project (Sebastian 2008) was completed using data from the Utah Test and Training Range (UTTR), a 6,796 square km (2,624 square miles) installation managed in part by the US Air Force and partly by the US Army, west of the Great Salt Lake in northwestern Utah (Figures 1 and 3).

Significance models, as discussed in detail in the UTTR report, are simply sets of computer algorithms that mimic the expert knowledge used by archaeologists with long experience in a particular area or with particular types of sites, to make decisions about the research potential and other values of sites, based on their surface manifestations (Figure 4). There are several good reasons for creating such models. For one thing, those archaeologists with experience-based expert knowledge are retiring at an increasing rate each year; we need to capture at least some of that knowledge before it is lost. Additionally, large land-managing agencies probably have hundreds of thousands of unevaluated archaeological sites under their stewardship. Making site-by-site judgments about the significance of each one would be prohibitively time-consuming. And finally, significance models make the rules being used to evaluate the significance of archaeological site explicit for all stakeholders, and transparent to those who did not take part in the activities and meetings required to create the rankings.

In addition to their other advantages as a planning tool for archaeological resource management, significance models can help resource managers develop more flexible approaches to archaeological valuation. Although archaeological resources are valued most often for their information potential, when evaluated under NRHP criterion D, they may have other values as well. For example, they may be important heritage resources for descendant communities and other shareholders. The UTTR pilot model was designed to take account of both current research importance, as required by regulations, and the need to address the broader issue of "loss or destruction of significant scientific, cultural, or historical resources" under the National Environmental Policy Act.

Significance models are based on the premise that there are physical characteristics of an archaeological site that can be used to predict the nature of the archaeological data that could be gained through data recovery at the site. Among the characteristics considered in the UTTR example are: types, numbers, distributions, and densities of artifacts; overall site size; presence (though not absence) of temporal diagnostics; indications of structures or features; presence of ash, charcoal, or other evidence of burning; and indications of buried cultural materials. Other useful predictors of information potential are aspects of the site's setting and environment. The models can also include measures for assessing other values associated with types of sites, types of features, and physiographic settings. For example, cultural heritage value might be derived from published ethnographic studies, recorded oral traditions, interviews, and consultation.

The decisions about which archaeological and environmental variables to use in developing the sorting algorithms and the resulting site significance and management categories are based on syntheses of local and regional survey and excavation data, including extant collections and records, the expert knowledge of agency personnel and local archaeologists, and the management needs of the agency or installation. The value categories into which sites are to be sorted need to be meaningful and useful for managers and cultural resource staff and for the local and regional community of archaeological researchers. The purpose of these categories is not, however, to create immutable "value" categories and rankings, but rather to create a straightforward set of classifications to guide everyday management and compliance decisions. Categories and assignments to categories may (and should) change through time as new information, new technologies, and new research and management needs arise.

Once a significance model has been developed and validated, it can be used to classify known sites into value-based categories, create sensitivity maps displaying the geographic positions of sites of different significance categories to be used in planning, and classify newly identified sites within an installation or other planning unit. Future excavation data would be used to test and refine the rules for significance category assignments.

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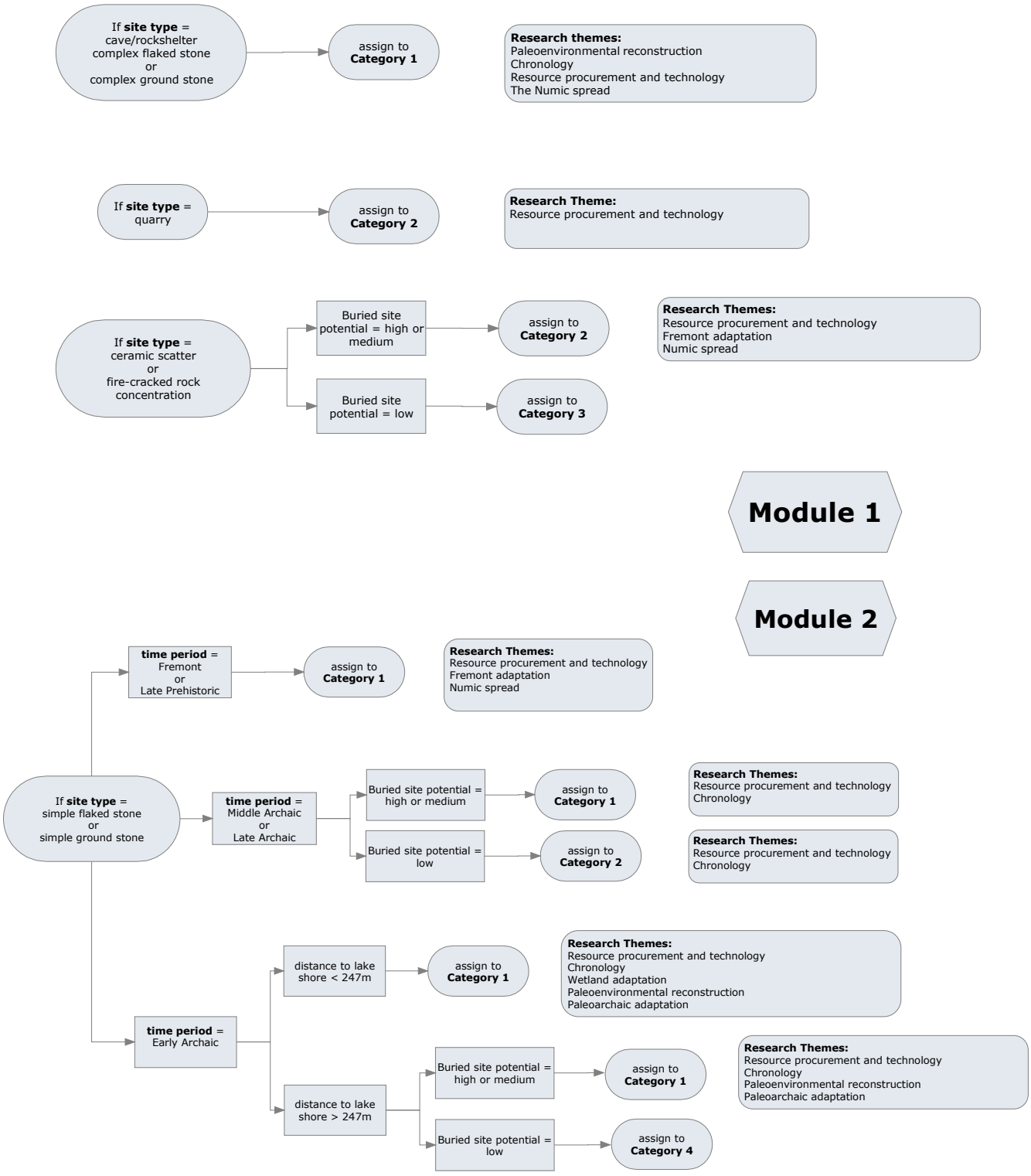

FIGURE 4. Diagram of Module 1 (upper half of page) and Module 2 (lower half of the page) of the UTTR Significance Assessment Model (Courtesy of Lynne Sebastian, SRI Foundation; Sebastian 2008).

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FIGURE 5. General location of White Sands Missile Range, Southeastern New Mexico.

Based on the promising results of the UTTR pilot project, a full-scale significance model was developed for White Sands Missile Range (WSMR), a 8,288 square km (3,200 square miles) US Army installation in southern New Mexico (Figures 1 and 5; Heilen et al. 2012). This model successfully sorted nearly half of the 3,445 largely unevaluated archaeological sites at WSMR into significance categories. This information is being used today to make management decisions about the treatment of individual sites and mitigation approaches in cases where sites will be adversely affected. Even more importantly, in the context of this article, the significance model results are used to make large-scale planning decisions about where military activities can most effectively be sited with the fewest potential conflicts with significant cultural resources.

The WSMR significance model sorts archaeological sites into high, medium, and low data potential categories, along with a fourth category called "high cultural significance." This last category comprises sites with features of concern to Native Americans—petroglyphs and pictographs, shrines, and burials. If ongoing consultations between the installation and culturally affiliated tribes should identify additional indicators of high cultural significance, the model can easily be updated to reclassify sites with those indicators.

The model assigns sites to data potential categories based on culture (e.g., PaleoIndian, Apache, Mogollon), temporal period (e.g., Early, Middle, or Late Archaic), assemblage size, and number of features. Because many sites on WSMR are multicomponent but the site is the unit of management for the installation, the model assigns sites to the data potential category of its highest-scoring component.

As with most archaeological endeavors, the success or failure of a significance-modeling project hinges on the availability and quality of the data. The variables used in the WSMR modeling effort were constrained by what data were available. Assemblage diversity is a key indicator of data potential, but this characteristic was not available or derivable from the data used in this case. Assemblage size, also a useful indicator, was not available for more than half of the WSMR sites. Available paper records could, with some effort and creativity, be made to yield proxies for the necessary information, in which case the model would be able to sort virtually all of the sites on the installation into significance categories for management purposes. However, this was not done as part of the WSMR project.

To make landscape-scale decisions about the management of archaeological resources, we need to be able to make valuation decisions for currently known sites in the region or installation of interest at that scale. Significance modeling is a new technique, still being explored, that shows promise of being able to help cultural resource managers do just this. The principle is one of simple logic—using "if, then" statements in a hierarchical, recursive process. The model can easily be rerun to include new data, new sites, or revised categories. One of the great advantages of this technique is that other values for archaeological sites beyond data or information potential can be included in the ranking process, and other ways of looking at data potential itself, beyond the simple "pass/fail" of National Register eligibility, can be developed.

IMPLEMENTATION OF VALUES-BASED LANDSCAPE-SCALE MANAGEMENT PROGRAMS

A values-based landscape-scale management plan is a living document that requires periodic review of the value(s) of resources. How we recognize the values of archaeological resources varies with our perspective about these resources and our changing notions and questions about the past. All types of projects can be valued, but the treatment of archaeological resources often varies depending upon whether a project proponent is a land managing agency or a developer. In the following case studies, we describe programs implemented by energy development projects and by land managing agencies and their management context.

Landscape-Scale Impact Mitigation Program

Landscape-scale management programs can apply to land management areas and to large-scale development projects, such as highways or reservoirs. The Fruitland Coal Gas Gathering Systems program used a landscape management plan developed

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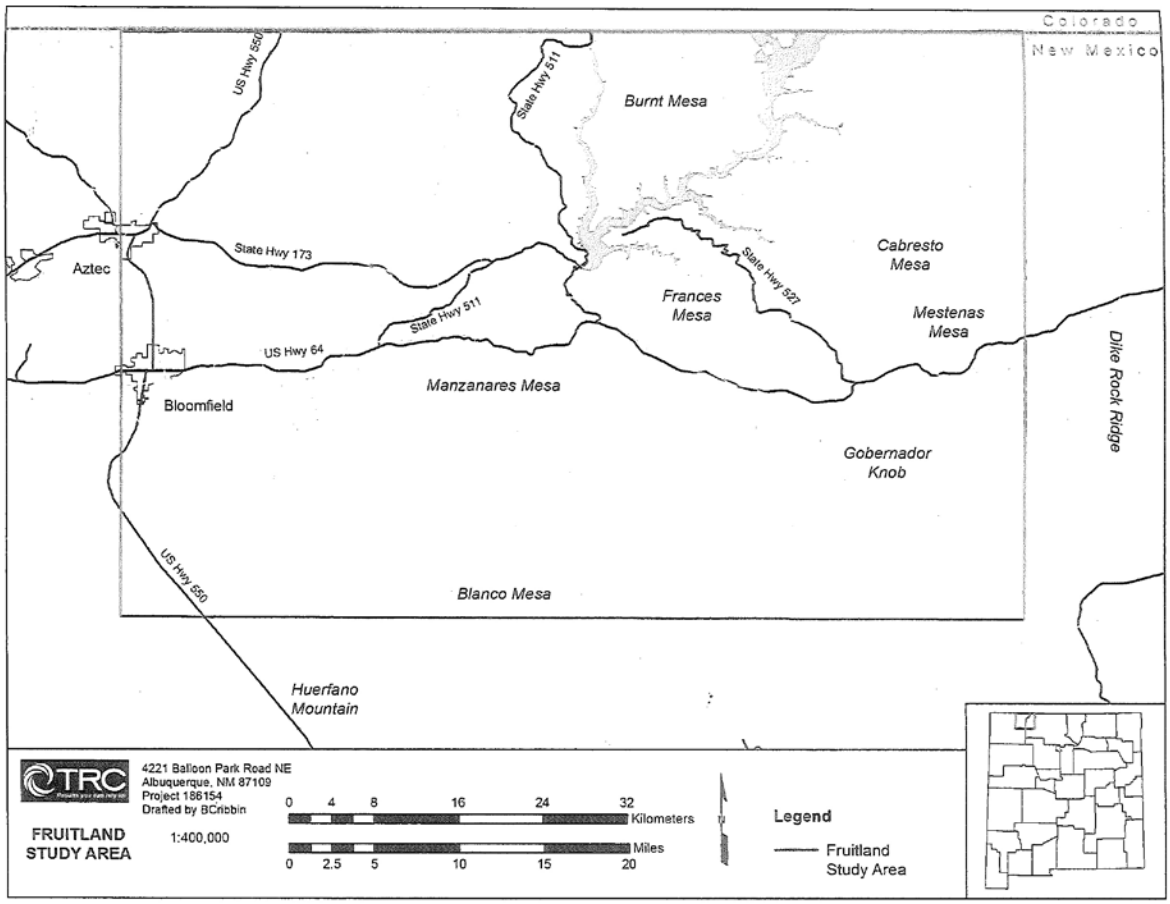

FIGURE 6. General map location of the Fruitland Coal Gas Recovery Project in Northwestern New Mexico.

and applied to archaeological resources in a clear, explicit, logical, and transparent manner. The archaeological activities were designed to mitigate impacts, usually through data recovery, associated with the development project at a landscape-scale. The treatment of resources varied according to different value rankings of the individual resources.

The Fruitland Coal Gas Data Recovery Project (Figures 1 and 6; Brown et al. 2014:1–2) refers to archaeological survey and data recovery investigations associated with the construction of over 600 miles of pipeline gathering systems located on and around Navajo Reservoir in northwestern New Mexico between 1989 and 1996. In addition to drilling hundreds of wells with associated well pads and roads and injection wells, etc., the energy companies involved constructed hundreds of miles of small pipelines connecting wells to storage tanks and processing facilities. The amount of ground disturbance was very high, as was the site density in the Fruitland play. To add to the challenges, the development was driven by a federal tax credit for recovering "non-traditional" energy sources and thus was on an extremely accelerated time schedule.

The land-managing agency, the BLM, and the SHPO recognized that a standard case-by-case data recovery effort in the Fruitland gas development would have resulted in hundreds of small undertakings carried out by a variety of energy companies hiring a large number of different CRM consulting firms, who would take scores of different approaches and ask dozens of different research questions at a multitude of sites. The BLM and SHPO, with the cooperation of industry representatives, instead developed an approach that would do better archaeology and meet the needs of the undertakings.

The resultant Fruitland data recovery program involved a values-based, landscape-scale approach to the mitigation of impacts for a large number of widely spaced individual developments within an area of more than 4,791 square km (1,850 square miles) (Brown et al. 2014:1–6). Some of its aspects were:

- All areas of potential ground disturbance were surveyed. All sites were recorded; every oil and gas company was responsible for having its own projects surveyed.
- The oil and gas companies jointly funded the development of a high-quality research design to guide the choice of sites for data recovery based on the relative importance of the research issues (Hogan et al. 1991).
- The oil and gas companies cooperatively funded the development of data recovery and analysis guidelines (Farmington Resources Area Cultural Advisory Group 1991) to ensure that compatible information would be used in a final synthesis and would be available for subsequent uses.

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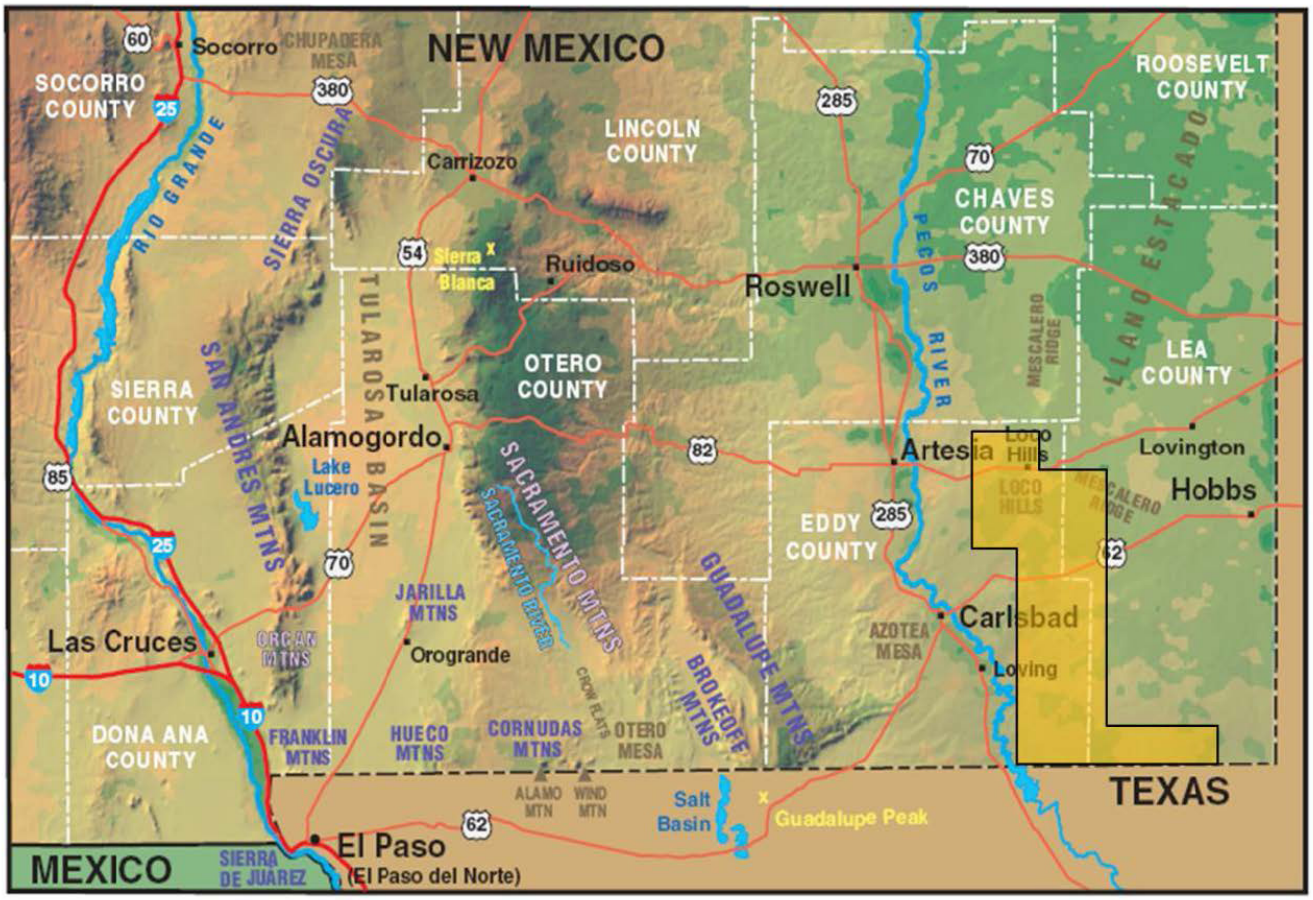

FIGURE 7. Southeastern New Mexico with the area of the Permian Basin program highlighted in light yellow (courtesy of Sarah Schlanger and Signa Larralde, Bureau of Land Management, from Schlanger et al. 2013).

- All NRHP eligible sites in or within 10 m of the right-of-way or well pad were placed in a "pool" of sites for potential data recovery.
- BLM and SHPO, with input from local archaeological and CRM firms, Navajo Nation, and the energy companies, selected a sample of sites for 100-percent data recovery. At all sites not selected for data recovery, construction was monitored and information from features discovered and impacted by construction was recovered after the pipe was in the ground. When construction had to take place before data recovery could be completed, provisions were made for laying surface pipe temporarily.
- In practice, when really large sites were selected for data recovery, they were generally subject to substantial but not total excavation.
- The final commitment for the companies was to provide funding, when the Fruitland development was over, for a high-level synthesis of what had been learned as a result of the archaeological work (Brown et al. 2014).

Early in the program it was recognized that the available background information was too limited to inform decisions about data recovery priorities. Better information was needed regarding the overall distribution and contexts of sites in the Fruitland landscape. To provide this contextual information, the program was adapted to include large-area archaeological surveys that were carried out in lieu of data recovery at a few selected sites where excavation would be problematic (Brown et al. 2014:4). By the end of the project, the data recovery program had extended over seven years, and 500 sites were placed in several mitigation pools and considered for data recovery, and 132 were chosen for complete or nearly complete data recovery (Brown et al. 2014:4).

In 2008, again in New Mexico, the BLM, SHPO, and energy companies agreed to a landscape-scale management of impacts to archaeological resources in the portion of the Permian Basin in the southeastern portion of the state, an area of approximately 4,403 square km (1,700 square miles) (Figure 7). Under this agreement, set up initially for a five-year period, the value of archaeological resources that will be impacted by energy development is "based on the potential of properties to address … research questions drawn from the regional research design [set up as part of the overall agreement] or from other studies carried out as part of the Permian Basin MOA [Memorandum of Agreement] (Schlanger et al. 2013).

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The Permian Basin program agreement enables BLM to expand its resource management activities beyond dealing with site-by-site impact mitigation. The primary work carried out under the agreement includes: "a synthesis of previous excavations carried out in the MOA area; additional targeted survey; ethnographic studies to identify traditional cultural properties…; analysis of existing museum collections; and an extensive program of excavations designed to investigate subsurface deposits and features for a variety of sites in the area (Schlanger et al. 2013:7)." Since 2012, a number of the reports from the Permian Basin MOA program have been made available via a collection in tDAR (BLM Carlsbad Field Office 2015; Larralde et al. 2016).

Landscape-Scale Resource Management

In the context of development programs, like the Fruitland and Permian Basin examples, the choices of resource treatment may be limited to the avoidance of impact, when appropriate, and the level and type of impact mitigation that are applied. Public land and resource managing agencies have a variety of treatments that can be applied to the archaeological resources under their stewardship. Their range of resource treatments includes avoidance or various types of mitigation when in situ resources are impacted by developments or operations within the management unit. Resource managing agencies, however, may have more latitude to undertake treatments that improve the stability or condition of resources that they manage and a wider variety of methods to interpret in situ resources or related collections and records. Because resource management functions generally are longer-term than development projects, there may be opportunities for resource "banking" or development of facilities for public outreach and education.

At the outset of this article, we emphasized the social benefits of archaeological resource management plans and procedures that include treatment options beyond avoidance or in situ preservation or basic data recovery as impact mitigation. Interpretation of the resources through guides and tours of in situ sites, museum exhibits that use curated collections, and publications and lectures oriented to public education and outreach are all integral to the broader societal benefits that derive from preservation of archaeological resources and are legitimate aspects of active resource management.

The NPS is a land-managing agency that is responsible for the care of tens of thousands of known archaeological sites, collections, and associated records. As a means of providing consistent appropriate and effective treatment of this large and variable population of archaeological resources, NPS maintains a set of national policies and standards directing and guiding archaeologists and managers at its hundreds of units (NPS 2006:59–76, Chapter 5 "Cultural Resource Management"). The guidance describes general and specific actions related to preservation, stabilization, protection, and data recovery treatments for archaeological resources. The exact manner in which treatments are carried out at NPS units accords with the specific content, materials, and structure of the archaeological resources, as well as these guidelines. For example, the preservation of original material of the ancient structures in Mesa Verde National Park is an essential part of the park's mission. Both the archaeological and maintenance staffs of the park have important roles in carrying out the preservation treatment (Mesa Verde National Park 2015). In the mid-1990s, excessive moisture and water seeping at Cliff Palace threatened portions of the site. Conservation actions by park maintenance, informed by site examination and documentation of the ancient structures by NPS archaeologists, made it possible to maintain the architectural and physical integrity of the ancient structure (Figure 8; Nordby et al. 2001).

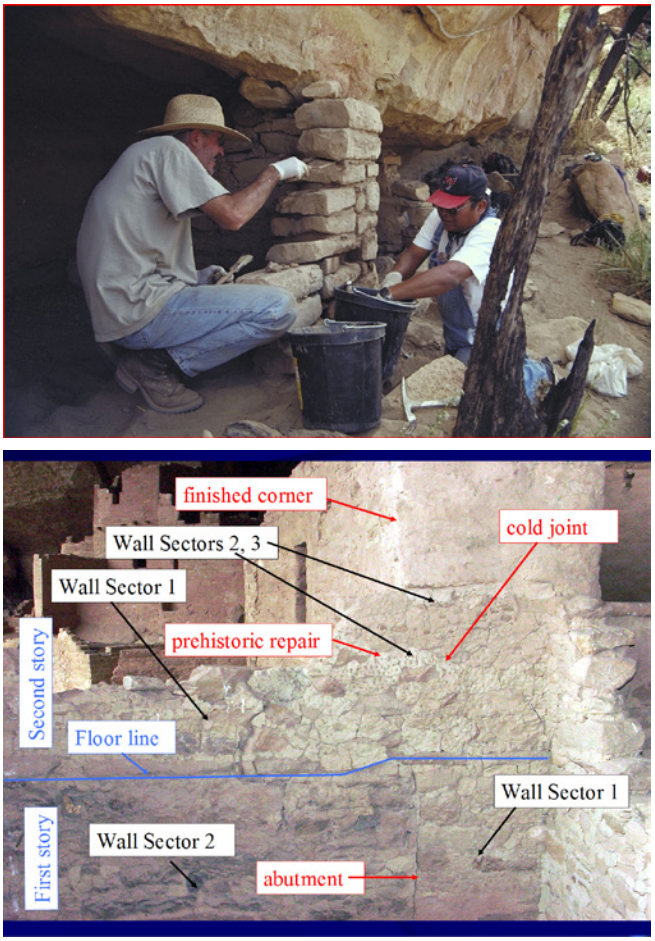

FIGURE 8. Upper Image: example of stabilization of ancient architecture at Mesa Verde; lower image: archaeological documentation of ancient architecture of Cliff Palace, National Park (images courtesy of Larry V. Nordby, 2006)

For land-managing agencies, which are involved in day-to-day actions that affect archaeological resources under their stewardship, updating and utilizing information about these resources is more pressing than the collection of information for statewide inventories described above. Information about known resources is kept up-to-date by periodic condition assessments and other site visits by staff, as well as by archaeological investigations. Reports about the resources provide important information for the periodic review of values ranking. NPS uses such studies (e.g., McVickar 2001; Mierendorf 1986; Powers and Orcutt 1999) to determine the research value and appropriate treatments for particular resources and resource types in areas that are being managed.

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FIGURE 9. Lower image: stabilization of soil and hiking surface covering the Cascade Pass archaeological site, North Cascades National Park by Park Trails maintenance staff; Upper image: finished, raised section of hiking trail at Cascade Pass (images courtesy of Robert R. Mierendorf, 2008)

Archaeologists in resource management units also need to work closely with staff whose activities have the potential to affect the archaeological resources, particularly those in interpretation, law enforcement and resource protection, operations and planning, and third party-user management. For example, in North Cascades National Park, archaeologists teamed with the trails maintenance program. The archaeological crew conducted site examination and data recovery investigations, which uncovered a 9,000-year-old hearth feature and associated artifacts (Figure 9). The area investigated was along the narrow Cascade Pass in mountainous terrain that currently is used by many hikers. Working closely with the trail crew, the archaeologists ensured that trail material and erosion control were placed in locations in a manner that would protect the remaining in situ site and allow the contemporary recreational hikers to continue to use the trail (Mierendorf et al. 2006; Steury 2010).

These brief examples describe activities based on landscape-scale plans that have identified important resources and the type and level of treatments to be undertaken to maintain the resources. In these specific instances, the primary resource values are research importance and public interpretation, although in both cases the importance of these resources in traditional cultural perspectives also may be involved.

EFFECTIVE VALUES-BASED LANDSCAPE-SCALE MANAGEMENT

It is feasible to develop and use value-based management approaches for archaeological resources and the mitigation of impacts to resources at a landscape spatial scale if the management framework, the care and diligence of its implementation, and the interests of the resources, proponent, and land managers are carefully considered. Accordingly, we summarize our recommendations regarding the necessary conditions and appropriate guidelines required for such a management program.

This approach offers a means of managing both individual resources and classes of resources for effective long-term preservation, protection, and appropriate uses. It further allows considerations that might forego impact mitigation at some less valued sites in exchange for an alternative important activity, investigations, or product that would better advance archaeological resource interpretation, management, or preservation. The detailed contextual information needed for this kind of management plan also makes it likely that its application will generate useful archaeological information for a variety of uses.

In order to enhance the public benefits that can be derived from archaeological resources, there are certain conditions and requirements necessary to develop and institute such management approaches. Of particular importance are the following.

- There must be sufficient background information about the archaeological resources in the area being managed. One important source of this information will be the collections, associated records, and other documents and data from past investigations of archaeological sites in the area. However, this corpus of material, including site inventory and survey records, may need substantial review and reanalysis to be useful in developing the management plan.

- There must be explicit and detailed consideration of the range of different values associated with the populations of known and potential archaeological resources in the area being considered for the program.

- There must be a clear, explicit, and transparent method for assessing the values of populations of known resources and expected resource types and for developing rankings or categories among the resources that can be used to differentiate how they are treated.

- There must be sufficient professional archaeological and other necessary expertise among the agency staff involved in developing and implementing the plan to ensure effec-

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tive application and use of it, as well as appropriate review and revision/updating.

- There must be management commitment to regularly updating background information about condition and potential that leads to: (1) regular review and update of valuations and management treatments; and, (2) long-term care of resources, including the sites, collections and associate records from those sites, and other relevant archaeological data, documents, and material.

Values-based landscape-scale management of archaeological resources has the potential to improve the stewardship of America's archaeological record. In appropriate situations, it will work better than managing resources in isolation or the review and mitigation of impacts individually, but it does not preclude consideration and management decisions regarding single resources if an individualized approach is appropriate and would yield better results. A landscape-scale approach requires certain amounts of background and contextual information, as well as a clear, explicit, and transparent approach to site valuation. We have tried in this article to describe how such an approach can be developed and implemented efficiently.

Acknowledgments

The co-authors of this article appreciate that Past-President of the Society for American Archaeology Jeffrey Altschul and the SAA Board identified this topic as important for current and future American archaeology and established a Task Force to assess the issues related to it. We want to acknowledge the important work done by S. Terry Childs, SAA Board member, who served as the Board Liaison with the Task Force. Terry participated in each of the conference calls that the Task Force held to identify and discuss issues, experiences, and projects that might serve as examples or case studies. She actively reviewed and commented on the various drafts of the Task Force report and of this subsequent article. We also are grateful to the editorial staff of *Advances in Archaeological Practice* for the clear and useful recommendations and suggestions provided on the substance of the material discussed in the article and its presentation. Finally, we acknowledge and thank the many archaeologists and resource managers who, through their professional work on the projects we drew from as examples and case studies for this article, are attempting to improve the management of archaeological resources for research on and improved understanding of the human past.

Data Availability Statement

The examples and information in this article come from a variety of sources that either contain the data upon which the examples are based or provide information about where these data can be obtained. More details concerning several of the examples can be found in tDAR (the Digital Archaeological Record). For these examples, links to tDAR records are included in the references cited. For other examples, links to websites or other digital repositories, if available, are included in the references cited.

Supplemental Materials

Supplemental materials are accessible via the SAA member login at www.saa.org/members-login:

Supplemental Appendix A: Task Force on Valuing Archaeological Resources.

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AUTHOR INFORMATION

Francis P. McManamon ■ Executive Director, Center for Digital Antiquity, School of Human Evolution and Social Change, Arizona State University; PO Box 872402, Tempe, AZ 85287-2402; fpmcmanamon@asu.edu.

John Doershuk ■ State Archaeologist, University of Iowa Office of the State Archaeologist, 700 Clinton Street, Iowa City, IA 52242-1030; john-doershuk@uiowa.edu.

William D. Lipe ■ Professor Emeritus, Department of Anthropology, Washington State University, Pullman, WA 99164-4910; lipe@wsu.edu.

Tom McCulloch ■ Senior Policy Analyst; Advisory Council on Historic Preservation, 402 F Street NW, Suite 308, Washington, DC 20001-2637; tmcculloch@achp.gov.

Christopher Polglase ■ Cultural Heritage Practice Leader, Gray and Pape, Inc.; cpolglase@graypape.com.

Sarah Schlanger ■ Field Manager, Taos Field Office, Bureau of Land Management, 226 Cruz Alta Road, Taos, NM 87571-5983; sschlang@blm.gov.

Lynne Sebastian ■ Historic Preservation Advisor; SRI Foundation, 333 Rio Rancho Drive NE, Rio Rancho, NM 87124; lsebastian@srifoundation.org.

Lynne Sullivan ■ Curator and Research Associate Professor Emeritus, McClung Museum, University of Tennessee, Knoxville, TN; lsulliv2@utk.edu.

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