PUBLIC WORKS TECHNICAL BULLETIN 200-1-134
15 MAY 2014

PRIORITIZING ARCHAEOLOGICAL SITES FOR COST-EFFECTIVE LONG-TERM MANAGEMENT

Public Works Technical Bulletins are published by the US Army Corps of Engineers, Washington, DC. They are intended to provide information on specific topics in areas of Facilities Engineering and Public Works. They are not intended to establish new DA policy.

DEPARTMENT OF THE ARMY
US Army Corps of Engineers
441 G Street NW
Washington, DC 20314-1000

CECW-CE

Public Works Technical Bulletin 15 May 2014

No. 200-1-134

FACILITIES ENGINEERING ENVIRONMENTAL

PRIORITIZING ARCHAEOLOGICAL SITES FOR COST-EFFECTIVE LONG-TERM MANAGEMENT

1. Purpose

a. Most large military installations manage hundreds or thousands of archaeological sites. These sites collectively represent a serious obstacle to military training due to the requirement to avoid disturbing them until their eligibility for the National Register of Historic Places (NRHP) has been determined. Adding to the management challenge is the fact that additional archaeological sites are being documented faster than the existing site inventory can be reduced via current management approaches.

b. This Public Works Technical Bulletin (PWTB) transmits a method that Cultural Resource Managers (CRMs) can use to prioritize sites and/or to select a representative sample of sites for long-term management (LTM). This method includes the use of models to predict both site location and the likelihood that groups of similar sites will be eligible for nomination to the National Register. Adoption of this method will allow CRMs to identify and effectively manage a representative sample of sites, streamline the compliance process, reduce restrictions on military training, and prepare for the possibility of future budget cuts. This PWTB hopes to encourage CRMs to consider the pros and cons of such an approach, to be prepared for the possibility of future substantial cuts in funding for CRM.

c. All PWTBs are available electronically at the National Institute of Building Sciences' Whole Building Design Guide webpage, which is accessible through this link:

http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215

2. Applicability

This PWTB applies to all Continental United States (CONUS) Army and other Department of Defense (DoD) facilities that manage large numbers of archaeological sites, which can present obstacles to military training.

3. References

a. National Historic Preservation Act (NHPA) of 1966, Public Law 89-665; 16 U.S.C. (United States Code) 470 et seq., as amended.

b. Native American Graves Protection and Repatriation Act (NAGPRA) of 1990, Public Law 101-601; 25 U.S.C. 3001-3013; 104 Stat. 3048-3058, Nov. 16, 1990.

c. Archaeological Resources Protection Act of 1979 as amended, Public Law 96-95 at 16 U.S.C. 470aa-mm.

d. Army Regulation (AR) 200-1, "Environmental Quality, Environmental Protection and Enhancement." Headquarters, Department of the Army, Washington, DC, 13 December 2007.

4. Discussion

a. The NHPA requires federal agencies, including the Army, to take into account the effects of their undertakings on historic properties (including archaeological sites) that are or may be eligible for the NRHP. Sections 106 and 110 of the NHPA (in 36 CFR [Code of Federal Regulations] Part 800) and selected National Register Bulletins define a compliance process that includes identification of historic properties, evaluation of their eligibility for the NRHP, and consultation with interested parties including the State Historic Preservation Office (SHPO).

b. Archaeological sites tend to be discovered at a faster rate than their NRHP status can be determined. The result is a large and growing backlog of potentially eligible sites that must be protected until their actual NRHP status has been formally determined. The need to avoid impacting large numbers of these protected sites can fragment the land available for military training and decrease training realism.

c. Most prehistoric and many historic archaeological sites are evaluated under NRHP Criterion D. This criterion addresses a site’s potential to provide information that is important to history or prehistory. The importance of the information a site can provide is evaluated by using a historic context. Most sites are evaluated for NRHP eligibility on a case-by-case basis. The slow rate and significant costs of this process combined with the ongoing discovery of many new sites suggests that the Army’s need to avoid archaeological sites will increase rather than decrease.

d. The condition of the nation’s economy and the related pressures on the federal budget suggest that CRMs would be wise to prepare for future decreases in funding. Even if funding cuts do not occur, it is important to identify responsible management strategies that could reduce the backlog of unevaluated archaeological sites that the Army currently must avoid. One option would be managing a sample of sites rather than all sites.

e. If this sampling approach was adopted, it would be necessary to identify a representative sample of sites. One component of this process might be prioritizing sites on the basis of one or more management criteria (e.g., information potential). Integrating archaeological site predictive locational models and significance models (the latter is a relatively recently developed concept). Using these models could streamline the compliance process by allowing sites to be evaluated as groups rather than singly, providing opportunities to reduce the number of sites that must be avoided and costs associated with site management. This PWTB discusses several possible approaches to site sampling and prioritization.

f. Adoption of a sampling approach would require consultation with the SHPO, Advisory Council on Historic Preservation (ACHP), relevant Native American tribes, and other stakeholders.

g. Appendix A describes the need for site prioritization and sampling to avoid a growing backlog of archaeological sites, and how that backlog currently poses a serious constraint on realistic military training.

h. Appendix B reviews the approach to evaluating the NRHP eligibility of archaeological sites under Criterion D by using historic contexts to determine if the sites can provide information important to history or prehistory. This brief review provides the background needed to assess an alternative approach (discussed in detail in Appendix F) that uses significance models rather than historic contexts.

i. Appendix C discusses prioritizing areas for archaeological survey by using the Pennsylvania Watershed Model's approach.

j. Appendix D discusses prioritizing the sites by using an automated tool for monitoring archaeological sites (ATMAS).

k. Appendix E discusses a method for selecting a representative sample of sites for southeastern New Mexico.

l. Appendix F describes the potential benefits of integrating predictive site locational models and significance models into an installation's compliance program.

m. Appendix G discusses a number of issues to consider when developing a prioritization or sampling method.

n. Appendix H lists the references cited and Appendix I gives spell outs for abbreviations used in this PWTB.

5. Points of Contact

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APPENDIX A:

THE NEED FOR SITE PRIORITIZATION AND SAMPLING

The US Army manages approximately 13.3 million acres of public lands within the 50 states. To date, more than 90,000 archaeological sites have been recorded on those lands. Some 64,000 of the 90,000 known sites are located in maneuver areas, and many of those sites must be avoided during training exercises. Since only about 43% of Army lands have been surveyed in determining those known sites, tens of thousands of additional archaeological sites are likely to exist.

The Army's training mission involves intensive use of the landscape, including many activities that can have adverse impacts to archaeological sites (Means et al. 2011). The Army's strategy for managing known sites that are or may be eligible for nomination to the NRHP is based on avoidance. Civilian federally-funded and/or permitted undertakings, such as highway construction, often mitigate adverse impacts to NRHP-eligible sites located within a relatively restricted area of potential effects (APE) by using a program of data recovery. Mitigation programs often include large-scale excavation, analysis of the recovered materials and information, preparation of a detailed report, and long-term curation of artifacts.

In contrast to civilian land uses, military training occurs repeatedly over much larger areas. For example, a mechanized infantry battalion can include 100 tracked vehicles and require up to 24,800 hectares (61,282 acres) while conducting training exercises (Means et al. 2011, 21). Thus the costs and delays to training that would result from mitigating military impacts to all eligible sites would be enormous. Even the evaluations needed to determine NRHP eligibility are expensive, with costs ranging from $5,000 to more than $20,000 per site.

Most large Army installations with ground-disturbing military training programs have ongoing survey and NRHP evaluation compliance efforts, but because of the cost, most installations conduct relatively few site evaluations per year. Archaeological survey of Army lands also occurs incrementally, but new sites are being found and categorized as potentially eligible at a faster rate than they can be evaluated, leading to a growing backlog of sites that must be avoided by ground-disturbing training exercises. Note that the term "potentially eligible" is very widely used in CRM, and in this document, to refer to sites whose NRHP eligibility could not be determined based on the limited information collected during archaeological survey. Survey data typically indicates that many sites are not eligible, but the data is rarely adequate to support a finding of eligibility. Sites that are not found to be “not eligible” at the survey stage must be managed as if they are eligible until further investigations can resolve their status.

Despite the Army’s policy of avoidance, the condition of many archaeological sites is gradually worsening (Richardson and Hargrave 1998). Since 2001, training has evolved in response to a focus on counterinsurgency and counterterrorism combatant tactics. As US troops return from Afghanistan, the Army is again changing its training to prepare for possible future conflicts. The Army is returning to Full Spectrum Training that will prepare units to execute missions required by all types of conflict, ranging from unstable peace to insurgency to general war. The Army will again conduct large force-on-force exercises, suggesting that future use of Army training lands will be both intense and diverse. If the 2012 efforts to avoid the so-called fiscal cliff and sequestration are any indication, it seems wise to assume that funding for resource management may decline, perhaps at the same time that training intensity and diversity increases. While this view may be pessimistic, historic preservation may benefit from managers developing contingency plans for both short-term crises and long-term changes in funding priorities.

Resource managers on Army training installations appear to have several options. They can continue with the current strategy of managing an increasing number of sites, many of them potentially eligible for nomination to the NRHP. This option will require the training community to structure military exercises to avoid an increasing number of sites. While the costs of site avoidance are difficult to quantify in dollars, they have very real consequences for the realism of military training. Despite the best efforts of resource managers, military trainers, and military units undergoing training, it is likely that the condition of many sites will continue to deteriorate. Decreases in funding would further exacerbate the situation.

This PWTB suggests that CRMs should consider the costs and benefits of managing a thoughtfully selected sample of the NRHP-eligible and potentially eligible sites. With careful planning and by using sound principles of CRM, managers could achieve an acceptable balance among multiple goals that include complying with historic preservation laws and regulations, supporting the military mission by reducing management costs and restrictions on training, and ensuring that an adequate sample of archaeological sites is protected.

Most of this PWTB is devoted to an overview of four previously developed strategies for prioritizing sites and/or selecting a sample of sites for LTM (Appendices C–F). The four different geographic locations are shown in Figure 1. Appendix G discusses a number of issues that the manager should consider when developing his/her own strategy. Most managers will probably find it necessary to have technical specialists develop certain parts of their strategy, particularly GIS-based models that predict site locations. It also is likely, however, that no one understands the character, strengths, and weaknesses of an installation’s archaeological sites like the individuals who have managed them for some time. Those individuals should bring as much of that knowledge as possible into the process of developing a management strategy.

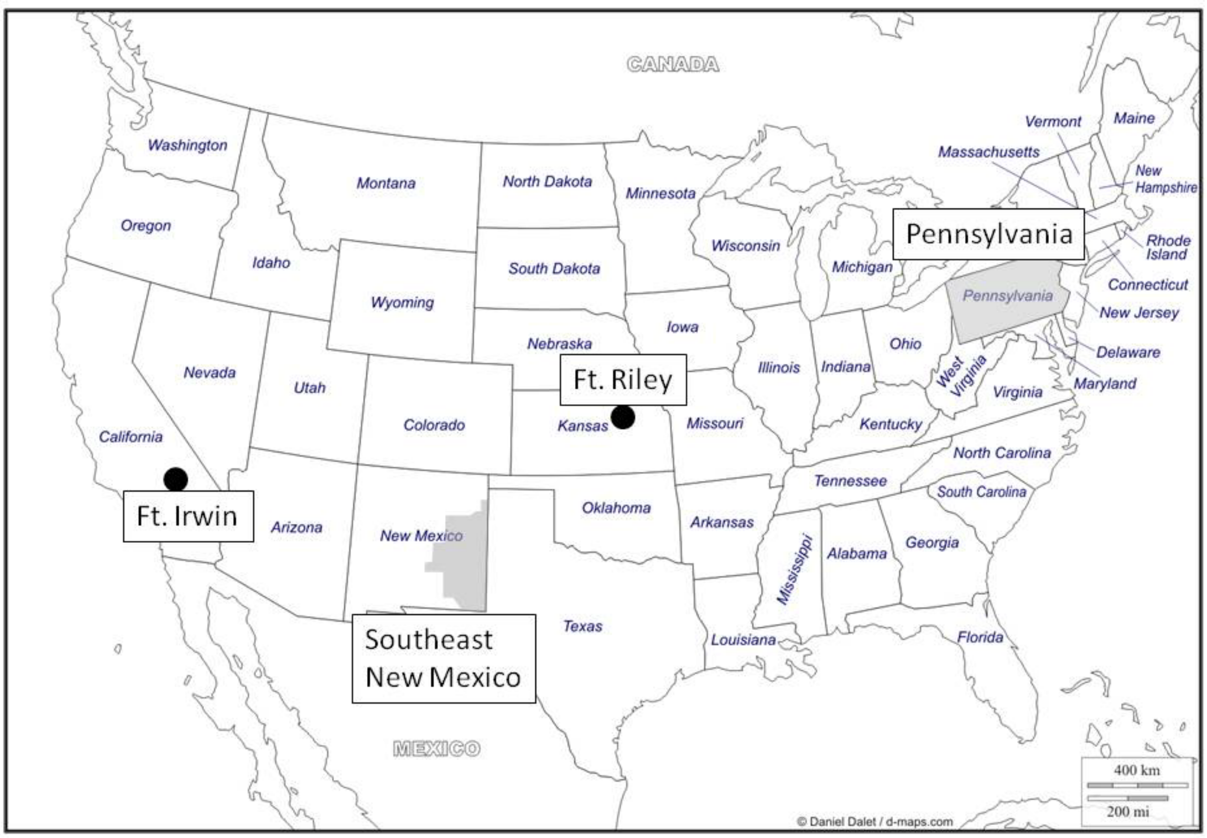

Figure 1. Varied geographic locations of the four installation study areas discussed in text. (US map used under terms of use at: http://d-maps.com/carte.php?num_car=5184&lang=en.)

APPENDIX B:

EVALUATING SITE SIGNIFICANCE BY USING HISTORIC CONTEXTS

This appendix provides a brief overview of the prescribed approach for evaluating the NRHP eligibility status of archaeological sites under Criterion D by using historic contexts. An alternative approach described in Appendix G that is already in wide use but not officially recognized would facilitate the use of significance models (Cushman and Sebastian 2008) to streamline the Section 106 compliance process and reduce the backlog of archaeological sites awaiting NRHP evaluation. This alternative approach would also have implications for compliance with Section 110, including the use of surveys designed to find examples of site types that are underrepresented in the installation’s portfolio.

The NHPA plays a central role in the nation’s historic preservation and the Army’s CRM programs (US Congress 1966). The NHPA established the ACHP, SHPO, NRHP, and “the Section 106 process.” Also, under Section 110, the NHPA defined federal agency responsibilities related to inventorying, nominating, protecting, and using historic properties including archaeological sites.

Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties and to provide the ACHP a reasonable opportunity to comment on those undertakings; it also outlines the process for compliance with NHPA that is used throughout the United States. Subsequently, the ACHP has issued regulations to implement Section 106 (US Congress 2004; see ACHP 2012a for a brief summary of the process). Under Section 106, federal agencies are required to search for historic properties within areas that may be impacted as a result of an agency undertaking and then evaluate those properties for eligibility to the NRHP by using four standard criteria. Interested parties must be allowed an opportunity to comment on potential impacts to significant sites. NHPA does not require that the agency identify all historic properties or that a particular site be avoided, protected, or mitigated, only that the agency make a reasonable and good faith effort to take impacts into account.

Note that in this document, the terms “impact” and “adverse effects” are used more or less interchangeably when referring to archaeological sites. In 36 CFR Part 800.5(a)(1), it states that “Adverse effects occur when an undertaking may directly or indirectly alter characteristics of a historic property that qualify it for inclusion in the Register.”[1] Of course, impacts such as vehicle ruts may occur at sites that are not significant and not eligible for the NRHP and at many locations where no archaeological site is present; in such cases, using the term “adverse effect” would not be appropriate.

AR 200-1, “Environmental Protection and Enhancement,” identifies federal laws, regulations, legal drivers (LD), and program requirements that define the Army’s policy for managing cultural resources. Under Section 6-2b, AR 200-1 specifies that the Army will “… (2) Establish a historic preservation program, to include the identification, evaluation, and treatment of historic properties in consultation with the Advisory Council on Historic Preservation (ACHP), State Historic Preservation Officer (SHPO), local governments, federally recognized Indian Tribes, Native Hawaiian organizations, and the public as appropriate. Document historic properties that will be substantially altered or destroyed as a result of Army actions. (LD: Section 110, NHPA; 36 CFR 800)” (US Army 2007, 29).

Two components of the Section 106 process that are particularly relevant to this PWTB are discussed below. In the interest of brevity and accuracy, selected excerpts are quoted. The level of effort required to identify historic properties (including archaeological sites) is relevant because the use of predictive site location models and significance models (described in Appendix F) could allow the Army to identify and evaluate the significance of groups of similar archaeological sites, avoiding substantial costs associated with treating them on a case-by-case basis. Also relevant are the procedures stipulated by National Register Bulletin No. 36 (Little et al. 2000) for using historic contexts to evaluate archaeological sites under NRHP criterion D. It will be explained in Appendices F and G that significance determinations can be (and in many cases, are) made effectively without the use of historic contexts.

Level of Effort in Site Identification and Evaluation

In 36 CFR Section 800.4 (b) (1), there is a provision for some latitude in how agencies can identify historic properties.

> “(1) Level of effort. The agency official shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample

[1] http://www.achp.gov/apply.html

> field investigation, and field survey. The agency official shall take into account past planning, research and studies, the magnitude and nature of the undertaking and the degree of Federal involvement, the nature and extent of potential effects on historic properties, and the likely nature and location of historic properties within the area of potential effects. The Secretary's Standards and Guidelines for Identification provide guidance on this subject. The agency official should also consider other applicable professional, State, tribal and local laws, standards and guidelines.”

The ACHP has provided a document that explains what is meant by a “good faith effort” (ACHP 2012b). Also directly relevant to discussions in Appendices G and H is the following statement about use of predictive models (ibid., 3):

> “It is also important to keep in mind what a reasonable and good faith identification effort does *not* require…”

> “…Ground verification of the entire APE. In many cases, areas can be considered to have a certain probability of containing historic properties based on current knowledge. This or similar characterizations can be used to justify where within the APE most identification efforts will or should be targeted. Predictive models that have been tested and found to be reasonably efficient can also assist federal agencies to meet the "reasonable and good faith" identification standard.”

Determining Site Significance and NRHP Eligibility under Criterion D

National Register Bulletin 36 provides guidance on how archaeological sites are to be evaluated for eligibility for nomination to the NRHP under Criterion D (Little et al. 2000, 19).

> “The quality of significance in American history, architecture, archeology, engineering and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, association, and…

> …D. that have yielded, or may be likely to yield, information important in prehistory or history”.

The bulletin then expands on each specific criterion (ibid., 18):

> “Criterion D requires that a property "has yielded, or may be likely to yield, information important in prehistory or history." Most properties listed under Criterion D are archeological sites and districts… To qualify under Criterion D, a property must meet two basic requirements:
>
> • The property must have, or have had, information that can contribute to our understanding of human history of any time period;
>
> • The information must be considered important.”

The bulletin outlines five primary steps in a Criterion D evaluation, as given below (ibid., 29):

1. “Identify the property's data set(s) or categories of archeological, historical, or ecological information.

2. Identify the historic context(s), that is, the appropriate historical and archeological framework in which to evaluate the property.

3. Identify the important research question(s) that the property's data sets can be expected to address.

4. Taking archeological integrity into consideration, evaluate the data sets in terms of their potential and known ability to answer research questions.

5. Identify the important information that an archeological study of the property has yielded or is likely to yield.

Historic Contexts

The concept of historic contexts is also explored in this bulletin (ibid., 14–15).

> “Historic contexts provide a basis for judging a property's significance and, ultimately, its eligibility under the Criteria. Historic contexts are those patterns, themes, or trends in history by which a specific occurrence, property, or site is understood and its historic meaning (and ultimately its significance) is made clear.”
>
> “A historic context is an organizational format that groups information about related historic properties, based on a

> theme, geographic limits and chronological period. Contexts should identify gaps in data and knowledge to help determine what is significant information.”

> “A historic context is a body of thematically, geographically, and temporally linked information. For an archeological property, the historic context is the analytical framework within which the property's importance can be understood and to which an archeological study is likely to contribute important information.”

> “All archeological sites have some potential to convey information about the past; however, not all of that information may be important to our understanding of the pre and post-contact periods of our history. The nature of important information is linked to the theories or paradigms that drive the study of past societies. It is important to realize that historic contexts, and therefore site significance, should be updated and changed to keep pace with current work in the discipline.”

Integrity

The second component in determining a site’s eligibility for the NRHP under Criterion D is integrity. An assessment of integrity occurs after a site’s significance has been identified as outlined in the bulletin (Little et al. 2000).

> “All properties must be able to convey their significance. Under Criterion D, properties do this through the information that they contain” (ibid., 38).

> “Archeologists use the word integrity to describe the level of preservation or quality of information contained within a district, site, or excavated assemblage. A property with good archeological integrity has archeological deposits that are relatively intact and complete. The archeological record at a site with such integrity has not been severely impacted by later cultural activities or natural processes” (ibid., 36).

APPENDIX C:

THE PENNSYLVANIA WATERSHED MODEL

> “…it is time to prioritize explicitly settlement pattern survey needs.” (Carr and Keller 1996)

In this PWTB, “prioritizing sites” refers to the practice of using one or more criteria to order or categorize known sites and to determine how they will be managed. Sites can be prioritized in other ways and for other reasons, and Pennsylvania’s Watershed Model represents an example that became somewhat controversial. The Pennsylvania Watershed strategy prioritized areas rather than sites for survey; however, that practice had important implications for the fate of sites that had not yet been documented within areas that would be impacted before first being surveyed. The potential for impacts prior to survey is a relevant issue for Army installations, many of which have substantial areas that have not yet been surveyed.

Before 1995, the costs of archaeological surveys conducted in Pennsylvania under state permits were borne by the applicants. More than 14,000 archaeological sites had been recorded by 1995. Senate Bill 879 (Session of 1995) shifted the responsibility for funding archaeological surveys to the state——specifically, to the Pennsylvania Historical and Museum Commission (PHMC), an agency that included the SHPO. The PHMC recognized that the amount of funding allocated by the government would not be adequate to support the required surveys. In response to the budget decreases, the PHMC developed a plan to prioritize areas for archaeological survey. In essence, this plan involved identifying areas that would not be surveyed (Carr and Keller 1996).

The PHMC also recognized that the most common site type in the Pennsylvania uplands was the lithic scatter, and most of these types of sites were multi-component, not stratified, disturbed by plowing, and thus unlikely to provide unique scientific information (Carr and Keller 1996). The commission developed criteria to identify those drainage basins wherein an adequate number of such sites had already been documented. The criteria included (ibid.):

> “…site densities; ratio of upland to riverine sites; upland sites representing all expected time periods and cultural phases; upland sites that contain data on lithic utilization; upland sites with features; regions sampled by

> Phase I level surveys; and regions with a sample of controlled surface collections from upland sites."

Those variables were quantified for individual watersheds and physiographic zones that contained multiple watersheds. Regional averages and ranges were calculated for each of the variables, and thresholds were identified. Watersheds were identified that had a good sample of upland and riverine sites, all chronological components, data on patterns of lithic use, data from excavations, systematic surveys, and controlled surface collections. Nineteen of the state's 104 watersheds were found to already have high-quality data for upland sites. The new strategy called for surveys to be conducted in riverine areas and for all documented sites in those 19 watersheds to be protected, but the PHMC would not require additional archaeological surveys for state and federal projects in upland areas. Instead, limited funds would be allocated to watersheds that did not yet have good samples of upland sites (Miller 1997; Carr and Keller 1996).

Pennsylvania's decision to modify their previous process for complying with Section 106 was controversial, and the SAA Bulletin published excerpts from a discussion of that topic by CRM professionals who represented the major components of that industry (Weed and Pape 1997). The discussants addressed the following questions:

1. Did the Watershed Model's prioritization of areas for archaeological survey violate the intent and spirit of Section 106, in terms of its mandate to inventory and evaluate all cultural resources that might be impacted?

2. What are viable alternatives that would reduce time and cost expenditures yet preserve the essence of Section 106?

3. Is it appropriate to single out specific resource categories (in this case, lithic scatters) or should they all be considered equally?

4. If all categories must be viewed as equal, what type of spatial modeling approach is appropriate?

The discussants expressed a number of concerns that are relevant to this PWTB. In the interest of brevity, the following statements are paraphrased and are not attributed to individual discussants to avoid misrepresenting or oversimplifying their views. The participants did not achieve consensus on any of these issues.

- It is important to be clear about the reasons underlying policies that represent departures from the 106 Process as it is widely used, such as not surveying 100% of an area that may be impacted.

- The Watershed Model was more a response to political and economic factors than to research needs or resource protection.

- Decisions about excluding some areas from survey should be made in the interests of science or site protection, not simply to reduce costs.

- Excluding large areas from future survey may not be consistent with the letter and intent of Section 106.

- Making the decision to not survey an area because an adequate number of upland lithic scatters has already been documented may create a bias against other site types (e.g., historic sites) that occur in the same areas.

- Rather than not surveying large areas, options such as abbreviated surveys or alternative mitigation could be considered.

Developing a management plan nearly always requires one to compromise between competing goals. Those who developed the Watershed Model apparently decided that dividing the diminished available funds equally among all of the watersheds and site types (if such a thing were actually possible) would not have yielded a satisfactory result. The plan they created was a good-faith effort to comply with the intent of the Section 106 process as much as possible given the situation. Different individuals would have created different plans, but ultimately, all would have to reduce the level of effort to that permitted by available funds. The only fully satisfactory solution would have been the infusion of additional funds, and none of the individuals who developed, implemented, or critiqued the plan had the power to achieve that. Those who developed and administered the plan had the responsibility to make their political masters aware that resources were inadequate and that the program might not be in compliance with legal requirements. That done, they should not be faulted for devising and implementing a plan to accomplish their management responsibilities vis-à-vis the intent of the Section 106 process as well as is possible within the context of inadequate resources.

APPENDIX D:

PRIORITIZING SITES USING ATMAS

ATMAS, an automated tool for monitoring archaeological sites, was developed to meet the need for a systematic approach to site monitoring by Army installations (Hargrave and Meyer 2002, 2009; Meyer and Hargrave 2003). It was developed on the Microsoft® Access 97 database platform, but subsequent developments by Microsoft have unfortunately rendered ATMAS obsolete. ATMAS' capabilities to support monitoring have been summarized in a previous PWTB (Hargrave 2009). What is relevant here are the approaches used by the two versions of ATMAS to prioritize sites as described below. ATMAS 1.0 was developed for Fort Riley (Hargrave and Meyer 2002). ATMAS 2.0 was developed for use at Fort Irwin and incorporated the approach to site prioritization that the Fort Irwin cultural resources program was already using (Fort Irwin DPW [Directorate of Public Works] 2001).

ATMAS 1.0

Fort Riley includes approximately 100,656 acres of rolling grass-covered prairie in the Flint Hills region of eastern Kansas. When ATMAS 1.0 was developed, Fort Riley had more than 1,000 documented sites. Many of the sites, including nearly all of the prehistoric sites, were not readily recognizable due to vegetation cover. Many of the known sites, as well as sites in areas that had not yet been surveyed, were vulnerable to inadvertent adverse impacts from military training that included the use of tanks and other heavy vehicles. The difficulty of continuously monitoring all of the sites categorized as eligible or potentially eligible for nomination to the NRHP created a need to prioritize and schedule the sites for periodic monitoring. Both versions of ATMAS allowed the user to select random samples of sites from three priority groups (high, medium, and low), provided a protocol for describing and quantifying impacts, and stored information from sequential monitoring visits in a manner conducive to detecting change in site condition (Hargrave and Meyer 2002).

Eligibility for the National Register is technically a threshold because a site either is or is not eligible; however, many CRMs recognize that all eligible sites are not equal in terms of their scientific and cultural value. Sites whose deposits exhibit integrity vary greatly in terms of their overall condition, role in past settlement and subsistence systems, chronology, potential to provide data relevant to important research questions, and cultural value to Native Americans.

ATMAS 1.0 assigns each site to high, medium, or low priority groups for each of three criteria chosen with input from the installation CR managers. The three criteria are:

- the likelihood that a site will be eligible for the NRHP under criterion D (in Little et al. 2000);
- the likelihood that a site will be of particular relevance to native American groups; and
- the risk of future adverse impacts.

Assignments were made by using archaeological site data that had previously been derived from Kansas archaeological site forms for use in a predictive model at Fort Riley, as developed by James Zeidler (1998). As is true throughout the United States, the original site forms had been completed by various individuals over the course of several decades and differed greatly in their specificity and reliability (Hargrave and Meyer 2002).

Sites were assigned to priority categories using a sequence of if-then statements. The likelihood that a site would qualify for the National Register under Criterion D was categorized as 1 (low), 2 (medium), or 3 (high), based first on its cultural component, then its level of disturbance, and finally, its site type. For example, all sites were initially assigned a National Register priority of 2. If the site's cultural component was recorded simply as prehistoric, it remained in the intermediate category. If the site's cultural component was a more specific period (e.g., Archaic, Early Ceramic), its priority rose to 3. If the site did not have a high level of disturbance, its National Register status based on cultural component would not be altered. If the site was recorded as being heavily disturbed, National Register status would be reduced to 1.If site type was recorded as an isolated find, National Register status would remain at or be reduced to 1. If site type was recorded as "village," National Register status would be raised to 3 even if disturbance was high (Hargrave and Meyer 2002).

The likelihood that a site would be particularly relevant to Native Americans was based on its cultural component and the presence of features or other evidence suggesting that burials could be present. All sites were initially categorized as low priority for Native American relevance. If their cultural component was Early Ceramic through Protohistoric (giving them some current or possible future basis to be related to known tribes), their priority rose to intermediate. If cairns, mounds, or any other indications of burials were present, sites were categorized as high priority (Hargrave and Meyer 2002).

ATMAS 1.0 assumes that the risk of future adverse impacts is positively correlated with the amount of previous disturbance. Information (field observations) from the site forms was used as one basis for prioritization. All sites were initially assumed to have an intermediate priority, and maintained that status if the site forms made no mention of disturbance, or if disturbance was characterized using terms indicating other than “high” or “extensive”. Sites that were described using those terms were elevated to the high-risk category. Many older site forms included no information about disturbance.

ATMAS 1.0 also quantified risk using information from a disturbance map developed for Fort Riley (as described in Guertin 2000). That map predicts the likelihood of particular areas being impacted by vehicle traffic over the course of a year based on an extrapolation/interpolation of Land Condition Trend Analysis (LCTA) data between LCTA plots (Anderson et al. 1996). Predicted disturbance values ranged from 0–85. Sites located in areas with values from 0–28 were categorized as low priority, values of 29–56 were intermediate risk of future disturbance, and values of 57–85 were high risk (Hargrave and Meyer 2002).

ATMAS 1.0 used a simple formula to combine the rankings for National Register eligibility, Native American relevance, and risk of future impacts into a single ranking that also consists of high, medium, and low priority groups. The rankings could be weighted as desired to assign greater or lesser importance to each of the three management criteria.

In this case, priority refers to the overall need for periodic monitoring to prevent adverse impacts to sites (Hargrave and Meyer 2002).

ATMAS 2.0

Fort Irwin is the Army’s National Training Center and covers an area of approximately seven square miles in southern California’s Mohave Desert. It is characterized by linear mountain ranges and alluvial valleys. ATMAS 2.0 prioritized Fort Irwin’s sites for monitoring based on their Information Potential and Predicted Risk. The software used data that resided in a current copy of the installation's cultural resource database (Fort Irwin DPW 2001; Meyer and Hargrave 2003). Information Potential was calculated using the method that had been developed previously by the Fort Irwin cultural resources program. It is summarized as follows in the installation's Integrated Cultural Resources Management Plan (Fort Irwin DPW 2001l also see Table 1):

> "… the Fort Irwin rating system assigns 0, 1, 2, or 3 points to a site for each of six variables: NRHP eligibility, site type, site age, integrity, subsurface deposits, and area. An example of this rating scheme is shown in Table 1.[2] Points are assigned using data available in the Fort Irwin Cultural Assessment Resource Database (FICARD). Information Potential is calculated by totaling the points for each of the six variables. Information Potential of a CR site may range from a minimum of zero (for a site known to exist, but for which essentially no data are available) to a maximum of 18 (for a site that gets three points for each of the above six characteristics)."

Sites with more specific chronological information and less extensive disturbance are very likely to have greater information potential. Similarly, sites known to have subsurface deposits are much more likely to provide important scientific and cultural information that those that are simply surface scatters. Larger sites are more likely to provide important information, either because they are qualitatively different from most sites, or because they are the result of a large number of occupations and a larger sample which is more likely to include unusual and therefore potentially important examples. Already having been found to be eligible for nomination to the NRHP under Criterion D is obviously a very strong predictor of information potential. Sites that have not yet been formally evaluated are, as a group, less certain sources of important information.

The most difficult decisions that will confront those who develop a prioritization strategy are concerned with which site types are likely to have the greatest information potential. Such decisions demand a substantial knowledge of one's own site inventory, particularly the findings of previous NRHP eligibility evaluations and perhaps the results of a few larger-scale excavations that may have been conducted in conjunction

[2] The table in quotation is presented in this document also as Table 1.

with large infrastructure expansions on or near the installation. A careful review of the regional archaeological literature and consultation with SHPO, academic, and CRM archaeologists working in the region will result in the best possible plan.

Table 1. Method for categorizing sites developed by Fort Irwin CRM Program (adapted from Fort Irwin DPW 2001).

Characteristic	**Point Value**			
	0	**1**	**2**	**3**
NRHP Eligibility	Not eligible	Potentially eligible	Eligible	Listed on NRHP
Site type	No data	C, CNP, LRS, LS, SC, TP, CNH, R, WSS	CS, FH, FPS, HUNTS, LQ, PS, MILS, MS, RS	HS, RAS, RSS, VS, HCS, HSS, RDS, RES
Site age	No data	Prehistoric, but period unknown	—	Any site assigned to a particular period
Integrity	No data	> 80% Disturbed	30%-80% Disturbed	< 30% Disturbed
Subsurface deposits	No data	Surface only	—	Subsurface deposits
Area	No data	< 120 m^2	120 m^2-44,500 m^2	> 44,500 m^2

Notes: C=Clearing, CNP=Cairn (prehistoric), LRS=Lithic Reduction Site, LS=Lithic Scatter, SC=stone circle, TP=trail, CNH=Cairn (historic), R=road, WSS=Water storage site, CS=Camp Site, FH=Fire Hearth, FPS=Food Processing Site, HUNTS=Hunting site, LQ=Lithic Quarry, PS=Pottery scatter, MILS=Military site, MS=Mining site, RS=Ranch Site, HS=Habitation site, RAS=Rock art site, RSS=Rock shelter, VS=Village site, HCS=Historic campsite, HSS=Homesteading site, RDS=Refuse disposal site, RES=Residential site.

Two other variables that play important roles in ATMAS 2.0 are “Observed Risk” and “Predicted Risk.” Observed Risk is based on the assumption that evidence for past adverse impacts is a good predictor of the risk of similar impacts in the future, and it is calculated using information derived from monitoring visits. For example, if a particular site has sustained damage from numerous fighting positions and tank tracks, it can be assumed that similar damage may occur in the future (Meyer and Hargrave 2003).

Predicted Risk is based on available information about planned changes in training, infrastructure development, or other activities that may impact site condition. For example, the CRM may be informed that, over the next few years, a particular training area will be used more intensively and that several new tank trails will be constructed there. It is logical to predict that the sites in that training area are at a heightened risk of adverse impacts and should therefore be monitored more frequently. ATMAS 2.0 provides a "Predicted Risk override" capability by which the user can ensure that individually selected sites will be allocated the highest prioritization. This capability would be used in the case of particularly important and/or threatened sites that need to be monitored more frequently than would result from normal use of ATMAS (Meyer and Hargrave 2003).

The intended uses for Observed Risk and Predicted Risk were to identify sites that warrant more frequent monitoring, but they could also be useful in selecting a sample of sites for LTM. Sites that fall into high-priority categories for both variables may represent poor choices for inclusion in the LTM sample, simply because they are located in areas that have been and/or are likely to be used heavily for military training. It may, however, be necessary to include sites in such areas simply to achieve a sufficiently large or varied sample. Predicted Risk will typically refer to large tracts or perhaps to entire training areas, and one may be able to identify sites that are, by virtue of their topographic position or vegetation cover, less exposed to impacts than many others.

APPENDIX E:

SAMPLING DESIGN FOR SOUTHEASTERN NEW MEXICO

An example of a very comprehensive strategy for prioritizing sites based on research value is the research design developed for southeastern New Mexico by the Office of Contract Archaeology, University of New Mexico, for the New Mexico State Office, Bureau of Land Management (Hogan et al. 2006). The plan was developed to maximize the value of information that will be recovered from future excavations of prehistoric sites, but for our purposes, it can also be viewed as a sophisticated approach to prioritizing both research topics and sites based on the sites' potential to produce information required to address the topics. The strategy includes the identification of a comprehensive set of regional research topics, sampling strata for the natural environment, a typology of site types, and standardized protocols for analyzing artifacts and subsistence remains (ibid.).

The southeastern New Mexico study area includes 31,590 square miles, only about 3% of which has been surveyed. Over 9,000 sites have been recorded, but more than 300,000 additional sites may be present (Hogan et al. 2006, 2-20). The study area confronts archaeologists with management issues that are in some ways more challenging, but in other ways, less daunting than those that confront the Army. All Army installations are obviously much smaller, most have surveyed a much larger portion of their land than the southeastern New Mexico study area, and in that sense are in a better position to select a representative sample of sites. Some Army installations also have excavation data from a good number of their sites, although in most cases this has been restricted to the relatively small-scale work needed to evaluate a site's NRHP status.

While site destruction is occurring at an alarming rate across the nation, managers at some Army installations are confronted by the challenge of protecting sites in the presence of ongoing, sometimes very intense ground-disturbing military training. The New Mexico BLM plan is explicitly focused on research, whereas plans for Army installations must necessarily emphasize site preservation by means of avoidance. This distinction is, however, less meaningful than it might seem. The proximate reason for installations to protect cultural resources is to comply with historic preservation laws and regulations, but the ultimate reason for doing this is to ensure their installation's potential to contribute to future research even if it is not within the Army’s mission to pay for most of it. On balance, when viewed from a site-preservation perspective, the New Mexico plan has a great deal to offer Army CRMs who may need to develop their own strategies for identifying a representative sample of sites.

Relative to the New Mexico study area’s great size, surprisingly few (n=51) excavations have been conducted since 1990 (a date chosen to ensure that all excavations used current research methods; Hogan et al. 2006, 3-16). While much is known about the study area’s prehistory, the plan’s developers emphasize that it is necessary for a great deal of future research to focus on fundamental issues such as temporal and spatial variability in culture history, settlement, and subsistence strategies. The plan provides a detailed overview of the prehistoric period, and specifies a variety of research questions and topics for the Paleoindian, Archaic, Ceramic, and Proto-historic periods, many of which have been previously subdivided in briefer and/or more localized phases (Hogan et al. 2006, 4-1 to 4-63).

Previous researchers have suggested that the adaptive strategies of prehistoric people were strongly influenced by the characteristics of the region’s three broad physiographic sections: the Sacramento Section of the Basin and Range Province, the Pecos Valley, and the Llano Estacado Sections of the Great Plains Province (Hogan et al. 2006, 2-1; Katz and Katz 1985). The heterogeneous Pecos Valley was divided into six units, yielding a total of eight regional sampling units (RSU). The plan’s authors also developed geoarchaeological maps that use the age of surface deposits to identify areas where relatively well preserved buried sites may occur, as well as areas where exposure to erosion is very likely to have substantially degraded the depositional integrity and research value of many sites. From 70%–86% of the overall study area is characterized by Pleistocene or older surfaces whose archaeological sites tend to be very heavily eroded (Hogan et al. 2006, 2-13).

Twelve site types were defined based on observed characteristics and inferred site function (Hogan et al. 2006, 3-1 to 3-41). The terms site and component seem to be used nearly interchangeably, and this may reflect the fact that only about 5% of the known sites in the study area are categorized as multicomponent (Hogan et al. 2006, 3-4). The types include artifact scatters, single residences, multiple residences, residential complexes/communities, quarries/lithic procurement areas, possible structures, ring midden/burned rock midden, bedrock mortars/metates, domestic features, rock shelters, caves, and miscellaneous features (Hogan 2006, 3-13 to 3-14). The adequacy of this typology was evaluated by comparing it to types used to characterize previously excavated sites, and results of that comparison justified the new typology’s use in preliminary settlement studies and as sampling strata. The small excavated sample (51 sites) did not include examples of all site types, and only the domestic artifact scatter type was represented by more than a few examples. Given this, the authors recommend that future research work be focused on developing a sample of excavated sites that is representative of all site types (ibid., 3-25).

To ensure that the site typology is used consistently, the authors developed a coding key. Using the key requires one to answer questions about a site’s characteristics. A first question could be, “Is the component a scatter of lithic and/or ceramic artifacts with no other features?” If the answer is “yes,” the component type is artifact scatter. If the answer is “no,” one moves to the next question. The second question could be, “Does the component have one or more residential structures (e.g., isolated room, pithouse, ramada/shelter, roomblock, tipi ring, or wickiup)?” If the answer is “yes,” one moves to the third question, which could be, “Is there only one residential structure/unit?” If the answer is “yes,” the component type is “single residence” (Hogan et al. 2006, 3-14).

The southeastern New Mexico plan’s development is viewed as an ongoing, iterative effort. Sites will initially be selected for investigation by using a cross-tabulation of the 12 site types and temporal periods for each of the eight regional study units (Hogan et al. 2006, 5-2); however, in the future, both strata should be refined and subdivided. For example, the authors suggest that their proposed subdivisions of the Archaic and Ceramic periods should be incorporated into the sampling matrices. Subdivision of the artifact scatter site type based on artifact contents is identified as another high priority. Authors of the New Mexico plan suggest that initially, priority needs to be given to developing a better understanding of regional chronology and subsistence. To achieve that objective, research should initially focus on site types likely to provide data relevant to those topics. Artifact scatters and quarry sites are unlikely to provide such data and would not be the primary target of initial research. Addressing the full range of research questions will eventually demand the investigation of examples of all site types (Hogan et al. 2006, 3-25).

Previously excavated sites suggest that, with the exception of artifact scatters and quarry sites, all site types have similar likelihood of producing chronological data. The likelihood that subsistence data will be recovered appears to depend more on local preservation conditions than on site type. Similarly, site condition appears to be a much better predictor of a site's research potential than site type (Hogan et al. 2006, 3-25). Consequently, "…the sample of sites selected for excavation from each cell of the sampling matrix should be those least affected by erosional processes. The two best indicators of site condition that we were able to identify are 1) geomorphological setting and 2) the presence of charcoal/ash stains or midden deposits" (ibid., 5-2). While the geoarchaeological maps represent an important new resource to identify site condition, the maps are limited by the coarse resolution at which surface geology is mapped. Geoarchaeological maps provide useful information about broad differences in site preservation within regional sampling units, but they are poor predictors for preservation conditions at individual sites and do not support the recognition of small areas of Holocene sediments where buried deposits may be present (ibid., 5-2).

Modeling is intended to play an important role in the New Mexico plan's implementation. GIS data layers should be developed for each regional sampling unit, showing areas that have been surveyed and sites associated with each type and period. Variables such as vegetation, soils, hydrology, and geomorphology should be used in the future as sampling strata to better understand the variability within each RSU (Hogan et al. 2006: 5-6). Predictive models of site location will be used to investigate variability in settlement practices within and between regional sampling units. The potential for and value of predictive models will increase as survey coverage increases. Overall survey coverage for the study area is approximately 3% and much of that in the southern one-third of the area, whereas 10% is often viewed as a minimal survey sample for reliable predictive models (Hogan et al. 2006, 5-2).

APPENDIX F:

PREDICTIVE LOCATIONAL AND SIGNIFICANCE MODELS

Archaeological predictive models are tools that indicate the probability of archaeological sites being present at particular locations. When predictive models began to be used in CRM in the late 1970s, some land managers hoped that they could dramatically reduce the need for archaeological survey (Altschul et al. 2004, 5; Judge and Martin 1988, 572). The late 1970s saw the development of a number of models (Thoms 1988). In 1981 the BLM encouraged use of predictive models in states with intensive drilling for oil and gas. However, resource managers soon found “that predictive modeling was being employed in a wide variety of ways and that there was little mutually agreed-upon theory, method, or policy to guide the use of this technique” (Judge and Martin 1988, 571). The BLM’s Cultural Resource Predictive Modeling Project grew into a comprehensive assessment of the technique and its role in CRM. One of that study’s conclusions is quoted here (ibid., 575-576):

> “Predictive modeling of archaeological site locations can never be a complete substitute for actual field inventory (intensive survey)…it is unlikely that predictive modeling could, in the foreseeable future, be sufficiently accurate to satisfy the identification requirements in 36CFR800.4 (the implementing regulations for Section 106 of the National Historic Preservation Act)…”

That conclusion was widely accepted by land managers and as a result, use of predictive modeling declined for a time. However, use of predictive models has seen resurgence during the last two decades (Kvamme 1990, 2006; Mehrer and Wescott 2006; Verhagen 2007), partly due to increased funding and technical advances (GIS, digital databases) as well as a growing recognition of how predictive modeling can be used to good effect. In 1995, Minnesota became the first state to use an archaeological predictive model on a statewide scale (Minnesota DOT 2013). North Carolina initiated a statewide modeling effort in 2002 (Seibel 2006, 35-37), and a number of states now use predictive models of some type. Predictive models now play an important role in decisions about the need for archaeological survey of areas that may be disturbed by road construction, residential, or commercial development.

The Role for Predictive Models

Researchers affiliated with the SRI Foundation have led an effort sponsored by DoD's Environmental Security Technology Certification Program (ESTCP) and Legacy Resource Management Program to determine how military installations are currently using predictive modeling and to demonstrate how it could be used more effectively (Altschul 1989; Altschul et al. 2004; Cushman and Sebastian 2008). The DoD's primary motivation for evaluating the potential benefits of predictive modeling is its yearly expenditure of some $15 million to comply with historic preservation and other cultural resource laws (Cushman and Sebastian 2008, 11).

An assessment of the models used by DoD installations (Altschul et al. 2004, 36-37) found five issues that currently limit their effectiveness:

1. The models are highly diverse, and some are limited by unfortunate decisions made during the design process.

2. Most models are rudimentary in nature.

3. The models predict only surface sites, making little or no use of geomorphology.

4. Existing models typically have not been refined or updated after they were initially developed.

5. Predictive models are not well integrated into an installation's overall compliance process.

Cushman and Sebastian (2008) identified a number of ways that well-designed GIS-based predictive models could contribute to an installation's CRM programs. Their list includes but is not limited to managing effects on known sites, stratifying training and development impacts on a landscape or installation scale, and coordinating environmental planning. Models also can support the National Environmental Policy Act of 1969 (NEPA) process in the areas of project scoping, evaluating the impacts and costs of alternatives, and postponing the identification and evaluation of significant sites that would otherwise be required when evaluating some alternatives. Additionally, predictive models can contribute to the Section 106 process by predicting the kinds of properties likely to be present in an APE, planning survey costs, developing research designs and sampling strategies, identifying appropriate field methods, estimating mitigation costs, redesigning projects to lessen impacts and costs, supporting consultation with tribal stakeholders, and facilitating the development of programmatic agreements (Figure 2; Cushman and Sebastian 2008, 16-20).

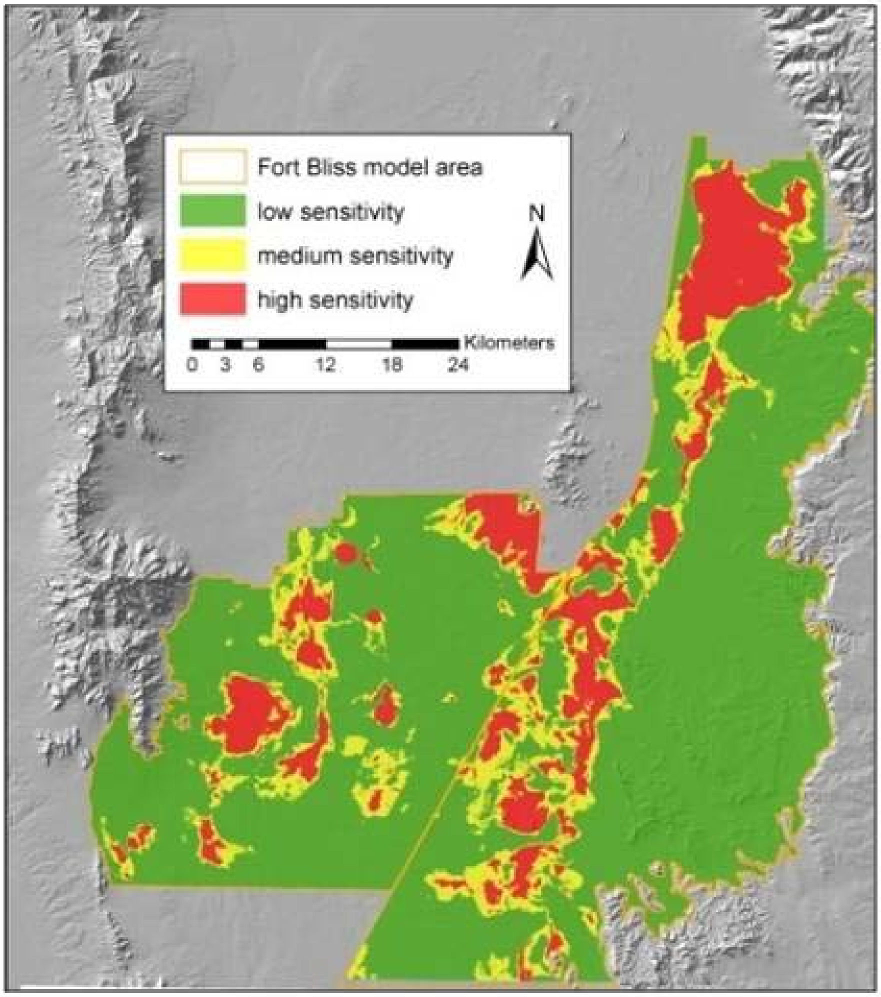

Figure 2. Archaeological sensitivity map of Fort Bliss indicates the likelihood of sites being present. (Source: Statistical Research, Inc. under contract W9132T-10-C-0042 to ERDC.)

Significance Models

Cushman and Sebastian (2008) advocate an innovative use of models to streamline the Section 106 compliance process. Models can be developed to not only predict the likelihood of site presence, but also to predict site significance. (Here, the term "significance" refers to the quality of integrity and the four eligibility criteria for the National Register, not to "statistical significance.") Significance models entail a set of rules that provides a basis for categorizing sites based on their potential to be well preserved (i.e., to exhibit integrity), include intact subsurface deposits, and thus to provide information about prehistory, history, and/or Native American cultural values. These factors represent the basis for determining an archaeological site’s eligibility for the NRHP under Criterion D (Little et al. 2000; see also Appendix B of this PWTB).

A broad implementation of significance models will require the CRM community to explicitly recognize and accept that there is a discrepancy between the officially sanctioned approach used to determine a site’s National Register eligibility and an alternative approach that is widely used but not officially sanctioned (Cushman and Sebastian 2008, 36). As stated, prehistoric and many historic sites are generally evaluated using Criterion D which focuses on a site’s likelihood to yield information important to history or prehistory. The guidelines for evaluating NRHP eligibility described in the regulations (36 CFR Part 800) and *National Register Bulletin No. 36* (Little et al. 2000) stipulate the use of historic contexts as a means of recognizing what kinds of archaeological data might constitute important information. Historic contexts are “…discussions of important research issues grouped by place, time, and theme” (Cushman and Sebastian 2008, 36). “They… organize information about the past into meaningful units for a particular time, place, or theme in history or prehistory and establish the attributes that historic properties must exhibit in order to be determined NRHP eligible in relation to those contextual units” (Little et al. 2000, 21). This process is outlined in more detail in Appendix B.

In many CRM archaeological reports, historic contexts appear primarily as overviews of regional prehistoric and historic knowledge. While summarizing current knowledge, these overviews often do not specify research questions to which data from the site or sites in question may apply. Thus decisions about a site’s eligibility under Criterion D are often reduced to considering the presence or absence of intact deposits (most commonly, features or midden strata undisturbed by plowing) as a minimal criterion for integrity, artifacts diagnostic of a particular culture-historical unit, and the delimitation of site limits. Archaeologists who frequently evaluate sites for NRHP eligibility under Criterion D often assume that they could make a more explicit argument for a site’s relevance to one or more formal historic contexts, but that step is often reduced to rather general statements such as how the presence of intact features or strata would likely yield artifacts, floral and faunal remains, and dateable materials that would advance our understanding of the past settlement and subsistence practices. Cushman and Sebastian (2008, 37) summarized this tendency:

> “What people actually do is to evaluate the physical characteristics (including setting) and the morphology (i.e., the form, content, and structure) of the site and make a decision based on those. Is the site largely intact or is it eroded or looted? Is it mostly buried or exposed on the surface? How many artifacts are visible? What kinds? Is there evidence of features or structures? Are there temporally diagnostic artifacts or features…?”
>
> “…Archaeologists gather a relatively fixed set of data from all archaeological sites: artifacts, features, structures, pollen samples, flotation samples, chronometric samples, ethnobotanical samples, perishables, faunal materials, human remains and associated grave goods, plus all of the provenience information for those things—maps, plans, notes, photographs, drawings, and so forth. Some sites have all of these categories of data, others only a few. But by looking at the physical characteristics and morphology of a site, archaeologists assess the site’s potential to yield many of these categories of archaeological data and use that assessment to design an excavation strategy and analytical approach.”

Cushman and Sebastian noted that these site characteristics are associated with certain combinations of geomorphology, soil type, slope, drainage, erosion, post-depositional impacts, etc. (ibid.). These variables are typically included in predictive locational models. Combinations of these variables often characterize groups of sites. For example, an archaeological site located on a sloping surface where there is little soil development is likely to have been relatively intensively impacted by erosion, decreasing the likelihood that it will exhibit the integrity and research value required to be eligible for the NRHP. This expectation would also apply to similar sites located in similar settings. In contrast, sites located on a stream terrace that represents an aggrading surface are more likely to remain relatively intact. Sites in that group would be more likely to have integrity and research value, and so the significance model would predict that they would be eligible for the National Register.

Management decisions would probably not be based solely on the site’s exposure to erosion, its burial beneath later deposits, or any other single characteristic. The site’s chronology, functional type, location relative to training lands, and other factors would also be considered. Management approaches described in previous appendices exemplify alternative ways to integrate multiple criteria. ATMAS 1.0 used sequences of “if-then” statements to assign sites to groups whereas ATMAS 2.0 used a point system (see Table 1 in Appendix D). The New Mexico strategy used a coding key that included a series of questions used to assign sites to site types.

Using significance models based on such sorting criteria would allow management decisions to be made for groups of very similar sites rather than individual sites. A significance model would, of course, generate some errors, and it would be advisable to conduct small scale excavations to test some of the predictions in order to determine the reliability of predictions made using the significance model.

Cushman and Sebastian go on to further discuss developing historic contexts (2008, 38):

> “These decisions do not require case-by-case evaluation of individual archaeological sites relative to developed historic contexts. They can be made by synthesizing existing survey and excavation data to understand the relationship among surface manifestations, geomorphic setting, and information potential, and then developing a set of algorithms or “rules” for predicting the information potential of a given site based on this past experience…”
>
> “…The premise of a significance model is 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 excavation and other forms of data recovery at the site.”

The authors (ibid.) note that the information needed to develop rules for categorizing sites include such things as the presence of artifacts and features, the site’s geomorphology and soils, the age of the landscape, its history of exposure to erosion and/or soil deposition, the extent to which depositional conditions would favor the preservation of pollen, and carbonized and uncarbonized floral and faunal remains. Characteristics that would make a site relevant to Native Americans could also be considered, including proximity to plant communities and important landmarks (ibid., 37).

Various combinations of these characteristics can be used to define site management categories. According to Cushman and Sebastian (ibid., 39) those categories could be:

> "… whatever is meaningful and useful for managers and cultural resource staff on the installation and for the local and regional community of archaeological researchers. The purpose of these categories is not to create immutable "significance" assignments, but rather to provide installation CRM personnel with a fairly straightforward set of management classes 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 sensitivity model using these categories is developed for an installation and validated, it could be used to classify known sites into significance categories, and the results of such a classification effort could then be used to create a map layer within the installation's locational model or other GIS-based representation of the installation's resources. This map layer could then be used to display the geographic positions of sites of different significance categories within the installation. For installations with a locational predictive model, this information could be used to develop a predictive data layer for sites not yet identified. This component of the predictive model would yield the locational probability scores for sites of the different significance categories and create a significance-based sensitivity map or set of maps."

A financial challenge to fully implementing this approach at an installation would be the need to develop or refine a predictive model, which would likely need to be done by technical experts. An installation's CRM team would, however, be best qualified to develop a significance model. The formal acceptance of the approach to evaluating significance for groups of similar sites rather than on a case-by-case basis using historic contexts would require some cultural, administrative, and perhaps legal issues to be resolved. Resolving these challenges could, however, provide an opportunity for installations to comply with the intent of historic preservation laws in a responsible and far more cost-effective manner.

APPENDIX G:

DEVELOPING A STRATEGY

Summary of Previous Approaches

Three preceding appendices contain methods[3] for prioritizing archaeological sites which are summarized here in Table 2. These examples of previous approaches were not chosen because they are viewed as the “best” approaches, but because all have characteristics that merit consideration by CRMs who may wish to develop their own approach. Site prioritization per se is not the primary goal for all of the approaches. However, selecting a sample of sites that is suitable for LTM is at least an implicit goal for each. This appendix begins with a few very brief statements about each approach, and ends by extracting some basic concepts offered as guidance.

Pennsylvania Watershed Model

The Pennsylvania Watershed Model (detailed in Appendix C) was the earliest of the approaches, and was the focus of some controversy within the CRM community (Carr and Keller 1996; Weed and Pape 1997). The model was developed in response to an abrupt decrease in funding for archaeological survey (survey costs were shifted from developers to the state). The model intended to allocate funds in a way that would avoid the collection of additional survey data in upland areas where relatively substantial previous work had been done, instead focusing resources on areas where existing data were sparse. Critics disapproved of the approaches’ emphasis on cost savings rather than research, feared that it would become mechanistic, and would continue a bias against historic resources (Weed and Pape 1997). The Watershed Model did not overtly seek to prioritize sites, but instead influenced the discovery of new sites by identifying areas (upland portions of watersheds) where additional survey would not be conducted. Despite its limitations, the initial version of the Pennsylvania Watershed Model was a well-intentioned and responsible effort to make the best of diminished resources——a situation that many CR managers may need to address in the future.

[3] In this document, the terms method, strategy, and approach have been used more-or-less synonymously.

ATMAS Method

The ATMAS tool's objective was to allocate resources (staff time) to monitor archaeological sites in a thoughtful way, not merely in response to an anticipated decrease in funding. The tool's monitoring capabilities included selection of a random sample of sites and provisions for recording the results of site monitoring visits in a way that would facilitate detecting changes in site condition (see Appendix D). The initial version developed for Fort Riley prioritized the installation's prehistoric sites using three management factors: Native American issues, research potential, and risk of future impacts. A second version developed for Fort Irwin prioritized sites using a method for ranking sites that the installation had developed previously (Fort Irwin DPW 2001). Both versions could have contributed to the selection of a sample of sites for LTM by identifying the highest-ranked sites and could have contributed to cost avoidance by identifying the lowest-ranked sites.

Southeastern New Mexico Strategy

In some ways, the most ambitious strategy summarized in this PWTB is the one developed for southeastern New Mexico (detailed in Appendix E), a region far larger than any single Army installation. That plan was motivated by a desire to identify the kind of prehistoric sites that could provide the data needed to address a prioritized set of questions about regional prehistory (Hogan et al. 2006). Sites and components were treated as largely synonymous. The initial approach for selecting a representative sample of sites entailed a cross tabulation of environmental divisions and time periods. The strategy is viewed as an ongoing effort, with the intention of including additional sampling strata (e.g., site type) as more data become available. The New Mexico approach is particularly strong in its emphasis on regional research topics, and this regional emphasis makes it highly recommended to installation managers who may want to develop their own approach.

Locational and Significance Models

The most innovative of the strategies summarized here (detailed in Appendix F) was developed by researchers affiliated with the SRI Foundation (Altschul 1989; Altschul et al. 2004; Cushman and Sebastian 2008). Its goal is to streamline the process for complying with historic preservation regulations using predictive locational and significance models. Predictive models have been used in US archaeology since the 1970s and are now inextricably linked to GIS.

Significance models represent a much more recent innovation (Cushman and Sebastian 2008). Significance models are sets of rules devised to assign groups of similar sites to categories defined to meet an installation’s management needs. The use of significance models is based on recognition that many archaeologists evaluate a site’s significance based on an assessment of its research potential (e.g., the presence of intact cultural strata, features, abundant artifacts, dateable materials) and condition rather than on using historic contexts as described in *National Register Bulletin No. 36* (Little et al. 2000). Use of predictive and significance models could allow the DoD to avoid many of the costs associated with evaluating its huge inventory of archaeological sites on a case-by-case basis while simultaneously improving the management of archaeological resources. The categories developed by a significance model could be used as sampling strata or figure into a system for prioritizing sites using one or more criteria.

Table 2. Variables used as sampling strata and criteria for prioritizing sites.

		Methods			
Criteria:	**Subcriteria**	**Pennsylvania Watershed**	**ATMAS 1.0**	**ATMAS 2.0**	**New Mexico**
Environmental Division		Yes			Yes
Periods					Yes
Site Types		Yes			
Information Potential	Period		Yes	Yes	
	Previous Impacts		Yes	Yes	
	% Disturbed			Yes	
	Physiography				Yes
	LCTA Data		Yes		
	Site Types		Yes	Yes	Yes
	NRHP Status			Yes	

Criteria:	Subcriteria	Methods: Pennsylvania Watershed	ATMAS 1.0	ATMAS 2.0	New Mexico
	Site Area			Yes	
	Subsurface Deposits			Yes	
Native Amer. Relevance	Burials, Mounds		Yes		
Risk of Future Impacts	Training Area Data			Yes	
Disturbance, Previous Impacts					To delete sites
NRHP Status					To delete non-E/PE

E= Eligible; PE = potentially eligible

Discussion of Strategy Development

CRMs at military installations who are considering developing their own strategy for prioritizing sites and/or selecting a sample of sites for LTM may benefit from considering the following questions and suggestions.

Why develop a strategy?

The possibility of future budget cuts is a reasonable concern, given the state of the national economy. Military training is almost certain to continue, even in situations where CRM capabilities are diminished. Managing a representative sample of an installation’s resources effectively may be preferable to managing all of them poorly. If some resources must suffer, most managers would prefer it be those already in poor condition, and perhaps, those that appear to be redundant, and/or those with intrinsically lower research potential and relevance to stakeholders. If managers choose to protect the “best” or abandon the “worst” sites (however those may be defined), they obviously need a strategy for prioritizing the sites. If one thinks it is best to protect a representative sample, then one needs to decide on sampling strata, a feasible sample size, and a strategy for sorting sites into the chosen categories.

The purpose of this PWTB is to urge CR managers to consider viable strategies for responsibly managing archaeological resources under possible future conditions of substantially decreased funding. It is beyond this document’s scope to develop detailed guidance on how an approach could be implemented. However, 36 CFR 800.14 provides guidance on how an agency can develop alternative procedures for complying with Section 106:

> “An agency official may develop procedures to implement section 106 and substitute them for all or part of subpart B of this part if they are consistent with the Council's regulations pursuant to section 110(a)(2)(E) of the act.”

> “The agency official shall consult with the Council, the National Conference of State Historic Preservation Officers or individual SHPO/THPOs, as appropriate and Indian tribes and Native Hawaiian organizations, as specified in paragraph (f) of this section…”

What are your objectives?

Developing a plan should begin with clear objectives. A few likely options are identified here.

Reduce the level of management to what is possible given the available budget.

Rather than lose essential staff, managers may prefer to cut “non-essential” activities such as contracts for archaeological survey and NRHP site evaluations. Some would consider systematic site monitoring to be non-essential, but if program cuts are deep, then coordinating with the training community, and educating military personnel who are new to the installation and site monitoring may be the most effective ways to protect sites.

If funding cuts reduce but do not halt survey and testing programs, one may try to use those efforts to achieve a more representative sample of sites. This could not be done over a brief interval, providing another motivation to take stock of the installation’s site inventory sooner rather than later. Survey could be focused on areas that have not previously been adequately sampled. National Register eligibility evaluations could focus on sites related to underrepresented areas, environmental settings, types, or periods. Some funds might be shifted from survey and evaluation to baseline monitoring in order to collect the data on site condition needed to permit sites to be prioritized.

Identify a representative sample of sites or components.

Several different variables were used as primary sampling strata in the approaches that were summarized in Table 2. Environmental divisions and time periods were used in the New Mexico study. These variables are logical choices, consistent with archaeology's traditional focus on cultural variability across time and space. Many archaeologists would choose to stratify the environment by using factors relevant to past settlement and subsistence practices. It might seem intuitively logical to use soil types or landform variables, but it is important to first demonstrate that they are correlated with site distribution and ideally, with site types, periods, etc. For all strata, one should attempt to identify and mitigate sampling biases (e.g., environmental zones where relatively little survey has been done). Using values recorded on older site forms or that were entered into databases without careful scrutiny is certain to introduce at least some inconsistency. GIS makes it possible, but certainly far from effortless, to identify environmental divisions that may correlate with site distributions.

Consider Possible Biases

Culture-historical periods and phases already exist throughout the United States, although they vary greatly in specificity. The results of survey and site evaluation work at many installations have contributed significantly to some regional chronologies. Some installations are nevertheless located in areas that were marginal to prehistoric culture centers, and established culture-historical units may be less applicable.

Various biases complicate the use of temporal divisions as sampling strata. Often the temporal divisions represent different lengths of time, and one may need to adjust for this factor when deciding on sample sizes. Important changes in site distribution could occur within established periods but may currently not be recognizable based on changes in diagnostic artifacts and assemblage composition.

Site formation processes may create significant biases in the frequency of diagnostic artifacts. Ceramic vessels break into dozens or hundreds of sherds, any one of which may be diagnostic of a temporal interval in some areas, whereas diagnostic lithic artifacts break into fewer pieces and are much more difficult to identify when fragmented. Many sites on military installations were heavily disturbed by training and other impacts that occurred prior to the implementation of historic preservation legislation. These issues are familiar to most archaeologists yet are often ignored during the normal course of site survey and evaluation work. Failing to consider such biases when selecting a sample for LTM could diminish the potential to address certain research topics in the future.

Fort Irwin's method for prioritizing sites (incorporated into ATMAS 2.0) in some ways anticipates the use of significance models (Fort Irwin DPW 2001; Appendix D of this PWTB). This method prioritizes sites in terms of information potential by assigning points on the basis of NRHP eligibility status, site type, period, integrity, presence of subsurface deposits, and size (refer to Table 2). Individuals would undoubtedly have different ideas about which of these factors are most important. While at some risk of becoming too complex, the approach could easily incorporate a capability for weighting the criteria. The distribution of point totals may well be polymodal, and installation archaeologists may already have developed an impression or even a sophisticated understanding of where the sites that comprise various modes tend to occur on the landscape. On balance, one can see how a weighted point system could be used to develop a significance model.

Prioritizations, categorizations, and all such schemes are only as good as the data they are based on. Some approaches discussed here (e.g., ATMAS and the New Mexico plan) include provisions to ensure that variables and their values are clearly defined so that they can be used consistently by many different individuals. It is likely that all of the other approaches have also addressed this issue, at least in terms of recent and future data recordation. Inconsistent use of terms (e.g., culture-historical units, artifact categories and formal types, physiographic units) occurs throughout many older site forms and reports; moreover, the inconsistency impact lingers after such data have been entered into databases. Archaeologists are well aware of these issues, but the issues do warrant close consideration when one makes "life or death" (i.e., preservation or delisting) decisions about how sites will be managed.

Consider Sample Size

CRMs should have a thoughtful answer to the question "How many sites do you *really* need to protect?" Decisions about the number of sites to be included in a sample for LTM can be based on a number of considerations. These considerations should include the size of the management area, number of documented sites, estimated number of undocumented sites, amount and nature of diversity in the site inventory, number and size of relevant sampling strata, nature of current and future training impacts, current and projected funding levels, and goals for reducing the need for site avoidance. Many managers might add regional research questions to this list, but these questions would be less important in a management strategy that includes the use of significance models.

Use Multi-Stage Approach

A multi-stage process should be used when identifying a sample of sites for LTM (Table 3). The sites should first be sorted into groups based on the primary sampling strata (environmental and temporal divisions, possibly site type). Sites are likely to vary widely in terms of previous impacts, artifact density, previously recovered artifact samples, the quality of contextual information, and so forth. In the second stage of sample selection, those variables will be used to identify sites that most warrant preservation. Installations may find that what initially appeared to be a large inventory of worthy sites is much diminished after sites are screened using relevant criteria. There may simply not be enough sites in many categories to permit random sampling. Supplementing the available sample by identifying “better” candidates may be possible only when one has the luxuries of time and funds.

Table 3. Steps in developing a management approach based on using models to predict site location and site significance, and LTM of a representative sample of sites.

Step	Action
1.	**Consult with installation management, the SHPO, ACHP, and stakeholders** about the pros and cons of adopting an alternative approach to the LTM of archaeological resources.
2.	**Work with the training community** to understand their current and projected land needs.
3.	**Develop and validate or refine the installation’s existing predictive model of site location.**

Step	Action
4.	**Develop site type categories based on multiple criteria**: e.g., site setting, condition and integrity, time period and culture historical unit, artifact assemblage, estimated feature assemblage, site function in past settlement and subsistence systems, possibility of Native American burials, other characteristics of special relevant to Native Americans and other stakeholders, etc.
5.	**Assign sites to initial site type categories.**
6.	**Evaluate the reliability of the site categories** using pedestrian survey, small-scale excavations, and results of previous NRHP eligibility studies.
7.	**Refine the site categories.**
8.	**Assign sites to refined categories.**
9.	**Identify site categories that are over-represented and under-represented.**
10.	**Conduct surveys to locate additional sites** for the underrepresented types.
11.	**Develop the significance model.** The model will entail a set of criteria for categorizing sites in terms of integrity and research value. Decisions about management strategy will be made using those criteria.
12.	**Use the significance model to identify sites that will be treated as eligible for the NRHP.**
13.	**Develop a stratified random sampling approach** to choose a representative sample of sites for LTM.
14.	**Periodically update** the predictive model, review the site categories, refine the significance model, and where possible, add sites to the sample to offset the need to impact others of the same type.

Step	Action
15.	**Periodically consult with stakeholders** to determine if the approach is consistent with their needs, relevant laws, and regulations.
16.	**Military training would be allowed on sites not included in the LTM sample.**

Assess Potential to Protect Sites

Our discussion has focused strongly on selecting a sample of sites for LTM based primarily on archaeological variables. All of the variables discussed have been used in many previous studies and are familiar to archaeologists. Also important are variables such as soil depth, vegetation, slope, and drainage that influence the likelihood and intensity of training impacts on a site’s archaeological deposits. In the future, it may be possible to develop an index of site vulnerability that would allow one to quantify the feasibility of protecting particular sites. Such an index would help reduce an important uncertainty — the potential to offer long-term protection of the sites selected.

Regulatory Hurdles

Implementing a CRM approach that is based on the use of significance models and/or managing a representative sample of sites would require consultation with the SHPO, probably the ACHP, the installation Commander and management hierarchy, and other relevant stakeholders. But such an approach would not represent a huge change from the current approach. As explained above, many archaeologists don’t really rely on historic contexts to establish significance. Sites that have integrity, chronological indicators, and defined boundaries are likely to be sources of important information about some aspect of history or prehistory. Of course, it would be preferable to make management decisions on a site-by-site basis, but that may not be possible if budgets are cut in the future.

Opportunities for Benefits

Making management decisions about groups of very similar sites would create opportunities for cost avoidance (only a sample of sites would be managed), streamline the evaluation process (installations would not attempt to conduct NRHP eligibility evaluations of every potentially eligible site), and create opportunities to open additional acreage for training (the goal of opening up large tracts for training would be an explicit goal of the sample selection process). These multiple benefits appear to argue for a closer consideration of the pros and cons of this alternative approach.

Would an alternative approach like the one outlined here cost more? It would be necessary to have a well-designed predictive model, and that might be a one-time cost for installations. To offset that one-time cost, however, great opportunities for long-term cost savings would come from no longer attempting to manage 100% of the installation’s sites. In addition, funds that would have been used to evaluate the NRHP eligibility status of sites could be diverted initially to smaller-scale excavations to assess the reliability of predictions made using the significance model. The most likely problems would occur if sites included in the sample for LTM were found to have less integrity than thought.

Managers could also be troubled by situations where sites with integrity and research value that were not selected for inclusion in the sample for LTM were later damaged by military training. Adopting an alternative approach to CRM based on LTM of a representative sample will require managers to recognize that not all worthy sites can be protected. Managers may have to decide to manage a sample of sites well rather than attempting to manage all of the sites poorly due to inadequate funding or other resource shortages.

Finally, installations could adopt some but not all of the changes discussed here. Managers also could select a representative sample of sites for LTM by using the currently accepted approach to evaluating NRHP eligibility. Sites not included in the sample could be made available to training without the usual NRHP eligibility evaluation. If installation CRMs, SHPO personnel, and other stakeholders discuss these options before funding cuts create an emergency, this PWTB will have achieved its purpose.

APPENDIX H:

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APPENDIX I:

ABBREVIATIONS

Abbreviation	Spelled Out
ACHP	Advisory Council on Historic Preservation
APE	area of potential effects
AR	Army Regulation
ATMAS	automated tool for monitoring architectural sites
CECW	Directorate of Civil Works, U. S. Army Corps of Engineers
CEMP	Directorate of Military Programs, U. S. Army Corps of Engineers
CERL	Construction Engineering Research Laboratory
CFR	Code of the Federal Regulations
CONUS	Continental United States
CRM	cultural resource manager or management
DPW	Directorate of Public Works
DoD	Department of Defense
ERDC	Engineer Research and Development Center
ESTCP	Environmental Secuirty Technoogy Certification Program
FICARD	Fort Irwin Cultural Assessment Resource Database
HQUSACE	Headquarters, US Army Corps of Engineers
LCTH	Land Condition Trend Analysis
LD	legal driver
LTM	long-term management
NAGPRA	Native American Graves Protection and Repatriation Act
NCDOT	North Carolina Department of Transportation
NEPA	National Environmenal Policy Act
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
PHMC	Pennsylvania Historical and Museum Commission
POC	point of contact
PWTB	Public Works Technical Bulletin
RSU	regional sampling unit
SHPO	State Historic Preservation Officer
US	United States
U.S.C.	United States Code