



Department of Defense Legacy Resource Management Program

PROJECT NUMBER 13-711

Evaluating a Cooperative Approach to the Management of Digital Archaeological Data

Sara Rivers Cofield and Jodi Reeves Flores

December 2014

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Sara Rivers Cofield
Curator of Federal Collections
Maryland Archaeological
Conservation Laboratory, Jefferson
Patterson Park and Museum

Jodi Reeves Flores
Digital Curator, Center for Digital
Antiquity
Council for Library and Information
Resources/ Digital Library
Federation Fellow

Additional Contributors

Francis P. McManamon
Executive Director, Digital Antiquity

Adam Brin
Director of Technology, Digital Antiquity

Grant Snitker
Digital Curator, Digital Antiquity

Chelsea Walter
Digital Curator, Digital Antiquity

Michael A. Smolek
Cultural Resource Manager
Naval Air Station Patuxent River

Amanda Vtipil
Curator of Education
U.S. Army's Women's Museum

December 31, 2014

Abstract

The Department of Defense (DoD) needs efficient access to data from past archaeological investigations at its installations in order to avoid sudden, unpredicted site discoveries that delay mission-oriented activities, programs, and projects. The ECAMDAR project is a test case designed to evaluate whether and how an online repository for digital archaeological and cultural resource management (CRM) data and information developed and managed by the Center for Digital Antiquity (Digital Antiquity) can fulfill this need. Digital Antiquity's online repository is tDAR (the Digital Archaeological Record).

With funding from Defense Legacy, digital files from archaeological projects at 23 DoD installations in Maryland and Virginia have been uploaded to tDAR, which is accessible through the tDAR website via the internet. This study finds that through tDAR, Digital Antiquity is able to ensure long-term preservation and accessibility of digital archaeological records while maintaining security by enabling DoD CRM officials to control and limit access to sensitive files. As files were uploaded for this project, DA-tDAR worked with physical archaeological collections repositories to develop procedures that address the backlog of digital files that are held locally at the repositories, but not currently in a viable long-term digital archive. These procedures may be applied to other DoD installations with pre-existing digital records. It is also important for current and new archaeological projects that the digital files created are placed in a digital archaeological data repository so that no further backlog of digital data develops. We suggest tDAR for this purpose.

This project demonstrates that it is more cost effective for the DoD to pay one-time fees for uploading of digital files to Digital Antiquity than it would be for the DoD to establish and maintain individual specialized departments or staff for the management of digital archaeological data at the installation or regional level. Finally, this study finds that the DoD should consider partnership with Digital Antiquity for the preservation and management of digital files generated by current and future archaeological projects.

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1. Introduction

Sara Rivers Cofield

1.1 Project Summary

There is currently no system at the DoD Service or Command levels for preserving and disseminating digital data generated by archaeological work on military installations. Essential documentation of archaeological investigations such as surveys and excavations increasingly are created and stored in digital form only. Digital files are vulnerable to corruption, hardware failure, and format obsolescence if they are not properly maintained, preserved, and migrated. This is a problem because the DoD's considerable past and ongoing investment in managing its archaeological resources is at risk. Without proper management and long-term accessibility and preservation of digital data, the results of expensive archaeological work may be lost altogether, wasting money and leaving installations unable to factor significant archaeological resources into their activities, developments, and training plans. This project explores a possible solution to the problem.

The Digital Archaeological Record (tDAR) is an international digital repository for the records related to archaeological investigations and resources, as well as other CRM data and information. tDAR's use, development, and maintenance are governed by the Center for Digital Antiquity (Digital Antiquity), an organization dedicated to ensuring the long-term preservation of irreplaceable archaeological data, broadening access to these data and encouraging the appropriate use of these data to learn about the past and manage archaeological resources effectively. Digital Antiquity (<http://www.digitalantiquity.org/>) is part of Arizona State University (ASU). Digital Antiquity is designated as a university center so that ASU provides administrative, legal, and high-level supervisory support for the Center's activities. In addition, Digital Antiquity also has a Board of Directors, independent of the university administration, which is composed of well-respected archaeologists representing a number of institutions (the University of Arkansas, ASU, the Pennsylvania State University, Statistical Research, Inc., Washington State University, the University of York Archaeology Data Service), as well as experts in digital library information management, not-for-profit organization management, intellectual property law, and finances. Digital Antiquity's business plan and operating methods are explicitly designed to ensure the long-term financial, technical, and organizational sustainability of tDAR.

The purpose of the ECAMDAR project is to evaluate Digital Antiquity as a potential partner for the management of all of the DoD's digital archaeological records and tDAR as an appropriate repository to meet the needs of the DoD. While the study does not look at digital files from installations nationwide, it does adopt a regional approach through the inclusion of data from two archaeological repositories: the Maryland Archaeological Conservation

Laboratory (MAC Lab) at Jefferson Patterson Park and Museum (JPPM), and the Regional Archaeological Curation Facility (RACF) at Fort Lee. Together, the MAC Lab and the RACF curate collections from 25 DoD installations, and the cultural resource officers responsible for these installations all supported the inclusion of their digital archaeological data in the project (Table 1).

Table 1: Participating installations from the Maryland Archaeological Conservation Laboratory (MAC Lab) collections and the Regional Archaeological Curation Facility (RACF) collections. Two of the 25 installations had no digital records whatsoever, so only 23 of the installations were able to contribute to the ECAMDAR project.

Repository	Installation	Data (nearest MB) Submitted	Approx. # Files Submitted	Point of Contact
MAC Lab	Naval Air Station Patuxent River	1229	2327	Michael Smolek
MAC Lab	Naval Air Station Patuxent River, Webster Field Annex	1462	1202	Michael Smolek
MAC Lab	Point Lookout	1286	224	Michael Smolek
MAC Lab	Bloodsworth Island	1	6	Michael Smolek
MAC Lab	Solomons Naval Recreation Center	276	111	Michael Smolek
MAC Lab	Naval Support Facility, Indian Head	145	425	Thomas Wright
MAC Lab	Naval Observatory	74	43	Julie Darsie
MAC Lab	Potomac Annex	10	37	Julie Darsie
MAC Lab	Washington Navy Yard	354	93	Julie Darsie
MAC Lab	Joint Base Anacostia Bolling	790	346	Julie Darsie
MAC Lab	Nebraska Avenue Complex	126	61	Julie Darsie
MAC Lab	Walter Reed National Military Medical Center	121	67	Julie Darsie
MAC Lab	U.S. Naval Academy	394	217	Kimberly Hickey
MAC Lab	USNA Dairy Farm	177	64	Kimberly Hickey
MAC Lab	North Severn	386	124	Kimberly Hickey
MAC Lab	U.S. Army Garrison Aberdeen Proving Ground	1666	1625	Mark Gallihue
MAC Lab	U.S. Army Garrison Adelphi Laboratory Center	934	638	Jim Krake
MAC Lab	Fort George G. Meade	1448	1003	Jerry Glodek
MAC Lab	Fort Detrick	20	30	Alfred Lynn Hoch
RACF	Fort Lee	1331	665	Amy Wood
RACF	Fort Monroe	1745	146	Amy Wood
RACF	Fort Eustis	N/A	N/A	N/A
RACF	Quantico Marine Corps Base	862	516	Kate Roberts
RACF	Dahlgren Naval Support Facility	N/A	N/A	N/A
RACF	Fort A.P. Hill	7813	1653	John Mullins

Determining whether Digital Antiquity would be an appropriate partner and tDAR a good tool for DoD-wide management of archaeological digital records requires the consideration of four important questions:

- 1) How would partnership with Digital Antiquity using tDAR support the DoD’s military mission?
- 2) What are the potential security risks in using tDAR, and can these risks be mitigated?

- 3) Is the use of tDAR cost effective?
- 4) Why should the DoD create a partnership with Digital Antiquity and use tDAR instead of its own internal information technology (IT) resources and staff?

The following sections of this report summarize the project background, methods, and results, including the results of a survey conducted to solicit comments from participating installation points of contact. Case studies drawn from the experiences of archaeological curators, Digital Antiquity staff, and installation points of contact will appear throughout the report to illustrate key points.

The results of the project suggest that using tDAR as a digital archaeological archive is a cost effective and secure method of preserving DoD digital archeological records. Furthermore, tDAR offers a level of access to archaeological records for installation CRM staff that traditional curation cannot provide, and this ease of access is generally not allowed or desirable for internal DoD computer systems. Fast, secure access to archaeological records facilitates efficient planning and impact-assessment for mission-oriented activities, projects, and construction that could impact archaeological resources.

Because the current project argues that Digital Antiquity is an organization that the DOD as a whole should consider using for archaeological data management and preservation, this report draws from its findings to develop language and templates that may facilitate the adoption of Digital Antiquity's services, such as:

- 1) **Justification for services:** Explanation of the services and the laws requiring such services. This justification may be needed to facilitate the procurement process.
- 2) **Language for scopes of work:** Standardized language can be included in scopes of work for archaeological projects to ensure that the digital records generated are addressed.
- 3) **Sample fees:** Digital Antiquity has a fee schedule in place and can offer quotes for addressing existing digital data, uploading files from new projects, and a variety of other digital curation services.
- 4) **Logistics:** Procurement procedures vary by installation, so logistical possibilities are described for the inclusion of digital archiving in CRM SOWs, curatorial repository SOWs, or directly between client installations and Digital Antiquity.

The suggested language developed as part of the ECAMDAR project is included in appendices where it can be copied for use in developing new policies that will ensure the protection and availability of archaeological data generated by the DoD.

1.2 Authorship

The ECAMDAR project has been a team effort, but since the team includes both repositories and installation PoCs who tested tDAR, as well as the tDAR staff being tested, it is necessary to

clarify authorship throughout this report to make it clear that the findings are not simple self-promotion on tDAR's part.

The primary leads initiating the ECAMDAR project were Sara Rivers Cofield, Curator of Federal Collections at the MAC Lab, and Amanda Vtipil, a Versar, Inc. employee contracted with Ft. Lee to act as the Curator for the RACF. Not long after the ECAMDAR project was funded, Vtipil changed positions, so her contributions were primarily limited to the project preparation. In her stead, Amy Wood became the contact for the RACF as the Ft. Lee Cultural Resource Manager. Wood also changed positions in October 2014, however, so Rivers Cofield acted as the author of the report on behalf of both of the curation repositories.

Points of contact from the participating installations contributed to the ECAMDAR project by working with Digital Antiquity and their curatorial repositories to provide background information and feedback through surveys, e-mails, and phone conversations. Their point of view is therefore incorporated throughout the report.

Finally, Digital Curator Jodi Reeves Flores acted as the lead for the ECAMDAR project on behalf of Digital Antiquity, and is a lead author on this report along with Rivers Cofield. By necessity, the portions of this report relating to Digital Antiquity and tDAR as an organization, the technical foundation of tDAR's work, and the operational details of how tDAR took in the DoD data included in this project, were all authored by Reeves Flores with input from Digital Antiquity's Executive Director, Francis P. McManamon and tDAR's Director of Technology, Adam Brin.

The different authors are listed for each section to clarify the point of view presented (curator/installation vs. Digital Antiquity). However, as the report will make clear, even the people responsible for evaluating tDAR approached this project with optimism and the assumption that using tDAR would probably be a good idea. There was always a possibility that tDAR would not live up to expectations, so critical analysis was applied throughout the experiment, but ultimately, tDAR was adaptable enough to address any criticisms. All sections of the report therefore reflect a pro-tDAR point of view regardless of the author.

2. Background

2.1 Defining the Problem -Sara Rivers Cofield

Archaeology performed by the DoD to comply with laws and regulations results in the need to curate physical artifacts uncovered during excavation, related paper documents and records, and digital data and files that record the site (DoD 2005: Appendix A). Documentation is essential because excavation is destructive. It cannot be redone if the original descriptive documents and analytical results for an archaeological project are lost. Without both artifacts and documentation, the contextual information needed to interpret the site, undertake further study, and make collections meaningful is lost.

For example, archaeologists take photos of excavations to record soil layers and features that are destroyed by the act of excavation (Figure 1). The data captured in these images is essential for understanding a site. Recent years have seen a decline in film photography that produces archival-quality, paper-based, photo printing. Instead, archaeological photos increasingly exist in digital form only, making it imperative that careful digital data management be provided in order to prevent the loss of information about archaeological sites. This information has been collected for the public benefit at great expense to the DoD.

Similar problems exist for digital files such as artifact inventories, reports, and maps. The software used to generate these files and the hardware used to store the files becomes obsolete as rapid changes in technology take place. Professional digital archiving practices and procedures that ensure the long-term preservation of digital documents, data sets, images, etc., such as the use of appropriate standardized file formats, are needed to avoid technological stagnation and information loss. Old files must be diligently migrated and automatically and systematically monitored to detect and remove obsolescence and corruption. As the influx of digital files swells, and the files themselves age, the need for professional and dedicated digital archivists becomes imperative.

The proportion of archaeological records in digital form is already substantial and is increasing exponentially (Figure 2). Some of the records of contemporary archaeological and CRM investigations, e.g., geospatial data sets (GIS and GPS data) and artifact or landscape (LiDAR) scan files, exist only in digital formats. Curatorial studies may also result in files that are exclusively digital, such as 3D scans. For example, the Virtual Curation Laboratory at Virginia Commonwealth University is a 3D scanning project that generated enormous digital files using Defense Legacy Program funds (Haynes and Means 2011; Means 2013). Just as artifacts need

a physical repository, the 'virtual' artifacts created through this effort will need a digital repository in order to be viable long-term.



Figure 1: Excavation of archaeological sites is destructive. As part of excavation, soil layers are removed along with evidence of human habitation such as post holes, storage pits, and artifact clusters. Archaeologists therefore document each step of excavation with maps, drawings, and photos of the soil differences exposed. Soil profiles (top) show differences in color indicative of features where human hands have altered the landscape. As sites are excavated, photos are taken to show the exposed features, the extent of excavation (bottom left), and *in situ* placement of notable artifacts (bottom right). Images such as these, taken during the VXX helipad project (see Case Study 6), are all that remains of sites that are later impacted by development, and these images exist only in digital form.

Digital Records Submitted to the MAC Lab 1995-2012

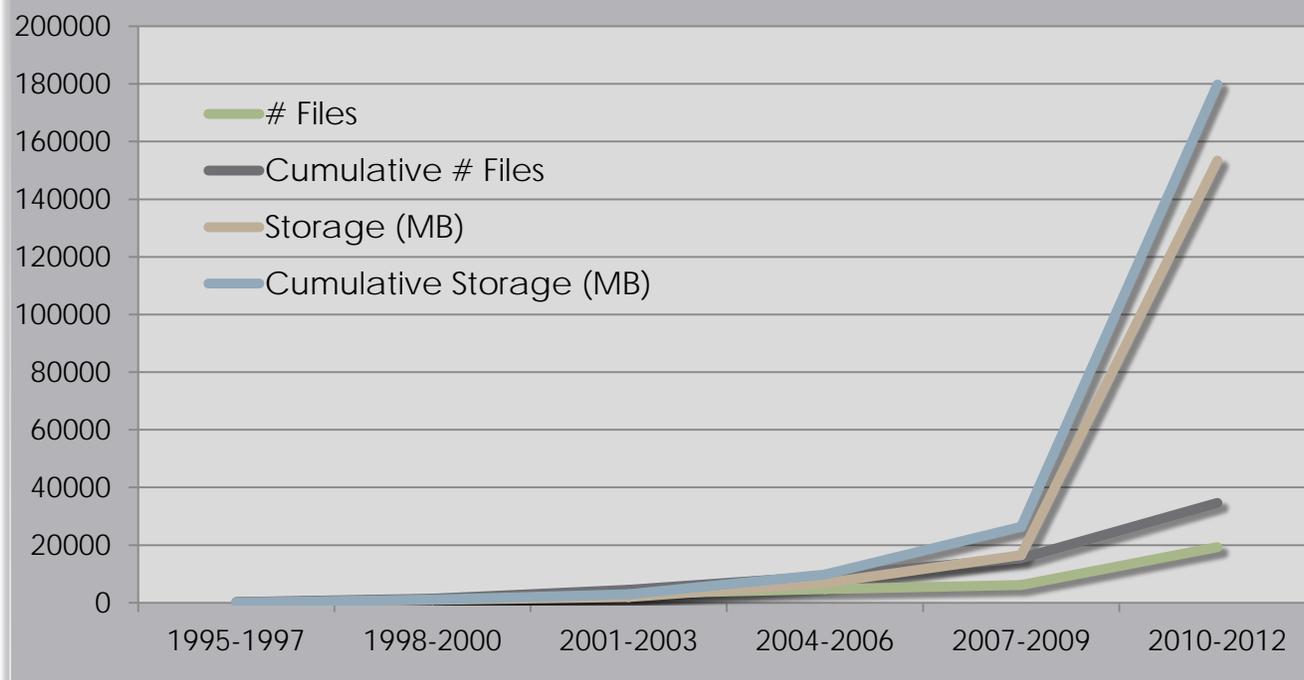


Figure 2: Total digital records submitted to the MAC Lab from 1995-2012. Recent years have seen a dramatic increase both in the number of files submitted and in the storage space needed to keep them.

Federal regulations, in particular, but not exclusively, 36CFR§79, require that archaeological collections, including artifacts and associated digital and paper records, must be properly curated and preserved to ensure that the public interest in cultural resources is protected even if sites are destroyed by DoD activities. A legal review conducted by Cultural Heritage Partners, PLLC (2012) found that the laws that mandate archaeology and the curation of resulting collections apply to digital records and mandate that these records be accessible and preserved in perpetuity (Appendix A, Part 2).

Previous Defense Legacy projects have generated recommendations for processing DoD archaeological collections, including electronic media, and the guidance offered would ensure the long-term preservation of data (Griset and Kodack 1999; Sagebiel et al. 2010). However, in the short-term it is not necessarily the case that curatorial repositories are capable of fulfilling the suggested requirements, and in the long-term the processing recommendations are unlikely to remain relevant as technology changes.

In 1999, Griset and Kodack (1999:62-67) said that electronic media should be stabilized and organized for accessibility. Emphasis was placed on ensuring that files could open without errors or viruses and that storage media (especially CDs) were properly labeled. Ultimately,

however, Griset and Kodack (1999:67) argued that digital data is not permanent, it cannot replace “original” documentation, and it should be viewed as a convenience for access, not as a long-term solution for data storage. Instead, hard copies of all digital files must be printed and retained as a more stable record. That recommendation was made before the exponential increase in the use of digital media that has occurred over the past 10 years. More recently, Sagebiel et al. (2010) expanded on Griset and Kodack’s (1999) guidelines by offering more detail about how to preserve electronic media (Figure 3). Hard copies are still emphasized as a necessary accompaniment to the digital files, but there is also more information about data management.

Electronic media

- Should be checked for viruses and errors.
- Both an electronic and hard copy should be made.
- Hard copies of all files should be made on acid free paper and labeled with the number of the corresponding electronic media, file name, and the software used.
- Magnetic media such as diskettes, floppy disks, hard drives, DAT, and similar tapes are susceptible to magnetic fields, static, dust, and humidity. Optical media (CDs and the like) are more stable.
- Do not use rewritable disks.
- Electronic media should be numbered, labeled directly, and further described in the catalog or finding aid.
- Do not use stickers to label disks, use pens designed specifically for labeling disks.
- For each electronic file, record the format, version of the software used, date of creation, creator’s name, file relations, and database structure and related scripts or macros (Sullivan and Childs 2003:37–38).
- The type of software used should be carefully considered for compatibility and long-term utility (Sullivan and Childs 2003:37–38).
- Electronic files will need to be transferred to new media periodically. Most have only a 10-year life span because of hard and software compatibility issues.
- Document each transfer or update (Sullivan and Childs 2003:37–38).
- Use publicly defined file formats rather than proprietary formats. For example, do not use Word’s Doc format but RTF or uncompressed TIFF format (Childs and Corcoran 2000, www.nps.gov/history/archeology/collections/Field_02.htm; Eiteljorg 2004).
- Do not embed files such as photographic files within a text file because that complicates data migration (Eiteljorg 2004).
- Avoid using glossy or compressed formats for photographic files (Childs and Corcoran 2000 www.nps.gov/history/archeology/collections/Field_02.htm).
- Disks should be placed in polypropylene containers.
- Corrosion Intercept® pollutant scavenger inserts may be added to protect CDs from gases and fumes in the environment (Brady et al. 2006 http://www.sha.org/research_resources/conservation_faqs/curation.cfm).
- Should be stored in a cool, dry, environment with 20–30% humidity.
- A good resource is the Library of Congress’s “Digital Preservation” webpage (<http://www.digitalpreservation.gov/>).

Figure 3: Extract from Sagebiel et al. (2010: 36) listing the recommended preventive conservation techniques for preserving and storing archaeological data on electronic media.

While the bullet points outlined by Sagebiel et al. (2010: 36) for preserving digital data are valid, their implementation is problematic. Some of the points summarize essential processes that are much more complex and difficult in practice than the list suggests. For example, the report says that electronic media, “should be checked for viruses and errors,” and, “electronic files need to be transferred to new media periodically” (Sagebiel et al. 2010:36). Both statements are absolutely true, but ongoing assessments of file viability and periodic upgrades require specialized IT skills. Curators could open each file manually, check the CDs, migrate formats as needed, and copy to new CDs in case the old ones deteriorate, but the work would increase exponentially with each new collection acquired. Such rigorous data monitoring would require dedicated digital curators and well-supported technological infrastructure; assets that archaeological repositories are unlikely to have. As Wendy Bustard (2000:12), a Curator for Chaco Culture National Historical Park, pointed out in 2000, “Migrating data files to new media every five years or so is a worthy goal, but one that may not be realistic, given other curatorial concerns and crises.”

Other parts of the guidelines are subject to rapid change. Even though Sagebiel et al.’s (2010:36) recommendations are only four years old, data storage has already changed dramatically as CDs have largely been replaced by flash drives and “cloud” storage has entered the mainstream. Formats can become obsolete within a few years, software may not prove to have long-term viability no matter how carefully chosen, and the ease with which files are migrated is subject to change as technology changes. Like many curators, Bustard expressed an interest in having national standards for migration, verification, and preservation of digital media, but at the same time she acknowledged that, “The media change so quickly that long-term preservation studies are non-existent and would be largely irrelevant” (Bustard 2000:12). In short, digital technology is a dynamic force that will not be predictable in the same way that archival bags and tags are predictable, so guidelines for digital data management will require revision much more often than other curatorial standards.

This is undoubtedly why archaeologists and collections managers rely heavily on having a hard copy of everything. Acid-free paper is a known quantity, it is stable, and it is something curators can predictably preserve. However, reliance on hard copies is problematic as well. The long-term stability of printed records depends on the quality of the printer and ink, which can vary greatly and is difficult to regulate. More importantly, however, digital files are undeniably “original” records of excavations, not just convenient formats for access. Photography is almost exclusively digital, reports and figures are computer-generated, and field forms are increasingly created using portable tablets. In other words, hard copies are not necessarily the original documents anymore, and in an increasingly paperless society, they are unlikely to make a big comeback in the near future.

As early as 1997, Federal courts ruled that e-mails preserved by the National Archives and Records Administration (NARA) in accordance with Federal law could not just be kept as hard copies. Instead the ruling stated that, “electronic communications are rarely identical to their paper counterparts; they are records unique and distinct from printed versions of the same record” (quoted in Chittenden 1998:17). The preservation of the integrity of a digital file therefore must include the maintenance of its functionality as an electronic document. This means that the long-term viability of original digital records is a concern regardless of whether or not a hard copy is made.

Unfortunately, curatorial repositories built and staffed for the preservation of physical archaeological collections are not equipped with full-time experts in IT or the professional procedures and practices needed to ensure that digital information is preserved and remains useful (Case Study #1). Digital files require different kinds of care and procedures than physical collections to ensure that they are properly preserved and accessible for appropriate uses (Table 2). The nature of digital curation is not necessarily more complicated or expensive than physical collections, but it is specialized and the DoD needs to take affirmative steps to ensure that the archaeological data about their resources and from their projects are deposited in an archive or repository where the expert care, principles, standards, and techniques of digital curation are followed.

The two repositories participating in this project, the MAC Lab and RACF, represent leading professional standards in archaeological curation. Both boast relatively new construction of facilities designed for the needs of artifacts and paper records. Neither, however, has a digital archivist on staff. At the MAC Lab, digital records are copied to a local area network by accession number and they are also stored on archival CDs. All files are backed up on tapes which have daily, weekly, and monthly back-up cycles. The data is therefore protected from immediate loss if the network crashes. However, this system does nothing to check files for corruption, nor are files migrated to new standard file types as the software used to produce them becomes obsolete. It is not uncommon to find that when old digital files are needed for research, they no longer open. The existing system does not provide an easy means of sharing the data, even with the installations that are responsible for the resources from which the data are derived.

The RACF recently amended collections standards to require depositors to submit electronic copies of all associated documents (RACF 2012). This has greatly increased the number of digital records housed at the facility. Currently all digital files are copied to a 1TB external hard drive, a policy that resulted in part from the problem of relying on the stability of CDs as a storage medium (Case Study #2). Use of the external hard drive is limited to non-networked computers though, because the use of USB connections is not authorized on computers on Ft. Lee’s network. Subsequently, access to and sharing of the digital records is limited. The information contained on the external hard drive is backed up on CDs which are stored at an

off-site location. Similar to MAC Lab practices, files are not regularly migrated or checked for corruption.

CASE STUDY #1
Curation Desperation

Sara Rivers Cofield
Curator of Federal Collections
Maryland Archaeological Conservation Laboratory

Many years ago I inherited an ex-employee's drawer full of 3.5" floppy disks because they contained the working files for a number of archaeological projects on Navy property. As the Curator of Federal Collections, it was my responsibility to ensure that all documentation of the Navy projects would be preserved in-perpetuity. So before our last computer with a 3.5" floppy drive died, I uploaded the contents of all of the disks to our server.

Unfortunately, it was already impossible to open many of the files because we no longer had the software programs that generated them. Additionally, sometimes moving the files rendered them unusable. For example, mapping programs like Surfer could no longer find the component files needed to generate the original maps. No one left any notes with the disks to indicate which files went together, and the file names were so abbreviated that they were not helpful in determining what each file was for. In frustration, I realized quickly that our facility may be "state of the art" for storage and conservation of artifacts, but we are not at all equipped to deal with digital file preservation. The skill set is totally different, and we were still operating as if film photography and paper records were the norm for site documentation.

The IT staff in our parent offices initially wanted us to clean out our old files, not understanding that we were responsible for in-perpetuity curation. Even when we made that clear, it still is not their expertise, since archiving digital records is different than general maintenance of a workplace IT system.

Eventually I discovered that the library sciences are the best resource for digital archiving, and the ideal solution would be to hire a specially trained full time digital archivist. Maryland State government has been cutting positions and budgets in recent years, however, so the outlook for getting a digital archivist is bleak. Plus, the longer we wait for the staff position, the more inundated we are with a backlog of unmanaged files. In the meantime, how could I answer a client if they asked why the records they had deposited with me were no longer viable? Still, we need to fulfill our stewardship responsibilities, so I continued to look for a solution.

I had heard of tDAR and learned that it was the best option available. My options were to either ignore the problem or seek funding to test tDAR with my Federal records. Even if the project is finite and does not address our whole facility's backlog of digital files, at least we could work with professionals to develop standards that might be adopted for the future submission of digital records. That is how this Defense Legacy project developed. By giving tDAR a try, we could do something to cover this gap in our ability to care for collections.

Table 2: Examples of the requirements for the professional preservation and management of digital data versus artifacts, paper, and photo documentation.

Requirements	Digital Data Curation	Artifact/Paper Curation
Maintain a storage facility within the collection's region or State of origin for ease of access.		✓
Monitor the storage environment for relative humidity, temperature, mold, pests, and other agents of deterioration.		✓
Recognize the deterioration of materials and seek conservation as needed.		✓
Maintain secure storage and handling methods to prevent loss from theft or artifact breakage.		✓
Offer work spaces for the physical inspection of artifacts by curators and researchers.		✓
Facilitate artifact loans and exhibits as appropriate.		✓
Address requests for repatriation in compliance with NAGPRA.		✓
Conduct periodic inventories and inspections of artifact boxes and boxes of associated paper records.		✓
Facilitate public access to collections while protecting confidential information such as site locations.	✓	✓
Regularly and systematically check digital files to ensure that no deterioration has occurred. If file deterioration is detected, take steps to remedy it.	✓	
Periodically migrate and/or refresh the digital files to provide for their long-term accessibility and preservation.	✓	
Plan for obsolete technology.	✓	
Maintain files in open and preferable formats, and accommodate new industry standards for archaeological information.	✓	
Store rich, descriptive metadata with each digital object.	✓	
Ensure that all materials deposited are properly backed up.	✓	

CASE STUDY #2 **CDs ≠ Stable Archives**

Amanda Vtipil
Curator of Education
U.S. Army's Women's Museum
(Former RACF Curator)

In the U.S. Army, CDs are the common device for digital storage, as use of USB ports is not authorized on government computers. Even before the Fort Lee Regional Archaeological Curation Facility's Collection Standards were changed in June 2012 to require the submission of digital records on archival quality CDs, the collections held there contained a large number of CDs. There was no comprehensive inventory of the digital files though and the CDs were in various states of preservation – wrapped in notebook paper, slipped into a box of artifacts, in protective cases, etc.

For this project all boxes were systematically inventoried for digital records. All digital files stored on CDs were copied to our external hard drive and backed up again on more CDs. During this process, several CDs were found to be no longer viable. Unfortunately, the information stored within these CDs is essentially lost to time. While we tend to think of CDs as relevant and safe forms of digital storage we need to recognize the danger of relying solely on them as a means of preservation in perpetuity.

According to the U.S. National Archives and Records Administration (NARA 2014):

CD/DVD experiential life expectancy is 2 to 5 years even though published life expectancies are often cited as 10 years, 25 years, or longer.... Life expectancies are statistically based; any specific medium may experience a critical failure before its life expectancy is reached. Additionally, the quality of your storage environment may increase or decrease the life expectancy of the media. We recommend testing your media at least every two years to assure your records are still readable (NARA 2014).

While CD/DVDs may last longer than 2-5 years, the NARA (2014) figures indicate that counting on the medium to last longer is a gamble. Add digital obsolescence on top of this and reliance on CDs as a media storage device is even riskier. That is why it is so important to consider other means of digital preservation like The Digital Archaeological Record (tDAR). As a field we need to recognize the need to create good records, deposit them with trusted repositories and ensure the future accessibility of these records.

Curatorial staff versed in the care of artifacts and paper records are well-suited to the long-term preservation of analog data in that they are trained to keep physical objects safe and to recognize deterioration as it arises (Figure 4). Digital media, however, shows no physical signs of decay and inexorably becomes unstable and unusable. It must be checked on a regular basis, replaced if it deteriorates, and migrated to improved standard file formats as these develop and improve information management. At present, there is no DoD-wide system for

long-term preservation and management of digital archaeological data. Federal agencies in different parts of the U.S. already have difficulty finding 36CFR§79-compliant repositories, and the requirement of digital data management standards for repository qualifications aggravates the problem (Bawaya 2007; Bustard 2000; Childs 1995, 2004; Kodack and Trimble 1993; Thompson 1999).

Fortunately, technology allows digital data to be stored, maintained, and accessed remotely, eliminating the need to develop, staff, and operate multiple local or regional repositories in order to ensure accessibility. The DoD could therefore consider using a centralized digital repository to meet its archaeological digital data management responsibilities.



Figure 4: Archaeological repositories are typically equipped to ensure proper packaging and care of artifacts (top left), and photos, and paper records (bottom left), but simply adopting archival storage for computer disks (above) is not enough to ensure the longevity of the data they contain.

2.2 Cooperative Curation -Sara Rivers Cofield

Historically, the DoD has chosen to partner with non-DOD institutions to curate its archaeological collections. Instead of looking at DoD facilities as possible repositories, the Army Corps of Engineers (USACE) has specifically evaluated non-military curation facilities throughout the country as potential partners in an effort to maximize the research value of

collections and minimize the DoD's need to focus on activities that are important, but not primary to the function of the military (Bustard 2000; Felix, et al. 2000; Langness, Marino, and Van Arsdale 2000; USACE 1999). According to the Mandatory Center of Expertise for Curation and Management of Archaeological Collections (MCX-CMAC):

Military installations or other DoD/USACE facilities were not [studied as] potential partners since these institutions' primary mission is not the long-term curation of archaeological collections; their primary function is not archaeological collections management, staff are not always available to care for the collections, and public education and use of the collections cannot always be assured. [USACE 1999:ix-x]

Upon implementation, the creation of curatorial partnerships has proven to be cost effective as well as beneficial for research (Futato 1996; Hanniball 2000; Rivers Cofield 2005). By depositing collections with universities, for example, installations can eliminate significant infrastructure and staffing costs while putting collections in locations that promote their use in conjunction with academic resources such as DNA laboratories, libraries, and faculty expertise (Futato 1996). While a potential drawback of cooperative curation is loss of control on the part of the DoD, each installation can decide to stay involved as much as they see fit through a carefully negotiated Memorandum of Understanding.

The cooperative curation model has been tested and has proven to be successful and cost-effective for the DoD's archaeological collections, so it is reasonable to expect that a similar approach could work for digital archaeological records. Just as the MCX-CMAC office evaluated curatorial repositories for physical collections (artifacts, photos, paper records), this project is designed to evaluate a repository for the digital files associated with DoD collections.

Unlike the USACE curation options projects, the ECAMDAR project is not studying a variety of repositories nationwide. Instead, only one repository— tDAR— is being evaluated. The reason for the limited scope of the ECAMDAR project is simple; tDAR is the only digital archaeological repository in the U.S. at this time. Ideally, it would be beneficial to evaluate a number of options and make recommendations, but it is too risky to let existing digital data go neglected while waiting around for more choices to present themselves, especially when a repository exists already that could work for DoD digital archaeological data nationwide.

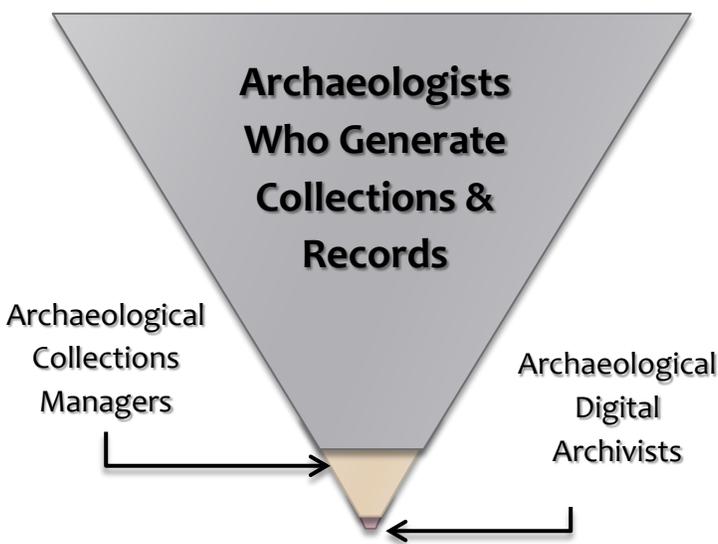
2.3 tDAR: An Option Worth Testing –Francis P. McManamon

The Digital Archaeological Record (tDAR) is an international digital archive and repository that houses data about archaeological investigations, research, resources, and scholarship. tDAR provides researchers new avenues to discover and integrate information relevant to topics they are studying. Users can search tDAR for information about digital documents, data sets, images, and other data resources. For a large percentage of these digital objects, registered users can download a copy of the digital document or other file, unless the digital object has

been marked “confidential.” The choice of whether or not to designate a file as “confidential” in tDAR is made by the individual who uploads the file or organization that authorizes the deposit of the file in tDAR.

The repository encompasses digital data, documents, and images derived from ongoing archaeological research, as well as legacy data derived from more than a century of archaeological research. Since September 2010, tDAR has been a fully functioning publicly-accessible, digital repository for archaeological information with a focused and skilled professional staff. tDAR has a growing number of registered users (6,186 as of 1 September 2014) and content (over 8,000 full-text document files, 17,480 images, and 875 data sets, plus over 360,000 document citation records enhanced and incorporated from the National Archaeological Database). Although most of the information relates to North American archaeology, tDAR includes data from all over the world. Additionally, tDAR is constantly evolving to meet archaeologists’ needs in preserving archaeological data—in 2013 tDAR started taking geospatial and scan data and recent 2014 releases addressed tools to increase usability, streamline the curation workflow, and improve data integration tools.

For archaeological data from the US and most international contexts, there is no viable alternative to tDAR as a disciplinary digital repository (Figure 5). At the University of York in England, the Archaeology Data Service (ADS) maintains an archaeological digital repository, but it includes only data from United Kingdom (UK) archaeological contexts or data that are generated by UK researchers. ADS and tDAR do not compete and have partnered on several



projects. In the US, the Open Context web-publishing site, which once advertised itself as a digital repository, has substantially modified its services over the last few years. It now focuses squarely on the peer review and publication of archaeological data sets. It uses other organizations to archive data that it publishes. Open Context also requires completely open access to the data it publishes and cannot protect confidential information, e.g. specific site locations, a function that is essential for public agency use.

Figure 5: At present, the people who work in the field of archaeology are primarily the ones doing the excavations and writing reports. Far fewer archaeologists are employed in curation facilities caring for the resulting collections, and the only people working specifically to archive for long-term preservation and easier access digital archaeological records generated in the U.S. are at the Center for Digital Antiquity.

There are general-purpose digital repositories, including those operated by universities for data their faculty create or utilize. However, many of these either do not accept or do not

adequately document the data types and metadata categories that archaeologists collect and require for adequate reporting of their results. Because of their general-purpose nature, these repositories cannot offer the functionality that tDAR provides for archaeological data. While they maintain standard technical metadata, they include only very general substantive metadata, seriously limiting both information discovery and reuse. tDAR, on the other hand, allows for the inclusion of detailed substantive metadata specifically tailored for archaeology and for the administrative and management needs of the federal agency. This metadata is essential for data discovery, reuse, and preservation, especially for systematically recorded databases. tDAR structures information and provides a user interface designed for archaeologists and the managers of archaeological information.

tDAR utilizes metadata that conform to standard and widely-used formats including Dublin Core and Metadata Object Description Schema (MODS). Metadata categories are tailored to describe clearly archaeological information and encode spatial, temporal, cultural, material, and other keywords, as well as detailed information regarding authorship, sponsorship, and other sorts of credit that must accompany any use of downloaded data (Appendix B, Part 1). tDAR makes it possible to record full citation information and systematic archaeological and administrative metadata, as well as metadata that is specific to the resource type.

Web-based forms guide data contributors through a streamlined process of metadata entry and file upload. For spreadsheets and databases, this includes documentation of individual data sets, with the ability to map columns to coding sheets and ontologies. tDAR is also able to store and preserve Geospatial files and Sensory Data/ 3D Scan data and the metadata fields are tailored to record important metadata about how the data was produced.

Materials contributed to tDAR can be kept strictly confidential, can be made available to defined lists of individuals, or can be made generally available. Any of these levels of access to the uploaded file can be selected by the individual or organization that creates the tDAR metadata record and uploads the file.

To avoid unnecessary repetitive efforts in metadata entry and maintenance, digital objects in tDAR may be organized into "projects" whose locational, administrative, and other general metadata elements are shared by the project's reports, data sets, images, etc. The tDAR metadata record for each digital object can also "inherit" the project metadata and/or it can be given more specific metadata. In addition, contributors can organize their data into "collections" within tDAR for ease of administration and to more easily control levels of access to the data.

Digital Antiquity curators and technical staff follow practices and procedures for archiving and curating digital files that ensure their long-term preservation and availability for current and future uses. These practices and procedures include:

- daily file backup and protection;
- weekly testing of metadata files and digital files uploaded to detect and remove any file deterioration;
- migration of files into new formats and standards as they develop; and
- secure copies maintained off-site for emergency and disaster protection.

In addition, tDAR metadata and uploaded files (with the exception of files marked “confidential”) are indexed by Google and other search engines and are highly discoverable. This function addresses the need to meet open data and access requirements, as well as making the data more accessible and useful to archaeologists performing work at DoD Properties. However, a person’s level of access to a file in tDAR is dependent on their user category, whether the resource is a “draft” or “active” resource and whether the file is publicly available. tDAR is therefore able to protect security and confidentiality when required.

There are three general types of tDAR users: unregistered, registered, and contributors. Unregistered users are able to search, find, and view lists of resources in tDAR based on searches that they do of the repository contents. Unregistered users also can view the metadata records, but they are not able to download or view any of the files from tDAR. To download or view actual files, a user needs to register and agree to tDAR’s user agreement (see Appendix B, Part 2). Registered users are able to download publicly available documents, i. e., files that have not been marked as “confidential” by the individual or organization who contributed them to tDAR. Registered users also may request access to restricted or embargoed files by contacting the individual or organization who uploaded or authorized the upload of the file. Even registered users cannot access files that contributors or Digital Curators have marked as “draft”. Typically, files and metadata records are marked as “draft” while they are part of active projects that Digital Antiquity is working on with clients. For example, the DoD Legacy project tDAR records and uploaded files are marked as “draft” until the review by CRM staffs at the installations is complete. The final type of tDAR user is the contributor. Contributors have to agree to the Contributor agreement (see Appendix B, Part 3) and are able to view and edit resources they have access to, including draft records (see Appendix B, Part 4 for more details). This tiered level of access allows contributors to control access to their materials, and ensures that users are aware that the archaeological records in tDAR should be used appropriately.

tDAR is an open source application developed by Digital Antiquity. Digital Antiquity constantly monitors the use and content of the repository to ensure that newly deposited content is appropriate, it is not infected by any malicious software or users, and performance remains high. The system architecture used for tDAR is designed to scale to growth. In one major episode of adding over 350,000 citation records over a weekend, tDAR did not experience any slowing in system performance. tDAR is set up to take advantage of an economy of scale and has developed pricing models to match this feature. Prices per record,

per file, and per megabyte of storage space needed decrease with increasing the numbers of records, files, and/or megabytes required for any given project.

As a centralized digital archive, tDAR is set up to accept deposits from many individual projects and organizations. Digital Antiquity can provide professional digital archiving services at a much lower cost per deposit than any organization that attempted to provide the same kind of digital archiving for a more limited amount of digital data. Because digital data can be accessed over long distances, there is no practical need that each individual organization include a digital archive with all the services available in tDAR at their home unit(s). Digital data archiving is ideal for an activity that utilizes an economy of scale approach.

Digital Antiquity currently works with public agencies, CRM firms, publishers, research organizations, and individual researchers who are using tDAR to address their archaeological information management needs. Digital Antiquity staff also have reached out to tribal archaeological and historic preservation programs as well. Several have expressed interest in using tDAR, but a lack of funding so far has prevented the development of a project with a tribal program.

One of tDAR's clients is the Bureau of Reclamation (BRec), whose Phoenix Area office is depositing in tDAR technical reports from over 40 years of large archaeological projects done as part of water management projects. The Phoenix area office in concert with Digital Antiquity also is developing links between the archaeological site inventory information in its GIS resource management system and tDAR records related to sites in the inventory. The BRec office also is directing (and funding) CRM firms carrying out current archaeological projects on its behalf to place the digital data generated by these current projects into tDAR as part of their contract responsibilities. The Bureau of Land Management's Permian Basin program in New Mexico is doing the same kind of digital curation using tDAR.

Digital Antiquity also has completed the first phase of a project with the Air Combat Command of the US Air Force to create digital archives for its bases. Collections for three bases are complete and the project is moving into the second phase, which will include Air Force-wide implementation of the use of tDAR to preserve digital archaeological materials. Digital Antiquity is working with archaeologists and CRM managers in the Air Force to create collections in tDAR for up to 50 different Air Force bases. Digital Antiquity project managers and digital curators will work closely with base CRM and command experts to review the digital documents and data being included in tDAR to ensure that confidential information, mainly specific site locations, as well as any sensitive military information, are shielded from general availability.

Digital Antiquity's successful relationship with federal agencies like BRec, BLM, and the U.S. Air Force's Air Combat Command suggests that other federal agencies might want to use these digital curation services as well. It was therefore chosen for the ECAMDAR Defense Legacy project to see if the DoD as a whole could potentially use tDAR as a resource.

3. Project Description and Objectives

Sara Rivers Cofield

During the proposal stage of the ECAMDAR project, installation PoCs were consulted to seek guidance about how a digital archive could be of benefit to them. A preliminary meeting with project participants and installation PoCs was held on 8 October 2013 at the MAC Lab to discuss the project and solicit questions. While all of the PoCs agreed that their digital documents should be preserved, they did have concerns about costs, security, and information control.

Some of these concerns could be addressed even before the project took place. For example, the question came up as to whether users would be charged fees to access information, such as a monthly subscription. This question could be addressed by existing tDAR policy. Registering for tDAR is completely free. The only charge is the one-time fee for uploading files to the repository. Once a metadata record is added to tDAR, there is no fee for adding to or editing the metadata or uploading replacements of the files. Additionally, viewing the records and searching in tDAR is free for any user and downloading files is free for registered users. This policy is central to Digital Antiquity's mission of making archaeological records as accessible as possible.

Other concerns could only be addressed by trying the tDAR system with actual data. The primary questions this project addresses are as stated above; namely, how could tDAR support the military mission, can tDAR maintain the security standards needed for DoD records, is the program cost effective, and why should the DoD use tDAR instead of caring for their own digital archaeological records. The following project objectives were therefore developed as a framework for addressing these questions.

Question 1: How would partnership with Digital Antiquity using tDAR support the DoD's military mission?

Objectives:

- Describe the relationship between the military mission and cultural resource management laws and mandates.
- Explain the role that digital archaeological records currently have in advancing the military mission.
- Compare the military mission contribution of digital archaeological records that are and are not in tDAR.

Question 2: What are the potential security risks in using tDAR, and can these risks be mitigated?

Objectives:

- Discuss the security considerations inherent in doing archaeology on DoD properties.
- Offer examples of installation policies that prevent archaeology from being a security risk.
- Explain the nature of archaeological documentation as it pertains to potential security breaches.
- Explain tDAR's policies with regard to system security (protection from hackers, malware, etc.)
- Assess tDAR's capabilities regarding redaction and confidentiality access.
- Explain how security concerns were handled for the data included in this project.
- Explain how the techniques used to ensure security in this project may (or may not) be applicable DoD-wide.

Question 3: Is the use of tDAR cost effective?

Objectives:

- Explain the fee structure adopted by tDAR and offer examples of fees associates with different types of projects.
- Consider the ongoing costs to the DoD of establishing its own certified digital archaeological repository.
- Compare the overall costs of using tDAR vs. establishing a DoD digital archaeological repository.

Question 4: Why should the DoD create a partnership with Digital Antiquity and use tDAR instead of its own internal IT resources and staff?

Objectives:

- Survey installation points of contact to establish current methods of managing archaeological data within different DoD settings.
- Evaluate current methods of internal DoD management of digital archaeological data by comparing current practice to DoD mandates, regulations, and guidelines.
- Evaluate tDAR's management of digital archaeological data by comparing current practice to DoD mandates, regulations, and guidelines.
- Point out the strengths and weaknesses of each approach to determine how well each method fulfills DoD requirements for archaeological stewardship.

The objectives outlined above are both ambitious and broad in nature, necessitating an approach that is designed to consider any situation the DoD might encounter in managing its digital archaeological records. Since it would not be realistic to include data from every DoD installation in this evaluation of tDAR, a regional approach was adopted and developed in a manner that would maximize the variables examined. These variables include:

- 1) **Time:** By using existing data, approximately 20 years' worth of files is included in the project.
- 2) **Format:** No file formats were excluded from the data sent to Digital Antiquity so as to evaluate how a range of files can be processed and ingested into tDAR.
- 3) **Archaeological project scale:** Every digital archaeological record associated with existing collections was submitted (e.g. Phase I, Phase II, and Phase III compliance excavations, research excavations, avocational projects, etc.).
- 4) **Number of files:** The amount of data per project varies from a single record to hundreds of files. This helps establish whether there is a minimum amount of data needed to make submission of a project to tDAR worthwhile.
- 5) **Number of repositories:** Each archaeological repository has its own system of organization, so it cannot be assumed that data ingestion from one curation facility would work the same way as another. Two facilities therefore contributed to this project to test tDAR's flexibility in accepting data from different curatorial systems.
- 6) **Number of project archaeologists:** Individual archaeologists and archaeological contract firms can establish their own unique documentation systems as long as they meet professional standards. Thirty different companies or individual archaeologists generated the data included in the ECAMDAR project, which again tests tDAR's flexibility in accepting data.
- 7) **Number of installations/administrative units:** This study covers 25 installations, and while some of these fall within the same administrative structures (e.g. the Naval District Washington/ NAVFAC Washington includes 16 facilities), many are stand-alone units (e.g. Ft. Meade, Ft. Detrick, Aberdeen Proving Ground, Ft. Lee, etc.).
- 8) **Different levels of security:** The installations in this study vary from low-security sites such as the Solomons Recreation Center, the USNA Golf Course, and the USNA Dairy Farm, to installations where high-security is needed such as Ft. Detrick, Aberdeen Proving Ground, and the Naval Support Facility Indian Head, which have housed centers for biological weapons, ordnance testing and storage, and nitroglycerin manufacturing, respectively. These facilities therefore cover a broad range that may be representative of the DoD as a whole.

These eight variables allowed rigorous testing of tDAR as a suitable digital repository for the DoD's archaeological data by presenting the project participants with many different scenarios and problems to address. The following sections of this report will discuss the process of ingesting the digital materials into tDAR, the results of these efforts, and the recommendations and guidelines developed along the way.

4. Project Procedures

4.1 Standard Procedures for Producing, Reviewing, and Curating Archaeological Records - Sara Rivers Cofield

Before discussion of the procedures followed for purposes of the ECAMDAR project, it is important to understand how DoD archaeological projects are conducted and how the collections that result from these projects are currently handled. Procedures vary somewhat by department and installation, but all Federal agencies share regulations that guide the process, so current practice can be described in general terms (Figure 6).

In accordance with Federal laws (DoD 2005), DoD installations initiate archaeological surveys (Phase I studies) to determine whether archaeological resources are present, and if so, assess the significance of the resources (Phase II). When sites are identified as eligible for nomination to the National Register of Historic Places, they tend to be preserved in place unless development is unavoidable, in which case a data recovery (Phase III) is undertaken. All three phases are subject to review by State Historic Preservation Offices (SHPOs).

The laws that require this archaeology do so because the protection of cultural resources is considered a public good, so ultimately the public is the intended beneficiary of all archaeological undertakings. While archaeological site location information is protected by SHPO offices, all other information generated by archaeologists should be publicly accessible as long as it will not have some kind of adverse impact. The SHPOs that oversee compliance archaeology act as custodians of public information. The DoD must therefore consider the public its audience when undertaking archaeological studies.

Installations hire archaeological contractors, generally known as Cultural Resource Management (CRM) firms, to conduct Phase I, II, and III studies by writing Scopes of Work (SOWs) and putting the projects out to bid. The responsibilities of the CRM firms are defined at this stage, including the curatorial processes that are followed. Each SHPO typically has its own standards for archaeological work and curation, and Federal agencies can follow the State standards or standards they have established for themselves. With regard to the appropriate documentation of sites and the adequate processing and submission of that documentation, installations may use Federal regulations and/or State standards and guidelines to outline the work required. The standards followed are often dictated by the curatorial repository to be used. For example, the MAC Lab is a State facility that accepts Federal collections, provided these collections meet Maryland's standards as defined by *Technical Update No. 1 of the Standards and Guidelines for Archeological Investigations in Maryland: Collections and Conservation Standards* (Seifert 2005).

Workflow Overview for DoD Archaeology Projects

Installations

- Define project requirements
- Hire and screen archaeologists

- Review documents and photos for security

- Review first draft of report

- Approve/reject final project results and payments

Repositories vary and may include:

- DoD facilities
- SHPO facilities
- Universities
- Museums
- Other

CRM Firms

- Conduct archaeological work
- Accumulate documentation

- Write report draft
- Submit report to installation for first review

- Edit report after installation review
- Submit 2nd report draft to SHPO

- Finalize report and submit it to the client and the SHPO

- Submit artifacts and documents for curation

Security Checks

SHPOs

- Review compliance reports
- Provide feedback to CRM firms and Installations

- Maintain records of archaeological projects
- Provide public access to information on cultural resources

Figure 6: This workflow offers a summary of how archaeological projects are conducted on DoD property. Documents and photos generated should go through several levels of screening before they are submitted to SHPOs and repositories as public information.

Ideally, the future disposition of archaeological collections is decided before excavations ever take place so that processing standards and fees can be taken into account in advance.

Many repositories charge one-time or annual fees for their services, and the easiest way to fund curation is often to include it as a line item in the budget of the archaeological project. This covers the initial cost of curation as just one part of the overall archaeological undertaking, and allows cultural resource programs some time to incorporate the growth of their collections into the next annual budget when yearly fees apply. With curation funding built into their budgets, CRM firms can submit collections directly to repositories that will check to ensure that all standards were followed in packaging and processing the collection. Sometimes, however, collections are left with CRM firms or given directly to the landowner. This is typical where no professional archaeological repository is available to accept collections, or the owner agency has not established a relationship with such a repository.

Just as each installation instigates the archaeological work and defines the work to be done through SOWs, each installation must also address the issue of security as it pertains to each project. Archaeologists should not be allowed onto secure installations if they do not meet the general screening applied to any civilian seeking access to DoD property. Such screening varies greatly though. Access to the US Naval Academy campus store and gift shop, for example, triggers only the inspection of a driver's license. Access to more sensitive areas might require background checks, escorts, and daily inspections of people, vehicles, and archaeological equipment (Case Study #3).

Since photo documentation is a standard requirement for archaeological work, camera use and inspection policies must be defined before access is given so that archaeologists cannot inadvertently leave an installation with security-sensitive images. However, if an archaeologist accidentally exits an installation with a compromising photo or map, there is generally a second level of security check whereby installations require report drafts and photos to be reviewed by a security office or public affairs office before they are allowed to go to SHPOs and curatorial repositories. SHPOs are not subject to DoD security clearance screening, nor are they equipped to protect confidential information other than site location, so DoD installations and SHPO offices should already have well-established procedures to ensure that archaeological compliance work does not result in the careless deposition of sensitive photos and maps in SHPO libraries and curatorial repositories.

If secure information has inadvertently been filed with archaeological records outside of a secure DoD installation, then security has already been breached. This may or may not have gone without notice. Historically, public access to the reports (also known as "gray literature") and collections generated by compliance archaeology has been limited, so some sensitive images or maps may have been filed without anyone realizing that they are a security concern. Because of that possibility, the ECAMDAR project includes additional review by installation representatives.

Moving forward, the increased use of digital reports and records is likely to facilitate unprecedented levels of public access to archaeological data, making it that much more important to ensure that sensitive materials are screened at the installation level. If that is

successfully enforced then the inclusion of digital archaeological records in tDAR will represent no threat to DoD security, while ensuring that the public has access to the archaeological discoveries their tax dollars paid for.

CASE STUDY #3

Mission-Sensitive Photographs and Security Requirements

Michael A. Smolek
Cultural Resource Manager
Naval Air Station Patuxent River
Regional Archaeologist
NAVFAC Washington

Naval Installations are commonly confronted with the need for archaeological investigations that take place in areas where there are classified and/or sensitive activities, equipment, and facilities. Therefore, the review and control of photographs of classified or mission-sensitive items becomes important. Typically individual Navy installations have their own general photographic policies that might require a photo permit, specialized training, and/or government escorts. Additionally there are often more secure areas within larger installations that have more restrictive photography policies.

Archaeologists working on the installations are normally instructed at the beginning of a project on what is allowed to be photographed and what might be considered mission-sensitive, and therefore not allowed. In some cases local personnel are required to escort and oversee photographic activities. Where there are on-going photographic needs, such as at an archaeological site investigation, an end-of-the-day review of the photographs taken might be made by facility personnel. Generally in sensitive areas, cell phones are also not allowed.

An example of the daily photographic review procedure is at the NAS Patuxent River munitions compound where there are a large number of significant archaeological sites, including the 17th century Anketills Neck Site included in this project. All photographs taken by the archaeologists were reviewed at the end of the work day by facility personnel to assure that no mission-sensitive photographs had been taken.

Such front-end restrictions on photographic activities assure that classified or mission-sensitive photographs are unlikely to be included in published reports or unpublished field records.

4.2 Identifying, Organizing and Ingesting the Digital Materials into tDAR

4.2.1 Standard Digital Antiquity Procedure- Jodi Reeves Flores

Digital Antiquity has two main models for its digital curation services. One of these is referred to as "self-service" digital curation, the other is "full-service." The "self-service" model involves clients using tDAR's Web-based forms to upload files and provide metadata that describes

each file. These forms were designed to be simple and user-friendly—with this “self-service” use in mind. Prior to uploading, the client pays a fee to cover the cost of the deposit. The fee is dependent on the number of files and file space needed and can be paid by credit card. Alternatively, a client can ask Digital Antiquity to create an account in tDAR with a certain amount of credit for uploading files and pay for the account through a simple contract.

The second model is referred to as “full-service” digital curation. Typical clients are offices of large public agencies that provide Digital Antiquity with digital files and background information that are used to create the metadata records for the files. Then Digital Antiquity staff perform some or all of the following, as dictated by the circumstances: organize the digital collection; convert files to up-to-date and/or archival standards; compose and enter metadata; redact confidential information and upload files (see Appendix B, Part 5). Full-service curation is generally done under a contract that includes hourly charges for professional service and fees for the upload.

For this project, procedure followed the full service model. However, as described in the Recommendations, the organizational system and curatorial approach developed as part of this pilot project can be applied to other DoD materials in the future—either as part of the self-service or the full service model.

4.2.2 Transferring Digital Materials from RACF to Digital Antiquity -Jodi Reeves Flores

At the beginning of the project, Amanda Vtipil, Curator, Regional Archaeological Curation Facility, sent Digital Antiquity a list of digital files from Fort Lee held by RACF, with files being organized by accession number and categorized as “upload”, “consider uploading” and “do not upload.” None of the files sent in this sample had been redacted or marked as confidential. Digital Antiquity Staff then requested a selection of those files to upload to tDAR. Vtipil transferred the requested files to Digital Antiquity using the AMRDEC SAFE (U. S. Army Aviation and Missile Research Development and Engineering Center - Safe Access File Exchange) on 30 September 2013. Digital Antiquity curators reviewed the sample files, created an organizational method and uploaded the files to tDAR. The samples were then used as examples to show to the project members during the 8 October 2013 meeting.

The rest of the files from RACF—which were from the facilities of Fort Lee, Quantico, Fort Monroe and Fort A.P. Hill—were sent by Amy Wood, Cultural Resource Manager, on a flash drive through the mail. The files were received by Digital Antiquity on 28 February 2014. This second batch of files from RACF had been reviewed before being sent, and many of the reports had been redacted before they were sent to Digital Antiquity. Digital Antiquity did not receive the original, non-redacted copies of these files. Therefore, only the redacted copies are available in tDAR as part of this current project. No descriptive list or additional metadata accompanied this second batch of files. They were primarily organized by facility, then by accession number or what usually appeared to be archaeological projects.

4.2.3 Transferring Digital Materials from the MAC Lab to Digital Antiquity -Jodi Reeves Flores

Sara Rivers Cofield sent the MAC Lab's digital files via mail on a flash drive which was received by Digital Antiquity on 28 October 2013. The flash drive contained 83 folders named by accession number, each of which contained the digital records from a single project. Additionally, the flash drive held a copy of the MAC Lab's accession database which contains metadata about each archaeological project. Unlike the files from Fort Lee, the reports and other materials from the MAC Lab were not redacted before they were sent to Digital Antiquity.

4.2.4 tDAR's Organizational Framework -Jodi Reeves Flores

tDAR makes it possible for contributors to organize, describe, and make their digital materials accessible using Collections, Projects, and Resources.

Collections. Collections are a convenient way to organize and display resources and to more easily manage permissions on groups of resources. Collections can be stacked or nested to allow you to group and embed projects, independent resources, and other collections. As Figure 7 shows, any combination of projects, resources, and collections can be placed under a parent collection.

Projects. Projects allow users to move from the Resource level and find other resources from the same project as well as set general metadata at the project level. Resources that are grouped under a Project can "inherit" the Project-level metadata automatically, saving users from having to enter repetitious metadata at the Resource level. Resource level metadata can be customized for each resource, allowing more specific information to be used for individual files or resources.

Resources. tDAR currently supports eight kinds of resources: Documents, Datasets, Images, Sensory Data, Geospatial Files, Coding Sheets, Ontologies, and Projects. Each resource type has defined file types that are accepted; for example a contributor or curator can upload a .pdf or .doc file to a Document Resource page. For more information on the accepted file types, see Appendix B, Part 6.

4.2.5 Organizational Framework for the ECAMDAR Project -Jodi Reeves Flores

Digital curators developed the organizational scheme based on how the materials are organized within the existing MAC Lab and RACF collections and in consultation with Rivers-Cofield. The judicious use of collections and child collections (sub-collections within larger collections) enables the organization of the materials by repository, installation/facility, and accession number/investigation. In addition to grouping the materials, these collections within tDAR also enable the control of access to the materials at each collection level. For example, MAC Lab staff can have the ability to edit all the materials within their collection, while the installation cultural resource managers will have editorial rights to only the materials from their installation. Editorial rights or access to confidential or draft files can then be given at the

resource level, the accession number level, the installation level, or for the whole of the MAC Lab's collections (see Figure 7).

The majority of materials easily fit into the organizational schema outlined in Figure 7. There were a couple of exceptions to the general rule. For example, several of the materials sent by Wood from RACF were not organized by accession number, but instead by what seemed to be discrete investigations. However, this closely mirrored other child collections so that they were easy to fit into the existing organizational scheme.

A more complicated example is outlined in Figure 8. In this case, several different accession numbers from the MAC Lab contained data and information from investigations conducted in relation to the Mattapan Site (18ST390). In consultation with Rivers Cofield, Digital Curators decided to combine these materials under one child collection, "Mattapany", within the

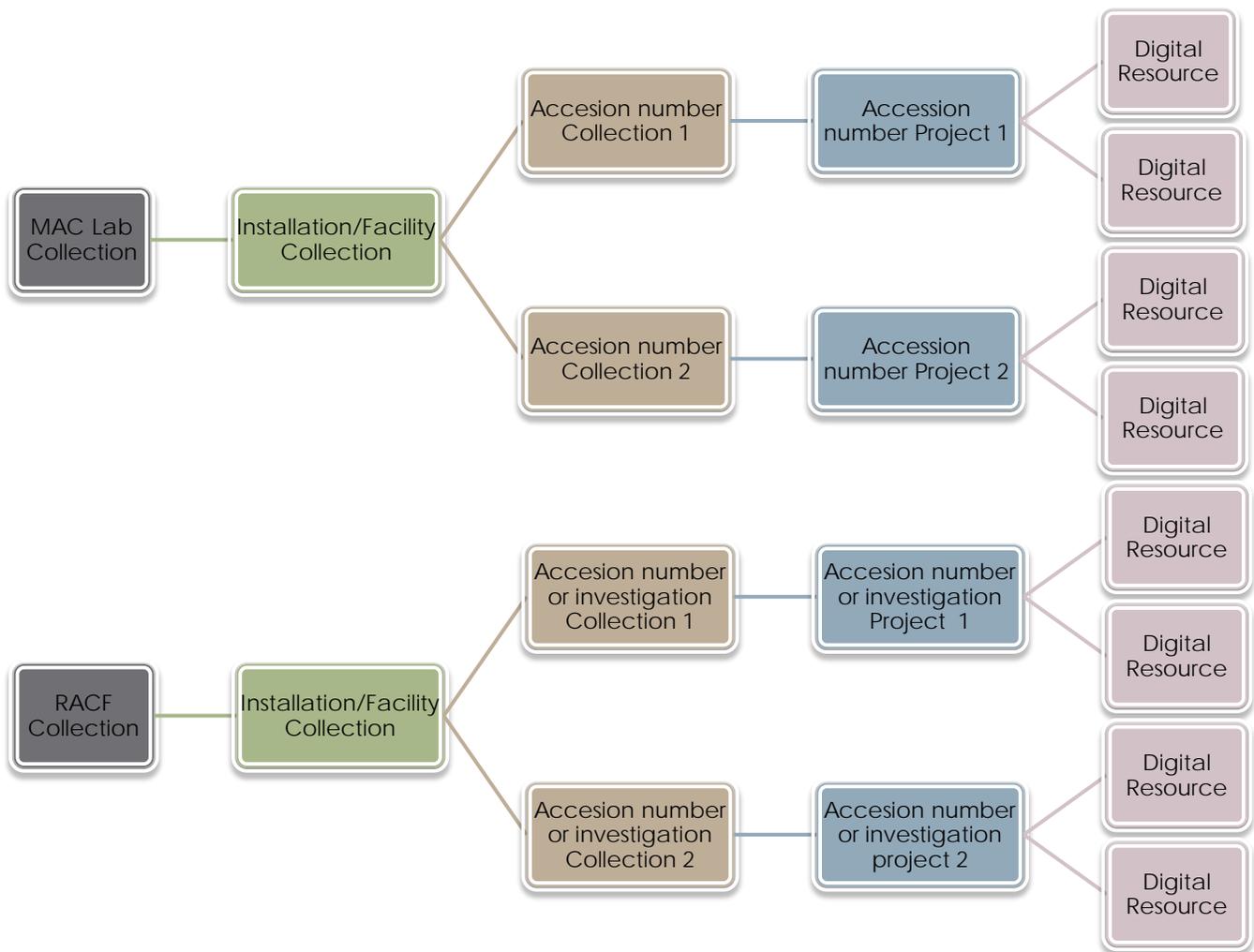


Figure 7: Organizational framework for the ECAMDAR project

Naval Air Station Patuxent River Collection. Additionally, Rivers Cofield had the opportunity to include new artifact photographs and artifact catalogs from three different sites: Posey (18CH281); Old Chapel Field (18ST233), and Mattapany (18ST390), as part of this curation project. The new photographs and artifact catalogs were produced as part of “Colonial Encounters: The Lower Potomac River Valley at Contact, 1500-1720 AD”, an NEH-funded research project led by Dr. Julia King of St. Mary’s College of Maryland. The digital materials produced for the Colonial Encounters project were designated as another tDAR child collection, enabling King to review the digital resources and to ensure proper administrative data was included for them while they were in draft form. The files were still included in the child collection for the relevant installation, but King was only allowed access to the installation records that belonged to the Colonial Encounters child collection.

The organizational schema developed for this project was applied to all of the RACF and MAC Lab collections and the system proved to be flexible enough to account for multiple levels of access. Individual projects and resources can be grouped within any number of child collections for ease of navigation. Additionally, grouping the collections in this way facilitates accessibility by multiple reviewers. Authority to modify files can therefore be granted in a hierarchical manner to mirror the internal structure of DoD organizations.

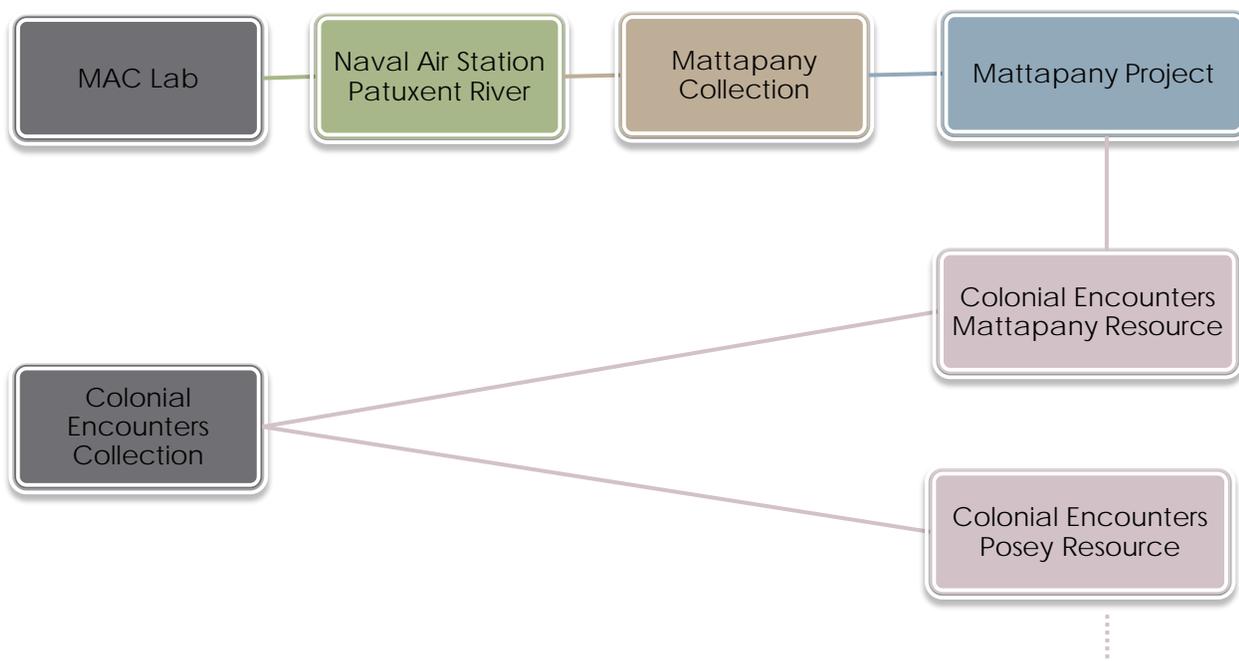


Figure 8: Organizing collections, projects, and resources in tDAR. This example shows how Digital Curators were able to use the flexibility within tDAR to place resources from the Colonial Encounters NEH-funded project into the appropriate Naval Air Station Patuxent River collections while also giving the principal investigator of the NEH project, Julia King, access to just those materials through a separate Colonial Encounters Collection.

4.2.6 Cleaning Up Old Files -Sara Rivers Cofield and Jodi Reeves Flores

As Digital Antiquity curators worked to organize the data submitted and prepare it for upload, MAC Lab curators worked on cleaning up particularly problematic sets of data (Case Study #4). The mere existence of a digital file does not warrant its curation in perpetuity, and the ECAMDAR project forced curators to make decisions about files that originally accumulated without much thought. Many files did not need permanent curation at all, while others could be consolidated for more efficient curation. Some problems were specific to the MAC Lab's digital files, but others were more general and affected materials received from RACF as well.

The unworthy files fell into the following categories:

- **Administrative forms:** When collections are submitted to a repository, several forms are typically required to accession the collection. For the MAC Lab, the forms include a transmittal form, a box inventory, a list of records, and a conservation checklist. Sometimes these forms are included on CDs submitted with collections, so they get transferred to the MAC Lab's digital media folders along with images, digital reports, and artifacts inventories. These forms comprise the accession files kept at the MAC Lab, but they are not needed in digital form because the information they contain is all entered into an Accession database upon delivery (Figure 9). The MAC Lab's forms were therefore not uploaded to tDAR. However, the equivalent forms were sometimes included from RACF collections because they contained potentially useful metadata for some of the projects that was not available elsewhere in the information supplied to Digital Antiquity.
- **Work Product.** Files that were more difficult to identify and sort through were those that were essentially 'work product' files and parts of datasets generated during the production of the project report, but not intended to be final products in themselves.
 - "Surfer feeders": Several of the projects were conducted by MAC Lab archaeologists in the 1990s and early 2000s when a software program known as Surfer was a commonly used standard for making report figures. Surfer is a program that builds maps by connecting different data sets, such as grid coordinates and artifact distributions, and the components that feed each figure are saved as separate files. The MAC Lab data therefore included hundreds of files with the suffixes .DXF, .GRD, and .SRF, all of which Rivers Cofield dubbed "Surfer feeders". These files could not be opened individually, so the only way to determine their content and viability was to use Surfer. There may be an advantage to keeping Surfer feeders so that someone can manipulate figures and maps when data changes, but the projects that generated these files are complete. However, Surfer is a proprietary software that, unlike something such as Microsoft Word, is not widely available. This limits the ability to access the files, especially as Surfer software changes over time, so preserving the feeder files seems unnecessary. Instead, the resulting figures and the quantitative data that created them were saved in more accessible file formats,

CASE STUDY #4

The MAC Lab's 'Problem Children'

Sara Rivers Cofield

Curator of Federal Collections

Maryland Archaeological Conservation Laboratory

Among the consequences of pursuing the ECAMDAR project is the fact that I had to clean up the messes in my digital data folders. Initially, I gave everything to tDAR in the hope that their expertise would allow them to do all that needed to be done, but tDAR has to know what a file was created for and what it contains before they can determine what to do with it. Files that lacked this key metadata bounced back to me as my 'problem children,' since I'm the person who should know what they were for, where they came from, and how they were relevant.

Fortunately, a lot of the files were just curation forms that CRM firms are required to send us so that we can fill out our accession database. tDAR already had the accession database, so they didn't need the forms. I marked them "DO NOT UPLOAD." Other files were not so easily tamed though. Some of the accessions represent projects conducted by archaeologists within the MAC Lab in the 1990s and they had a lot of raw data; distribution tables, Surfer maps, and unfinished draft reports. These were the old files from the 3.5" floppies that led to ECAMDAR.

The main problem with these files was their age. Some just needed consolidation because size limits once led people to save parts of reports in separate files for title pages, text, appendices, etc. Other files lacked crucial metadata, often because character limits for file names limited explanations of content. "POSEYBM.xls" for example, was a spreadsheet full of numbers, but it had no column headings. Eventually I determined it was distribution data for the Posey site's "building materials," but since I still didn't know which column represented brick, mortar, daub, or nails, the file was not usable.

Essentially, addressing these 'problem children' was a matter of doing a lot of research and cleaning up after past projects. This is the kind of work that emphasizes the importance of being efficient and organized in the first place. If we do not adopt standards and policies now, new 'problem children' will continue to accumulate, wasting time and resources down the road.

Project and Site Information

Accession # 2000.030.001 Acknowledement Letter Sent

Date Accessioned 12/12/2000

Date Deaccessioned

Project Information

Project Name PHASE I/II AT SITE W

Project Type COMPLIANCE

Investigation Type PHASE I, II

Sponsor ARMY

Consultant GARROW AND ASSOCIATES

Date Collected 8/1995

MHT Shelf # PR 182

Site Information

Site# or X-# 18PR465

Site Name WHITE OAK

First Lot 1

Last Lot 39

of Artifacts 87

Comments COLLECTION #5

State Ownership

Federal Ownership

Box Information

Record: 5211 of 8172 No Filter Search

Figure 9: Example of metadata received from the MAC Lab. This image is a screen shot of the Accession database.

- such as those accepted by tDAR (see Appendix B, Part 6). Files that could only be opened using Surfer were not uploaded to tDAR.
- o Report Components: Reports written in the 1990s and early 2000s could be very long and include many figures, but computer capabilities of the time did not allow whole reports to be saved as one file without slowing programs down too much to make work possible. To prevent program freezing and crashes, the reports were saved in different components such as the cover page, table of contents, report text, and appendices. Figures were not necessarily embedded within these files either, and were instead added at the time of printing. Thus one report could require four or more word processing files and many image files to be complete. Computers in 2014 are capable of combining all components in one file without great risk of crashes and slow programs. For tDAR upload, Rivers Cofield therefore consolidated report components into a single word file per report. This not only makes the upload and subsequent access to reports more efficient, but it also eliminates the need to keep individual figures as image files.
 - o Distribution Data: Much archaeological analysis is based on the location of different artifacts across a site, so many spreadsheets and tables are created

that list grid coordinates and the number of shells, nails, brick, etc. found there. This data is worth saving, but it can be consolidated. Many of the MAC Lab projects had separate Excel spreadsheets for every artifact type. However, including all artifacts in one spreadsheet is possible, and where such all-encompassing files exist, additional files with just a component of the same data are redundant. Additionally, multiple Excel files could be consolidated by copying each separate distribution table into its own worksheet within a single Excel file. By naming the worksheets according to content, metadata is preserved but the number of files to be uploaded is significantly reduced.

- ***Redundancies and versioning issues:*** In the short term it is easier and faster to save digital files and keep them all. However, when several pictures are taken of the same artifact in an effort to get good focus, light, and angle, quickly dumping everything into a catch-all folder leads to unnecessary redundancies. The same takes place when two or more copies or versions of a file is preserved, such as multiple copies of an artifact catalog, with one copy being an Excel file and the other being a PDF, or one being an older, less complete version. At some point it is necessary to choose the best images and most current or complete versions of redundant files. Such extraneous files can be retained in a less expensive offline archive or discarded, depending on their potential long-term utility. The ECAMDAR project prompted curators to finally make such decisions.
- ***Technical or Data Issues:*** Some files were plagued by technical issues or metadata issues, or sometimes both.
 - The file could not be opened and could not be migrated to an accessible format: Digital Curators and IT Staff made every attempt to identify obsolete or proprietary formats and migrate the files to a format that could be accessible and preserved. However, some files were irretrievable. See Case Study #5 for an example.
 - The content within the file lacked key metadata: This was the case with several datasets, where the file name did not indicate the content and there were no column headers within the data itself. Again, see Case Study #5.
 - The file's content was not relevant or contained only metadata that could be included on the resource/project page: Examples are images of archaeological crews not doing archaeological work and images of sandbags (Figure 10). An example of the second is images of photo boards not within the context of a trench or feature, as well as internal curation documents (Figure 11). This issue and the issue of redundant files are explored more fully below as problems that should be addressed in data submission guidelines.

Curator Sara Rivers Cofield worked to clean up the MAC Lab's digital files as described while Digital Antiquity curators uploaded projects that were already well-suited for ingestion. As Rivers Cofield cleaned up each project, she sent updated folders to tDAR, often significantly reduced in terms of number of files and storage space.

CASE STUDY #5

2000.030: The need for proper management and curation of digital files

Jodi Reeves Flores
Grant Snitker
Digital Curators
DA-tDAR

Accession number 2000.030 from Adelphi proved to be a particularly difficult collection to process. When we first opened the folder, the majority of the files lacked file extensions and could not be opened due to several issues related to the age of the files (as early as 1995). Eventually we were able to successfully migrate most of the files so they could be opened. The accession also contained 'work product'—such as interim artifact analysis data that was eventually used to produce figures for the report—some of which had not been clearly labelled and described and/or had been produced with proprietary software (see above for more information of the issues regarding 'work product').

A report and two artifact inventories were migrated to newer file types, but in the case of the report, several key figures and illustrations were missing from the 'final' version. Of the artifact analysis files produced using proprietary software (e.g., DeltaGraph and SPSS), we were able to salvage some of the images—a few were included in the report, while others were not. Things were further confused by multiple versions of documents—for example there were several versions of the report, one of which could only be opened using Notepad++. Much of this may have, again, been due to the fact that the files were actually work product and had been generated to include in the final report.

These are issues that could have been prevented with proper data management (such as keeping well organized, final versions of files in nonproprietary format) and proper digital curation (updating file formats as standards changed over time). However, this can be difficult if there are no existing guidelines on what digital files to preserve and if those files are then only stored on a CD or server.

Despite these issues, we were able to preserve some of the materials for future use, including the report and artifact inventories. Out of the 57 files originally received from 2000.030, 9 files (1.3 MB) were uploaded into tDAR. Several working data sets were condensed into one file or were identified as duplicates or already present in the report. Additionally, we organized the files, included valuable metadata about the project and, most importantly, the files that were salvaged will now be consistently evaluated for degradation and migrated to newer, accessible file types if needed in the future (See Figure 15).



Figure 10: When the images are not culled prior to submission for curation, many unnecessary files are stored as if they warrant in-perpetuity curation. These are examples of irrelevant photos sent to the MAC Lab as site documentation. Top: A project at the Washington Navy Yard included several pictures of orange sandbags and bicycles on some kind of brick patio. Since no images showed excavation taking place anywhere near this patio, there is no indication that they have any research value. Bottom left: Photography accidents happen, but images with fingers and camera straps in front of lenses should be deleted, not curated. Middle right: The turtle picture is cute, but not worthy of long-term curation. Bottom right: It is fun to have pictures of archaeologists at play, but for personal use, not for preservation.

In the case of RACF files, Amanda Vtipil went through the material intensely before the project started because she had to complete her portion of the work before leaving for a new position. Additionally, most of the materials received from RACF were final 'products' consisting of photographs, final reports and final artifact catalogs. One exception was the materials from the Phase I survey of Fort A. P. Hill conducted by Mid-Atlantic Archaeological Research. This project had only scanned field notes and draft documents. Digital Curators decided to upload the materials anyway, since it was the only record of this survey sent by the RACF. This decision proved to be helpful since the PoC from Fort A. P. Hill cited the records of this early project as one of the most useful resources for his work (see Appendix C). Sometimes the oldest projects are particularly useful to have in digital form because they are the most likely to have fallen out of institutional memory.

Overall, Vtipil's prep work ensured that the materials from RACF were generally straight forward when it came to accessibility/viability of files. However, both Ft. Lee and the MAC Lab suffered from some general problems that plague digital materials submitted by CRM firms to curation facilities as described above, and it was not always possible to weed out poorly collected digital files.

The files that could not be 'cleaned up' before they were added to tDAR were usually those that were simply not created or managed with in-perpetuity preservation in mind. These include:

- **Floating Photos Boards:** Some archaeologists use the ease of digital photography as a quick method for collecting metadata. Usually photo boards are in photos of excavations in-progress to explain what the picture is about. For some projects, however stand-alone images were taken of photo boards that held information about the next picture to be taken (Figure 11). In such cases, the metadata should be recorded in photo logs or file names for the actual excavation images, making the retention of floating photo board images unnecessary.



Figure 11: Sometimes "floating" photo board pictures are taken for the sake of expediency. Instead of having the photo board in the image of the archaeological excavation underway, it is photographed separately with information about the photo that will be taken next. This technique is not a problem when the information on the photo board is later used to rename the photo it represents or to record information in photo logs, but floating photo board image files should be deleted once the metadata has been recorded where it really belongs.

- Images of questionable relevance: Some images are not obvious irreplaceable records of excavations in progress, but are instead enthusiastic documentation of landscapes and vegetation that may or may not ever prove to have any value to future researchers (Figure 12). The need to keep such images is dubious, especially when many similar shots are taken, but it is problematic to have curators decide what is and is not relevant when they were not involved in the initial project. Archaeologists should critically evaluate such images before submitting them for curation.
- Images of unquestionable irrelevance: Digital photography has effectively removed the film and processing costs that once motivated archaeologists to limit photos to essential documentation, so many photos that are clearly not relevant site documentation creep into repositories (Figure 10). Keeping all photos taken is easier than making thoughtful decisions about what is and is not necessary, so photos are often dumped into folders for submission regardless of their content. Unfortunately, the photos



Figure 12: There are situations when images landscapes and vegetation have long-term value for research, but archaeologists should eliminate redundancies before submitting such photos for curation. All of the photos above were submitted as part of a single accession, but the necessity of keeping them in perpetuity is debatable.

submitted are generally included in photo logs, making simple deletion problematic. The photo logs and photos submitted should match to prevent the appearance of data loss. The ECAMDAR team tested whether generating contact sheets showing all photos, while eliminating particularly bad photos for upload as individual image files, would address this issue. This process proved not to be the space or time-saver it was intended to be, but even this process was informative for developing guidelines for future submission of images.

While the extra work of cleaning up old projects was necessary for the ECAMDAR project, and will be necessary for anyone who decides to send old digital files to tDAR, the process helped ECAMDAR curators develop procedures for eliminating unnecessary digital data and consolidating records for efficient archiving. The lessons learned are therefore reflected in the recommendations and standards discussed below.

4.2.7 Ingesting the Digital Materials into tDAR -Jodi Reeves Flores

Once the organizational framework was constructed, Digital Antiquity staff, based on input from Rivers-Cofield and observations from the files and internal project names, established a general naming convention for collections, projects, and resources. Digital Curators then began to upload the files into tDAR and add the descriptive metadata.

MAC Lab Data

Thanks to the catalog database provided by the MAC Lab, Digital Antiquity technology staff was able to automatically generate the collections and projects, as well as automatically include administrative metadata, including the project name, installation, sponsor, investigation phase, and a list of physical collections held by the MAC Lab (Figure 13). Digital Curators then reviewed the resulting collection and project pages as they ingested materials from each accession number, evaluating whether any changes were required to accommodate the digital materials. Curators also gathered additional metadata from the content of the files by reading through reports and reviewing datasets and photographs for important, descriptive, or administrative information. This metadata was added to the applicable resource and project pages, as well as to the collection pages where appropriate. Contact information for the MAC Lab—which included Rivers Cofield’s email address—was added to each resource. Some metadata was specific to the MAC Lab collections, such as lot numbers and MAC Lab accession numbers, while other metadata included information that is present in all tDAR records: title, date, and description, and optional metadata such as creator/author, temporal keywords, investigation types, etc. (Appendix B, Part 1).

RACF Data

The collections and projects for the materials from Fort Lee Curators were created manually within tDAR by Digital Curators based on installation, then accession number and/or how the digital files were organized when they were delivered to Digital Antiquity. Curators gathered metadata from how the files were organized, file/directory names, and the content of the files

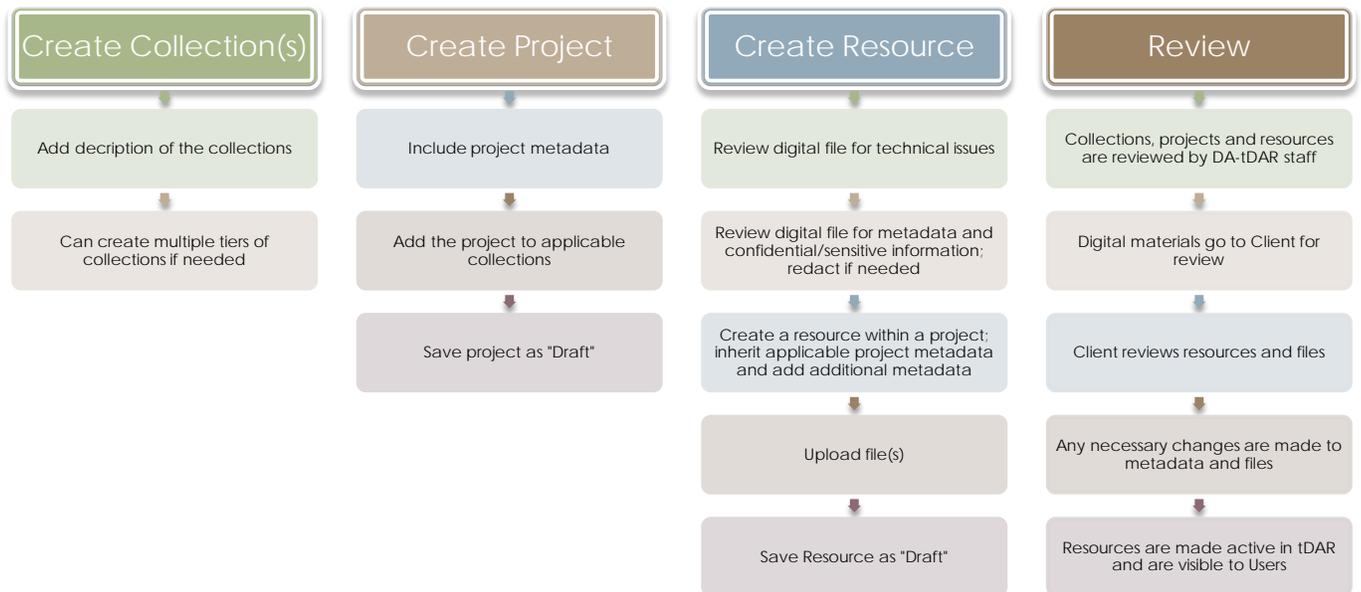


Figure 13: Standard Digital Antiquity-tDAR Digital Curation Process. Based on the established organizational schema, Digital Curators or IT staff creates the collection and project pages in tDAR. Digital Curators add descriptive information, upload files, and review them for metadata and confidential/sensitive information.

by reading through reports and reviewing datasets and photographs for important, descriptive, or administrative information. This metadata was added to the applicable resource and project pages, as well as to the collection pages where appropriate. Contact information for RACF—which included Wood’s email address—was added to each resource. Some metadata was specific to the RACF collections, such as accession numbers, while other metadata included information that is present in all tDAR records and optional metadata fields.

Addressing Issues Encountered

Once the metadata was complete and the file uploaded to the resource page, the resource was saved as a “draft” so that those with appropriate access could view/modify the resource. The majority of files that were reviewed and consolidated by the MAC Lab and RACF were ingested into tDAR. Where a file was plagued by one of the problems mentioned above or a technical problem, Digital Antiquity staff was often able to salvage the information from the file by working with the repository staff to address the relevant issue.

- *The file's content was not relevant or contained only metadata that could be included on the resource/project page:* Non-relevant files were not uploaded into the repository. For materials that contained just metadata, such as internal documents (administrative

forms) or photographs of photo boards, that metadata was transferred to the applicable resource and/or project page.

- ***Duplicate content and versioning issues:*** With files such as documents and datasets, Digital Curators identified the most up-to-date and/or complete version of the data that would be most useful for reuse in the future to upload. For duplicate images, Digital Curators selected the highest quality image for upload. This was the approach for cleaning up the issues created by digital “work product” being sent to the original repository.
- ***The file could not be opened and could not be migrated to an accessible format:*** Digital Curators and technology staff made every attempt to identify obsolete or proprietary formats and migrate the files to a format that could be accessible and preserved.
- ***The content within the file lacked key metadata:*** Digital Antiquity Digital Curators work with Repository staff to identify the file and the data so as to make it as useful as possible. When the data was identified or deemed possibly useful in the future, the file was uploaded.

Between September 2013 and June 2014, Digital Antiquity uploaded and created metadata for over 7,000 files from the 23 installations that contributed data for the ECAMDAR project (Table 3).

4.3 Reviewing Digital Materials in tDAR & Making Them Accessible -Jodi Reeves Flores

When the project pages within tDAR were complete for each installation, the process of reviewing the materials could begin (See Figures 14 and 15 for example project pages). Jodi Reeves Flores, a Digital Curator at Digital Antiquity, coordinated each step of the review. First the projects were checked internally by Digital Antiquity staff. The next step was to contact the installation PoCs and get them to register as tDAR users. Each installation PoC was only given access to their own ‘draft’ project pages, but they had to be registered and authorized to view their files before they could engage in the review process.

At the beginning of the review stage, Rivers Cofield and Reeves Flores compiled a two-part survey to solicit feedback from the participating installations. The first part of the survey was designed to collect background information on how each program managed their archaeological data, while the second part of the survey was about the materials that were added to tDAR as part of the ECAMDAR project. The results of both surveys are summarized in Appendix C.

Reeves Flores coordinated with the PoCs from each installation/facility to set up a phone call to introduce the materials to installation staff. During these phone calls, Reeves Flores discussed the draft materials uploaded to tDAR and their organization, as well as some of the challenges and successes of the project and how to edit materials, control access to materials, and search within the collection.

Table 3: The number of files uploaded from each installation was affected by the issues discussed in sections 4.2.6 and 4.2.7. Some files were migrated to newer and/or more accessible file types, others were redacted or multiple files were combined into one file for upload. This changed the file numbers and size of the files uploaded.

Installation	Data (nearest MB) Submitted	Data (nearest MB) Uploaded	Approx. # Files Submitted	Approx. # Files Uploaded
Naval Air Station Patuxent River	1,229	828	2,327	1,188
Naval Air Station Patuxent River, Webster Field Annex	1,462	884	1,202	570
Point Lookout	1,286	82	224	54
Bloodsworth Island	1	1	6	3
Solomons Naval Recreation Center	276	224	111	62
Naval Support Facility, Indian Head	145	193	425	176
Naval Observatory	74	34	43	31
Potomac Annex	10	10	37	30
Washington Navy Yard	354	211	93	81
Joint Base Anacostia Bolling	790	781	346	335
Nebraska Avenue Complex	126	78	61	56
Walter Reed National Military Medical Center	121	63	67	63
U.S. Naval Academy	394	304	217	210
USNA Dairy Farm	177	109	64	62
North Severn	386	384	124	121
U.S. Army Garrison Aberdeen Proving Ground	1,666	2,780	1,625	669
U.S. Army Garrison Adelphi Laboratory Center	934	183	638	265
Fort George G. Meade	1,448	900	1,003	469
Fort Detrick	20	22	30	28
Fort Lee	1,331	1,035	665	492
Fort Monroe	1,745	1,579	146	137
Quantico Marine Corps Base	862	504	516	391
Fort A.P. Hill	7,813	6,428	1,653	1,396
TOTALS	22650	17617	11623	6,889

Some issues arose during the phone calls, most of which centered on the review process, access to the materials, modifying the materials in tDAR, and adding other digital materials to tDAR:

- Several PoCs asked whether some of their co-workers could get access to the materials to help with the review process. This was subsequently addressed either by the PoC or Reeves Flores.
- One installation stated that they would want to talk to Sara Rivers Cofield, MAC Lab, about the best way to approach access to the materials that are in tDAR.
- Some PoCs from the Navy expressed the wish to confer with other Navy participants about how they would proceed in the review process and in making the materials active in tDAR.
- Most asked about possible levels of access to the digital files in tDAR.
- Only one installation suggested changes to the way the materials in tDAR had been described or organized (such as moving a project from one collection to another or modifying collection titles/descriptions). These issues were addressed easily by Reeves Flores.
- One PoC suggested that the inclusion of data on watersheds would make the materials more helpful. Such information can easily be added by using the keyword feature in tDAR.
- Other PoCs requested to be added as “Contacts” on the resource and project pages. This request was easily met by Digital Antiquity IT staff.
- Two PoCs expressed an interest in adding additional digital materials as part of this project, primarily archaeological survey reports that were not included in the digital materials received from the MAC Lab and RACF. Another PoC expressed interest in storing and preserving the installation’s new artifact inventory when it is completed. This request could also easily be met, since tDAR is able to store and preserve datasets. Additionally, contributors are able to replace files in tDAR as new versions become available without paying an additional charge.

After the initial introductory phone calls, installation PoCs had time to continue going through their tDAR content as they worked on responding to the second part of the feedback survey. This led to the following additional comments:

- Two PoCs asked about the submission of GIS data, as this data is typically required by installations and stored in DoD systems when archaeological projects are conducted. While tDAR can accept GIS data, none had been submitted to the MAC Lab or RACF, so the ECAMDAR project did not have GIS data to include. This may be something installations will want to consider in future.
- One PoC asked that several photographs of buildings used for sensitive purposes be removed from the materials initially curated into tDAR. Because of the flexibility of the

This record has been marked as Draft .

Phase I Archaeological Investigations at Fort A. P. Hill

Summary

This project includes materials produced as part of Phase I archaeological investigations at multiple sites at Fort A. P. Hill conducted by Mid-Atlantic Archaeological Research.

The materials in this project are primarily field notes, reports and draft artifact inventories. Most of the materials are divided by archaeological site or investigation area.

Cite this Record

Phase I Archaeological Investigations at Fort A. P. Hill. (tDAR ID: 393513)

Tweet this Share on Facebook Email a link to a Friend

Keywords

Culture Historic	General Phase I
Site Name 44CE0001 • 44CE0031 • 44CE0032 • 44CE0039 • 44CE0047 • 44CE0049 • 44CE0050 • 44CE0053 • 44CE0055 • 44CE0059 • 44CE0061 • 44CE0065 • 44CE0072 • 44CE0074 • 44CE0076 • 44CE0077 • 44CE0085 • 44CE0123 • Cook Camp • Windsor Mansion	Geographic Keywords Caroline County (County) • Fort A. P. Hill • Virginia (State / Territory)
Investigation Types Data Recovery / Excavation • Heritage Management • Reconnaissance / Survey	Temporal Keywords Historic

Spatial Coverage

Individual & Institutional Roles

Contact(s): Fort Lee Regional Archaeological Curation Facility

Contributor(s): Antony F. Opperman

Principal Investigator(s): Ronald A. Thomas

Repository(s): Fort Lee Regional Archaeological Curation Facility

Prepared By(s): Mid-Atlantic Archaeological Research, Inc.

Submitted To(s): Facility Engineer, Fort A. P. Hill

Record Identifiers

Contract #(s): DACA65-82-C-0116

Notes

General Note: Archaeological Investigations at Fort A.P. Hill, Caroline County, Virginia. Antony F. Opperman, Ronald A. Thomas. 1983 (tDAR ID: 145032)

system and the ability to save resources in 'draft' format for review, this request was easily met.

It was requested that Installation PoCs confirm that information included on the draft tDAR metadata record created by Digital Antiquity curators was correct. They also were invited to add to the description or summary of the file(s) in the tDAR metadata record if more information would be appropriate or useful. They were also asked to inspect files to see if anything needed to be redacted that had not yet been redacted by repository staff or Digital Curators. They were then asked to inform Reeves Flores by 30 September 2014 as to whether the materials had been reviewed and/or whether the files should be marked as confidential or if any other changes were required. Digital Antiquity would make the materials active and publically available at the end of the review process, unless directed otherwise.

Figure 14: Example Project Page for a Phase I Investigation at Fort A. P. Hill.

This record has been marked as Draft.

Phase I and II Investigations at Site W, Adelphi Laboratory Center (2000.030)

Summary

Garrow & Associates, Inc., conducted Phase II archaeological fieldwork at Site W on the Naval Surface Warfare Center in Prince George's County, Maryland. The project was conducted for the Baltimore District, U.S. Army Corps of Engineers in August 1995 for the Army Adelphi Laboratories, which has acquired a portion of the naval facility. The project tested two archaeological sites (18PF405 and 18PF460) within a parcel to be used for a wastewater containment pond, an administrative building, and a parking lot. The studies were done to assist the Army in their compliance with 36 CFR 800 and 36 CFR 66 of the National Historic Preservation Act of 1966, as amended. This document also provides the results of a previously unreported Phase I survey of Site W.

This project contains an artifact inventory and a final report, as well as material distributions, and a record of photographs taken during the investigation.

Cite this Record

Phase I and II Investigations at Site W, Adelphi Laboratory Center (2000.030). (DOIAR ID: 391664)

Twitter this Share on Facebook Email a link to a Friend

Keywords

Culture

Archae • Bare Island/Holmes • Colonial Period • Early
Archae • Historic • Late Archaic • Middle Archaic •
Yorcktown Stunned

Investigation Types

Data Recovery / Excavation • Site Evaluation / Testing

General

ARMY • Compliance • Phase I • Phase II • Shadrach Beall
homestead

Geographic Keywords

Adelphi Laboratory Center • Chesapeake Bay • Maryland
(State / Territory) • Naval Surface Warfare Center • Prince
George's County (County) • White Oak Naval Surface
Warfare Center

Temporal Keywords

Historical • Prehistoric

Site Type

Archaeological Feature • Artifact Scatter • Domestic
Structure or Architectural Complex • Domestic Structure
• Settlements

Spatial Coverage



Individual & Institutional Roles

Contact(s): Maryland Archaeological Conservation Laboratory Federal Curator

Sponsor(s): Army

Repository(s): Maryland Archaeological Conservation Laboratory

Prepared By(s): Garrow and Associates

Record Identifiers

Maryland Historical Trust Report #(s): PR 182

MAC Lab Accession Number(s): 2000.030

Notes

General Note: The following physical records are held at MAC Lab: Artifact Catalog, Black & White Prints, Black and White Contact Sheets, Fodochrome Slides, Photographs, List of Documentation

General Note: Date Collected: 8/1995

This Resource is Part of the Following Collections

Adelphi Laboratory Center
Phase I and II Investigations at Site W, Adelphi Laboratory Center (2000.030)
Maryland Archaeological Conservation Laboratory

Figure 15: Example Project Page for MAC Lab Accession 2000.030.

5. Project Results

Sara Rivers Cofield

Based on the procedures followed, the data ingested into tDAR, and the feedback gathered, it is possible to revisit the project questions and objectives to provide some answers and evaluate tDAR as a potential DoD partner.

5.1 Question 1: How Would Partnership with Digital Antiquity Using tDAR Support the DoD's Military Mission? – Sara Rivers Cofield

5.1.1 The Relationship Between the Military Mission and Cultural Resource Management

DoD cultural resource management programs exist to protect archaeological and historical resources from unnecessary destruction by DoD undertakings. Given that the DoD's mission is national defense, it makes sense that our shared national heritage is defended along with the nation's population and modern infrastructure. When the armed services are faced with security threats, the preservation of lives is paramount, but the heritage sites that have meaning to the population are also worth protecting. Shared histories help define national identity and connect the American population. Responsible stewardship of cultural resources on DoD property is therefore integral to the military mission.

With that in mind, laws have been passed to ensure that impacts to cultural resources are considered, and each branch of the DoD has developed regulations for compliance with these laws (Table 4). The regulations include mandates for collections care, and these mandates apply to all documentation associated with archaeological projects, including digital files.

Ideally, cultural resources should be identified and assessed prior to DoD undertakings that might impact them so that cultural resource protection is an integral part of ongoing DoD activities. The DoD can often avoid adverse effects on important cultural resources, but sometimes DoD projects are so essential that impacts cannot be avoided (Case Study #6). In such cases, the data recoveries allow the destruction of a site to move forward in a way that preserves information instead of the site itself.

There are times when problems arise because the inadvertent discovery of a significant archaeological resource puts different parts of the military mission in conflict. Proceeding with construction compromises cultural heritage, but delaying construction may compromise military operations. This typically happens only when installations have not proactively completed archaeological surveys, but such conflicts can also arise when surveys have been conducted, but the survey results are lost, inaccessible, or extremely cumbersome to find.

When documentation of DoD archaeological projects is lost or misplaced, the DoD may have to spend unnecessary time trying to locate old data or come up with funds to revisit sites that have already been surveyed. In either case, this wastes money and causes unnecessary delays.

Table 4: Regulations and guidance documents that specifically pertain to the curation of DoD archaeological collections and their associated documentation (DoD 2005, 2008; U.S. Army 2007).

Applicable Agencies	Curation Regulations and Guidance Documents
Federal Agencies (All)	36CFR§79: Curation of Federally-Owned and Administered Archaeological Collections (7-1-93)
DoD	Instruction 4715.16, Environmental Conservation (9-18-2008)
Air Force	Instruction 32-7065 (6-13-94)
HQ Air Mobility Command	Curation Guidelines for Archeological Collections (Draft)
U.S. Army	Army Regulation 200-1 (12/13/2007)
U.S. Army Corps of Engineers	ER 1130-2-540 (November 15, 1996), Environmental Stewardship Operations and Maintenance Guidance and Procedures, Chapter 6, Cultural Resources Stewardship
U.S. Army Corps of Engineers	EP 1130-2-540 (November 15, 1996), Environmental Stewardship Operations and Maintenance Guidance and Procedures, Chapter 6, Cultural Resources Stewardship
U.S. Navy	SECNAVINST 4000.35 (8/17/92)
U.S. Navy	OPNAVINST 5090.1B, Environmental and Natural Resources Program Manual, CH1 (2/2/98), Chapter 23 (Historic and Archeological Resources Protection)
U.S. Marine Corps	Order P5090.2A Environmental Compliance and Protection Manual (7/10/98), Chapter 8 (Historic and Archaeological Resources Protection)

5.1.2 Digital Archaeological Records and the Military Mission

Digital archaeological records represent a valuable asset to the military mission because they can be more easily accessible than non-digital archaeological data. The ability to locate information in digital form quickly and efficiently can streamline cultural resource management and facilitate site avoidance or mitigation.

However, without a long-term digital archive and management system there is a greater risk that digital archaeological documentation, which increasingly is the nature of the results from archaeological investigations, will be inaccessible and lost. Format obsolescence and corruption can compromise files that are allowed to age without diligent migration and monitoring. Neglected digital files may not be retrievable even if they have been backed up on DoD servers.

It is not in the best interest of the military to pay for archaeological information that is only viable in the short-term, so the maintenance of digital archaeological records is necessary to ensure efficient access to information.

CASE STUDY #6

Archaeology and the DoD Mission

Sara Rivers Cofield
Curator of Federal Collections

Maryland Archaeological Conservation Laboratory

Most of the collections we get result from pro-active surveys and significance evaluations (Phase I and II excavations) designed to identify archaeological resources. Some of the most important collections, however, come from mission-driven data recoveries.

The Naval Air Station, Patuxent River is a good example because it has grown a great deal in the past 20 years. The installation is on waterfront land that humans have occupied for over 10,000 years, and development has impacted archaeological resources. One important site dating from 1675 through the 19th century was slated for excavation because of potential impacts from a change in the parking lot of the Officer's Club. Once archaeologists exposed the extent of the archaeological resources, they realized that a full data recovery would be extremely time-consuming and expensive. In that case, the Officer's Club reconfiguration was not essential to the military mission, so plans were changed and the archaeological site was preserved instead.

In cases where construction was directly related to non-recreational military operations, however, development moved forward in tandem with archaeology. The 1993 Base Realignment and Closure (BRAC), for example, moved the Naval Air Systems Command (NAVAIR) Headquarters to PAX River, necessitating construction of a new facility. A late 18th-century slave quarter site in the impact area had to be excavated. The NAVAIR building still went in, but we now have a really great example of an archaeological collection from a slave quarter. Similarly, when facilities were needed to accommodate a new VXX Presidential Helicopter Program Support Facility at PAX River, data recovery took place on an archaeological site that represents American Indian lifeways in the Middle-Late Archaic period (7,000-1,250 B.C.). Both collections are particularly important because the site inhabitants left little or no written records, making archaeology essential for understanding that part of Maryland's history. In both cases, the military mission was paramount, but the sites were well recorded and they live on through the resulting collections.

5.1.3 How tDAR Can Contribute to the Military Mission

The benefit of tDAR in supporting the military mission lies in its ability to protect the information the DoD has collected and streamline access to that information. The following examples illustrate how this is helpful.

1) *tDAR prevents information loss.*

Archaeological documents may be irreplaceable records of excavations, but they are also easily lost if not properly managed. For example, unpublished archaeological reports are not typically printed in large quantities and they are only distributed to individuals who meet the professional qualifications for gaining access to site location information. That means that installations may not have many copies of their CRM reports and what copies do exist can easily get misplaced if they are filed with the paperwork of past cultural resource employees or they are loaned out in the course of a project. While it may be possible to obtain reports from SHPOs, this adds time and work that would not be needed if the reports were not lost in the first place.

Documentation such as field records, catalogs, and photos are also subject to loss if they are not properly managed. These kinds of records are typically not available from SHPO offices since they should be curated with the artifact collections. As this project points out, digital archaeological records of this sort are not being properly managed at this time. It therefore makes sense to require that digital documentation, including reports, field notes, artifact inventories, and images be uploaded to tDAR in order to ensure that they are archived, available (as appropriate), and not lost altogether.

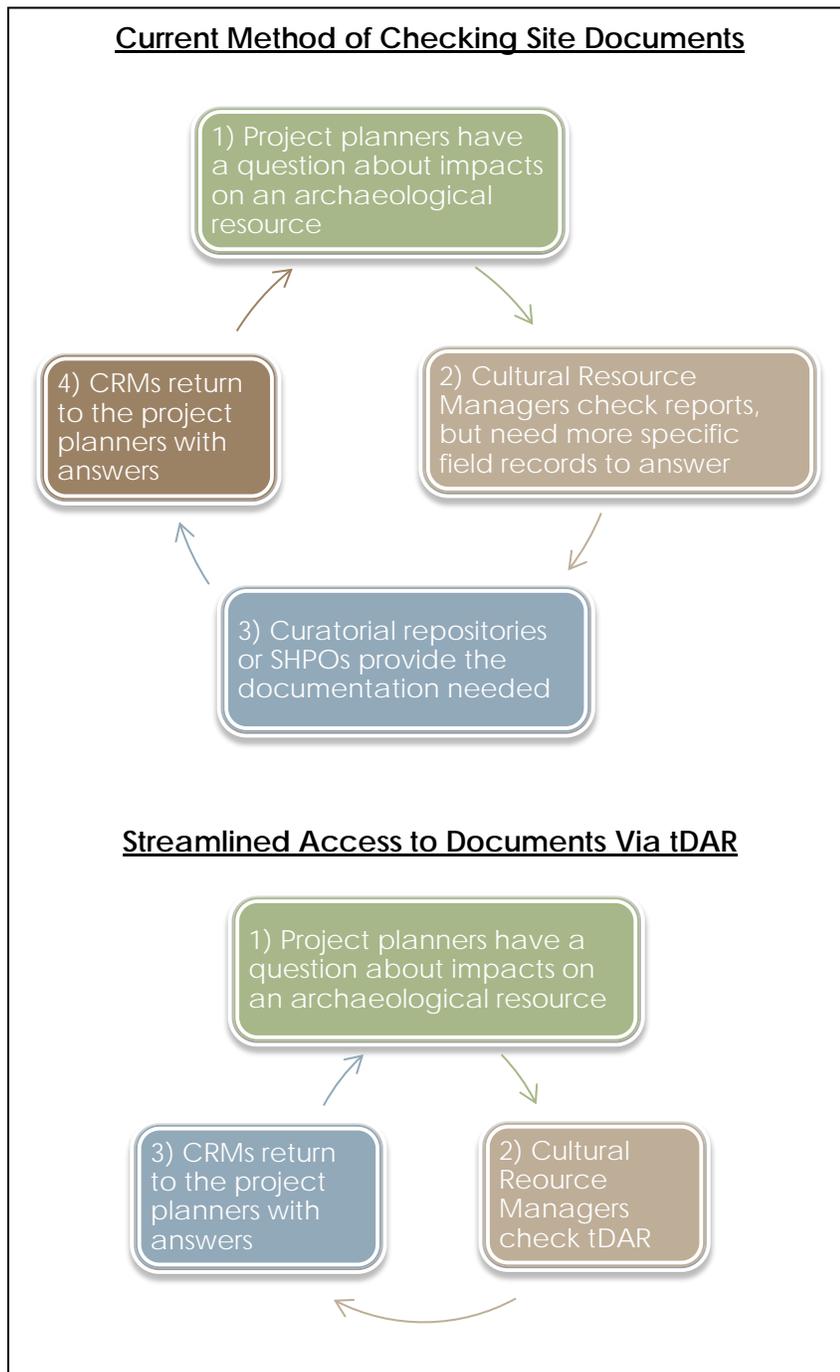
2) *tDAR makes cultural resource information accessible online, removing the need to contact physical curatorial repositories for access.*

Under the current system of archaeological documentation management, specific questions about site locations and survey results typically require a trip to collections repositories. CRM firms needing this information will charge installations for their time in traveling to repositories, or repositories may charge for making copies and sending them out. By using tDAR, the DoD could remove that step of the process by allowing cultural resource personnel direct access to digital documents no matter where the archaeological collections and paper records are stored, saving the DoD time and money (Figure 16).

3) *tDAR can eliminate inefficiencies caused by staff vacancies and turnover in cultural resource management offices.*

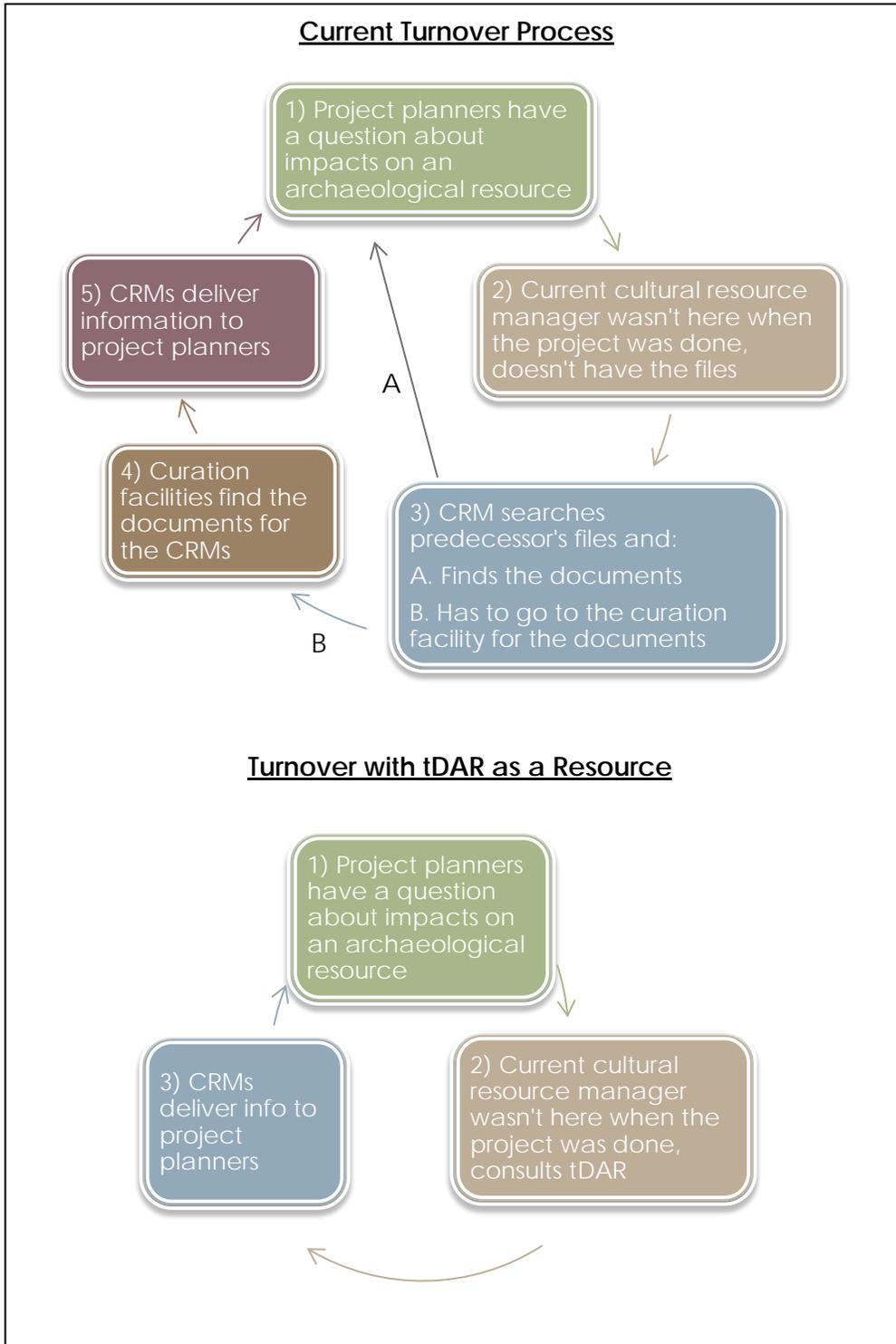
The feedback surveys included in this project show that installations are most likely to have problems with efficient cultural resource management when key staff positions are vacant or have a high rate of turnover (Appendix C; Case Study #7). At one installation, files were backed up on staff-specific protected hard drives that no other personnel could access, making the files useless once the hard drive user left. At another installation, the cultural resource management position has been vacant for over three years, leaving no one with specialized knowledge of these resources. Even if these situations do not lead to adverse

impacts on cultural resources, they almost certainly lead to inefficiencies and stress that could be avoided through better information management. It takes time for individuals to become familiar with the history of archaeological projects at any given location, and depending on how the files of past employees and projects are handled it is possible that new cultural resource personnel may not have enough information to be aware of all of the projects that have already taken place.



However, for digital files uploaded to tDAR, new employees would only need to know that tDAR should be consulted in order to gain access to project information in a centralized location. Additionally, if records and reports are scanned and uploaded for old projects that originally had no digital files, tDAR could represent a comprehensive resource on installation projects. This would allow any staff person who is tasked with cultural resource responsibilities to inherit a complete project history without having to clean out the office or computer files of their predecessors (Figure 17).

Figure 16: Getting detailed archaeological excavation information currently requires consultation of records at SHPOs or in curatorial repositories. If cultural resource managers have access to records via tDAR the process would be streamlined, saving time and money.



4) Developers and CRM contractors with a need-to-know can be given temporary access to archaeological files.

When construction takes place on DoD property near an archaeological resource, developers may be asked to avoid specific areas. In such cases, DoD cultural resource managers can authorize the developers to see only the relevant site information in tDAR. This would allow the developer to consult documents if a question arose, even if the cultural resource manager was not immediately available. Development can therefore proceed without delay and without impacting the archaeological resource. Developers who have access to archaeological data would have no excuse if they did something to destroy the resource, so information accessibility offers an

Figure 17: Every time cultural resource management responsibilities change hands, the person who takes over these duties is subject to a learning curve as they familiarize themselves with their new role and with the projects that have been done in the past. tDAR is a resource that can allow new staff members immediate access to project information without having to go through old files left behind by predecessors.

CASE STUDY #7

Installation POCs: Expertise and Turnover

Sara Rivers Cofield
Curator of
Federal Collections
Maryland Archaeological
Conservation Laboratory

I have been curating Federal collections at the MAC Lab for over 10 years now, and I have seen a lot of turnover in installation points of contact (POCs). For example, Andrews Air Force Base (now Joint Base Andrews) became a client in 2005 and since then my PoC with their cultural resources office has changed six times. As a result, I spend a lot of time helping new people understand archaeological curation.

Education is key, because only one of my installation PoCs is an archaeologist. The others typically ended up in cultural resource management as a lateral move or by acquiring new duties on top of preexisting ones. Cultural resource management is commonly grouped with environmental programs and that covers a broad range of activities. I have worked with people who specialized in history, wildlife management, and even pollution mitigation. When it comes to archaeology, these PoCs need access to people who are specialists in case they have questions. I am one of those people, as are the archaeologists at the SHPO and the CRM firms that get hired to conduct the work.

A major benefit of having tDAR as a resource is that new cultural resource managers can get immediate access to information on past projects, and I can use tDAR as a medium for helping people who are new to the field develop a better understanding of the archaeological resources they oversee.

extra layer of site protection.

5) tDAR facilitates nationwide access to cultural resource information.

Although cultural resources are typically managed at the installation level, centralizing all of the DoD's cultural resource information in one place may help the DoD develop new regional, command, service-wide, or cross-departmental strategies for managing archaeological sites. tDAR has data integration tools that allow registered users to carry out comparative research for resource management, public interpretation and outreach, and academic purposes. Nationwide access to archaeological information facilitates comparative studies that may lead to better predictive models for identifying and avoiding sites. Predictive models help the DoD identify sites that could delay important mission-driven projects.

6) tDAR may help provide information on site significance.

The more centralized archaeological data is, the easier it will be for cultural resource managers to evaluate site significance on a regional and national level. While SHPOs evaluate site significance and determination of eligibility (DOE) for the National Register of Historic Places, the DoD and SHPOs will

both be better informed if they have a centralized body of data including archaeological discoveries from all DoD properties. tDAR may not hold information about every site, but if it could be used to count how many sites have been documented of a particular type, such as 19th-century tenant farms or prehistoric lithic scatters, then this information may be useful for planning. Each installation could better assess the significance of a particular site by looking at other sites of a similar nature that have already been identified and evaluated by the DoD. Additionally, DoD site assessments can be compared to all other data in tDAR that does NOT belong to the DoD, allowing for comparison on a scale that is broader than what only internal DoD data would allow.

7) tDAR will save the DoD money.

Maintaining digital archaeological files long-term in compliance with Federal mandates (i.e. the National Historic Preservation Act, the Archaeological Resource Protection Act, and 36 CFR§79), requires specialized IT expertise, network maintenance, migration, hard drive storage, and above all, staff time. By partnering with one non-profit organization that specializes in this field, the DoD could eliminate the need to either maintain the data themselves or formulate multiple partnerships with certified digital repositories. DA-tDAR's one-time upload charge is more cost-effective than long-term digital data management at the installation level, and estimates also indicate that the use of tDAR would be more cost effective than the creation of a centralized DoD digital archaeological repository (See Section 5.3).

It must be acknowledged that the one-time fee will represent funds that the DoD does not currently pay, but that is not to say that NOT adopting tDAR could in any way save the DoD money. Neglect of digital files already costs the DoD some level of funding since it allows the investment in past projects to be lost. This may require archaeologists to revisit areas that have already been surveyed because the information the DoD already paid for is gone or irretrievable. These costs may not appear in annual operating budgets because they represent past expenditures, but the costs nevertheless far outweigh the one-time upload fees that would be added to project budgets for tDAR.

8) tDAR can ingest data from all DoD installations.

The broad range of installations involved in this project demonstrates tDAR's ability to ingest data from multiple kinds of installations in different departments within the DoD. Again, this streamlines cultural resource management so that each installation does not have to spend resources coming up with its own digital archaeological archive. tDAR strikes a balance between offering recommendations and standards for digital data and customizing access to that data to meet the needs of specific operations.

5.2 Question 2: What are the Potential Security Risks in Using tDAR and Can These Risks be Mitigated? – Sara Rivers Cofield, technical contributions by Adam Brin and Jodi Reeves Flores

5.2.1 Installation Security and Archaeological Work

The procedures summarized above for conducting archaeology on DoD property and preparing documentation for SHPO review and long-term curation indicate that several levels of security screening take place before records are submitted for curation, so images and documents with compromising information are generally absent from archaeological documents.

The one exception is site location information. Location data is essential to archaeologists, but can be sensitive for DoD installations. Fortunately, archaeologists are already well-versed in redacting and protecting site location information. It is standard operating procedure in the archaeological profession to keep this information private to prevent the looting and destruction of sites. Contributors putting materials into tDAR can redact location or other confidential information, and then upload both a confidential file and a public, redacted file. For the redaction policy employed by Digital Antiquity Digital Curators, see Appendix B, Part 5.

5.2.2 Confidentiality

The procedures developed for uploading data during the ECAMDAR project allowed each installation to determine which files, if any, should remain confidential. Again, location information was the primary focus in developing levels of confidentiality, but pictures of buildings, fences, and processing facilities were also cited in surveys as needing to remain confidential. Both location information and the confidential pictures could be essential resources for DoD project managers, but only on a need-to-know basis. For users to download files marked as confidential, they must request access from the listed “contact.” For this project the contacts are staff from the MAC LAB or RACF and the PoC for the installation if requested. Access is therefore restricted as needed for each installation without compromising the ability of authorized users to gain efficient access to site information. All of the installation PoCs surveyed for this project were satisfied with tDAR’s ability to meet their security needs (Appendix C).

One option not explored as part of this project was the ability to create citations within tDAR. This refers to resource pages with all the relevant metadata, but no file attached. This would remove any confidentiality risks and a user would still be able to discover that a file exists and request access. However, the file would not be preserved, removing one of the primary benefits of proper digital management and curation. Considering the level of review that the files pass through before being sent to Digital Antiquity, this option is not recommended.

5.2.3 Securing Digital Data in tDAR-

Installations should continue to screen archaeological documentation for sensitive military information prior to its submission for curation, and they should determine what is appropriate to upload to tDAR and what files should be redacted and marked as “confidential.” Then, the

use of tDAR should not result in security breaches that make sensitive photos or documents public. Only files that have been approved for public release will be available to registered users of tDAR; others will be redacted and the original copy will be marked as “confidential” to protect sensitive archaeological information. However, the digital sphere does present some security concerns that do not exist for artifact and paper records. The latter must be protected from physical theft and loss, but digital files must be protected from hackers, malware, viruses, and other cyber-attacks.

tDAR is developed with the security of its contributors in mind. tDAR has a 256-bit TLS 1.1 encryption and actions such as logging in, data entry, and record ingests (confidential or otherwise) all happen over a secure channel. Geo-location data for all sites less than one square mile are obfuscated. Content owners can control who may view accurate geographical information. The system is also designed to audit all data presented to the user, with specific careful attention to permissions and location information. All data the user does not have the right to see is obfuscated on the server prior to dissemination. Views and downloads of materials are digitally logged and maintained for two weeks in accordance with our privacy policy allowing us to audit breaches as identified.

Digital Antiquity has also automated tests that employ the same tactics that hackers use to compromise websites or obtain confidential files. Tests are run every time even the slightest modification of tDAR's source code is made. These tests comprise part of a suite of over 1,000 tests to confirm a version of tDAR is ready for deployment into production. Digital Antiquity regularly adds tests as new attack vectors or bugs are identified or features are added. tDAR is Open Source, which means that its security policies can be independently verified.

The data center that houses tDAR runs audits using a suite of common intrusion tools in order to find potential vulnerabilities. At the time of writing, tDAR has never failed such an audit. Digital Antiquity regularly monitors and patches all of its systems, and limits the applications that run on its machines to the minimum necessary to provide service.

Unauthorized access to tDAR's file store is prevented by employing multiple, redundant security measures. ASU restricts physical access to the data center which houses tDAR's file store. A firewall further restricts access to the machines that run tDAR, requiring physical access or VPN to administrative interfaces. The firewall protects not only from the external internet, but also heavily limits access to ASU's internal networks as well, by default blacklisting all requests unless specifically allowed. Digital Antiquity limits administrative access to the tDAR application to only those administrators who are trustworthy and require such access for their jobs. This list is audited regularly.

The fact that tDAR exists as a system separate from the DoD also adds a level of security for contributing installations. If tDAR were to be hacked in any way, there would be no impact to DoD servers, as there is no connection between the two systems. In other words, tDAR's

system for making archaeological records accessible could not be used as a 'back door' into secure DoD networks.

In case of catastrophic event, the data center's data is mirrored in a secondary location, allowing the recovery of data and the ability to run machines from that secondary location. Digital Antiquity also maintains a separate copy of the repository in a separate location. The redundant copies of the data, and instructions on how to restore the application, ensure that most disaster recovery situations can be addressed.

5.3 Question 3: Is the Use of tDAR Cost Effective? – Sara Rivers Cofield, with Digital Antiquity-related budgeting contributions by Francis P. McManamon and Jodi Reeves Flores

5.3.1 Cost-Benefit Introduction

Archaeological collections are the only evidence of prehistoric sites and many historic sites that are important to our national heritage, so these resources are priceless. However, the value that Americans place on shared cultural heritage is intangible, and can only be measured in dollars by examining the laws, regulations, and public agency budgets devoted to their care that are approved by the voting public. The Federal laws and DoD regulations that address archaeological resources trigger the investment of public funds in finding, assessing, preserving, and making available archaeological sites and collections and the information derived from them.

Costs associated with the management of cultural resources are accrued by the DoD in a number of activities, such as, developing and adopting policy, hiring cultural resource management personnel to oversee programs, paying CRM firms to conduct surveys and excavations, and curating the resulting collections. If curation is inadequate and collections are lost—be they artifacts, paper records, photos, or digital files—then the costs are twofold: 1) the value of the collection as an irreplaceable part of American heritage is lost, and 2) the dollar value invested in supporting DoD cultural resource programs and archaeological resource documentation and investigations is wasted. When collections are neglected and subject to loss, the DoD's entire investment in archaeology is at risk. This is not only contrary to policy and regulations; it is also a terrible misuse of public funds.

As this project has shown, however, the deposition of collections in 36CFR§79-compliant archaeological repositories for physical collections and records is not sufficient to ensure preservation of all documentation. Long-term digital file preservation is a specialization that typical museum-style physical repositories are not equipped to address, and there is no cheap solution.

In 1999, electronic records experts estimated that the cost of managing digital records long-term was roughly 10-16 times the cost of managing paper records, largely because of the need to actively update digital files through changes in software and hardware. Additionally, researchers determined that the cost of creating a digital file was only one third of the cost of digitization, with the remaining two thirds of costs covering metadata collection, cataloging,

and quality control (Vogt-O'Conner 1999). If the latter operations are not part of the initial investment, the entire digital file can be rendered useless (Eiteljorg 1998). However, these sources considered the manual migration and management of individual files, not efficient digital data archives such as tDAR which have developed within the last 15 years.

Digital records are an indispensable part of the associated records for archaeological collections and resources, so strategies have been developed to ensure that their preservation will not be prohibitively expensive in the long term. By integrating the perspective of continuing preservation and access of digital data into projects from the planning phase forward, these costs can be controlled and funds can be used efficiently. Systems now exist that can enforce file quality and metadata standards and do much of the maintenance and migration of files automatically under the direction of digital archive specialists. This makes for efficient preservation and management and brings down overall costs significantly. Digital Antiquity currently has such a system, but archaeological repositories for physical collections and DoD cultural resource programs do not.

The DoD may choose from any number of methods that would provide a digital archive. However, at present tDAR is the only digital archaeological archive available, so actual price comparisons between a variety of digital archives is not possible. A full cost-benefit analysis with dollar amounts would require research that exceeds the scope of the ECAMDAR project because essential data are not available.

What can be described, using information provided by the Center for Digital Antiquity, is the annual cost that the DoD would have to absorb if it were to create and maintain its own "in-house" digital repository. This cost can then be compared to the annual charges that would be incurred if archaeological data generated by DoD programs were deposited in tDAR where the data would be available (with controls) and preserved for future uses. This comparison assumes that the cost of maintaining the Center for Digital Antiquity would represent the minimum cost that the DoD would need to spend to maintain a single department wide "in-house" digital data repository. Of course, if each military branch and the USACE established and ran separate repositories, the annual cost would quadruple.

The estimates listed in the discussion that follows do not include associated costs of creating metadata records because this is a cost that would apply whether the DoD maintained an internal repository or used an external one. Instead, the focus of these estimates is the cost of entering each file into a system that will ensure long-term preservation and accessibility.

5.3.2 Cost-Benefit Estimates: Doing the Math

Digital Antiquity received initial startup funds from the National Science Foundation and the Mellon Foundation which totaled over \$3 million. This cost to create a digital repository is not included in the estimated annual costs described below. The annual cost of operating tDAR is just under \$750,000 (Table 5). Digital Antiquity's staff size ranges between eight and 10 depending on how many digital curators are employed on projects underway at any given time. This staff size and annual operating cost are likely the minimum numbers and amounts needed to maintain, operate, and regularly update a digital repository of the sort needed for DoD archaeological data and information. Such a repository must be capable of accepting the range of digital resource types and numbers of files that DoD archaeological and cultural

Table 5: Center for Digital Antiquity Estimated Budget for Operations in FY2015. Staff positions include: Executive Director; Director of Technology and programmer; second programmer; project coordinator; staff assistant; digital curators (3-5; more experienced and knowledgeable supervise less experienced).

Expense	Estimated FY 2015 Cost
Staff Salaries and Benefits	\$670,755
Equipment and Supplies	\$8,450
Computer Server & Software	\$6,500
Travel	\$33,475
Other Services	\$15,000
Total FY 2015 Budget: \$734,180	

resource investigations generate. The repository must be able to expand to include the amounts of digital storage required for the files and digital resources. The repository software also must be capable of allowing different levels of access so that general users can find and access most data, information managers can edit and maintain metadata for files associated with projects they have entered, and access to confidential records can be controlled.

In order to compare the annual cost of running a digital archive to the annual fees the DoD would pay tDAR to preserve their files, it is necessary to know how many digital archaeological files are generated by the DoD each year. The DoD collects information about its archaeological collections on an annual basis, but this data has concentrated on the cubic feet of artifacts and linear feet of paper records held by the DoD, so information has not been systematically reported on the number of digital files and MB of data that the department must curate. In the absence of such data, it is not possible to assess the actual cost of preserving the digital data files generated annually by DoD's archaeological activities. However, some information is available about the number of DoD archaeological projects undertaken each year, which can be used to come up with an estimate.

Since the mid-1980s, the National Parks Service Archaeology Program (NPS), on behalf of the Secretary of the Interior has collected from other federal agencies, including the DoD, information about their archaeological activities (NPS 2014). Based on data from these surveys, an average number of archaeological projects conducted each year from 1998-2008 can be established for the Navy and the Air Force (Table 6). The Army apparently has not reported to the NPS on the number of field investigations and data recoveries conducted since 1998, but an estimate for Army data is included in the following calculations based on the average number of projects undertaken by the Navy and Air Force. The resulting figures

therefore reflect the assumption that these three branches of the DoD have similar annual activities when it comes to archaeological work. Table 7 shows an estimated number of files per project based on the average number of files for 15 Army and Navy projects that were included in ECAMDAR. This data is then used to calculate how many total files might be expected from the DoD each year (Table 8)

Using the figures from Tables 6, 7 and 8 the digital data generated by the DoD on an annual basis can be estimated at about 30,000 files. Digital Antiquity charges file uploading and preservation fees on a sliding scale based on how many files are purchased at a time (See pricing in Appendix B, Part 7). If digitally curated as a single purchase for curation and preservation in tDAR, 30,000 files submitted by the DoD would qualify for the lowest bulk rate of \$5/file, and the total estimated annual cost would be about \$150,000 (Figure 18). This is far lower than the estimated annual cost of running a digital repository like tDAR, which is over \$730,000 (Table 5). If the total files were divided into a number of projects and uploaded separately by project, the cost per file would increase (Figure 18).

Table 6. Number of Air Force and Navy archaeological projects per year as recorded by the National Park Service Archaeology Program (2014). Some data is available dating back to 1985, but in order to target years that have generated digital files, only the period from 1998-2008 is included. Overviews represent general management non-project plans completed or updated under ARPA and NHPA (e.g. Integrated Cultural Resource Management Plans, forest overviews, preservation plans, historic context statements, archeological resource protection stewardship plans, etc.). Field investigations and surveys are studies carried out to identify (Phase I) and evaluate (Phase II) archeological sites. Data recoveries represent Phase III excavations.

DoD Units	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	Avg.
Overviews												
Navy & Marine Corps	72	40	0	377	398	53	26	52	258	49	58	123
Air Force & Air Nat. Guard	50	43	0	79	73	90	53	46	47	38	31	46
Army & Army Nat. Guard	2	21	130	117	149	155	0	68	25	34	69	70
Total Overviews												239
Field Investigations: Phase I & II Surveys												
Navy & Marine Corps	0	0	0	116	133	140	123	52	153	134	125	89
Air Force & Air Nat. Guard	0	0	0	140	185	132	268	168	231	286	249	151
Army & Army National Guard (Average of Air Force/ANG and Navy/Marine Corps)*												120
Total Phase I & II Surveys												360
Data Recoveries: Phase III Data Recoveries												
Navy & Marine Corps	0	0	0	11	17	8	9	13	21	29	21	12
Air Force & Air Nat. Guard	0	0	0	20	60	34	45	21	25	11	10	21
Army & Army National Guard (Average of Air Force/ANG and Navy/Marine Corps)*												17
Total Phase III Data Recoveries												50

* The Department of the Army and Army National Guard did submit data for the years 1998-2008, but the NPS spreadsheet shows zero field investigations and zero data recoveries for each of those years. This supposed lack of archaeological work is contradicted by the fact that the Army data listed the number of sites identified each year. Since sites cannot be identified without field investigations, it is likely that numbers simply were not recorded for field investigations and data recoveries, though they did take place. Because the data for the Army's "overviews" fell between the figures for the Air Force and Navy, the estimates offered for the Army's Phase I/II and Phase III surveys are an average of the Air Force and Navy figures.

Table 7: ECAMDAR projects used for projecting file estimates. DoD projects such as these represent the best real data available on which to make projections, but basing future file estimates on past performance has two problematic variables worth acknowledging. First, ECAMDAR did not have many recent Phase III studies that reflect projects completed since the rise of digital photography and documentation. Second, the studies that are recent include a lot of files that would probably be weeded out if standards were in place (See Section 4.2.6). Thus the file projections are probably too high for future Phase I and II surveys, and too low for Phase III data recoveries. Fortunately, the potential errors in these figures should cancel each other out.

Project	# Files
Phase I Surveys	
Phase I Investigations, Proposed Expansion of the Columbarium, US Naval Academy (2010.050)	60
Phase I Investigation of Spesutie Island, Aberdeen Proving Ground (1996.041)	44
Phase I Survey of 3,250 Acres, Naval Air Station Patuxent River (2004.029)	87
Phase I Investigations, Nebraska Avenue Complex, Washington D.C. (2010.067)	56
Phase I Investigation, The Button Site, Fort Lee (FL2009.007)	53
Phase II Surveys	
Phase II Investigation, Webster Field Annex, Naval Air Station Patuxent River (2013.016)	76
Phase II Archaeological Evaluation, Site 44CE069, Fort A.P. Hill (AP2012.001)	41
Phase II Investigations, P-140, Webster Field Annex (2013.019)	119
Phase II Investigations, Site 18ST372, Webster Field Annex (2010.062)	67
Phase II 18AN973 Downs Family Cemetery and Farmstead (2013.014)	75
Average for Phase I and II Projects: 68	
Phase III Surveys	
Phase III Investigations, Site 44PG317, Fort Lee (FL1990.002)	3
Phase II & III Investigations of 18CV361 and 18CV362, Naval Recreation Center Solomons (1999.024)	23
Phase I, II, III Investigations at 18ST704, Naval Air Station Patuxent River (2002.015)	68
Phase I/II Investigations at Gunpowder Meeting House & Phase III Investigation at Quiet Lodge, Aberdeen Proving Ground (2001.054)	20
Phase I, II & III Investigations for the G.A.T.E. Project, Aberdeen Proving Ground (2011.030)	439
Average for Phase III Projects: 111	

Table 8. This table uses the figures from Tables 6 and 7 to estimate the total number of digital archaeological files that the DoD might be expected to generate annually.

Estimating the Total Number of Projects and Associated Files				
	Overviews	Phase I & II Surveys	Phase III Data Recoveries	Annual File Estimate for DoD
Avg. # Projects (From Table *)	239	360	50	
Avg. # Files (From Table *)	<u>X 1</u>	<u>X68</u>	<u>X 111</u>	
Totals	239	+ 24480	+ 5550	= 30,269 Files

The Digital Antiquity prices illustrate the economy of scale that can be achieved when many users utilize the same digital repository. The pricing is on a sliding scale so that rates are cheapest when large numbers of file uploads are purchased as a unit (Figure 18). Some current Digital Antiquity clients (e.g., several NSF-funded research projects, a CRM firm, and the Corps of Engineers) have established agreements with Digital Antiquity to purchase a large number of file uploads up front to get the bulk rate, and then upload files as needed

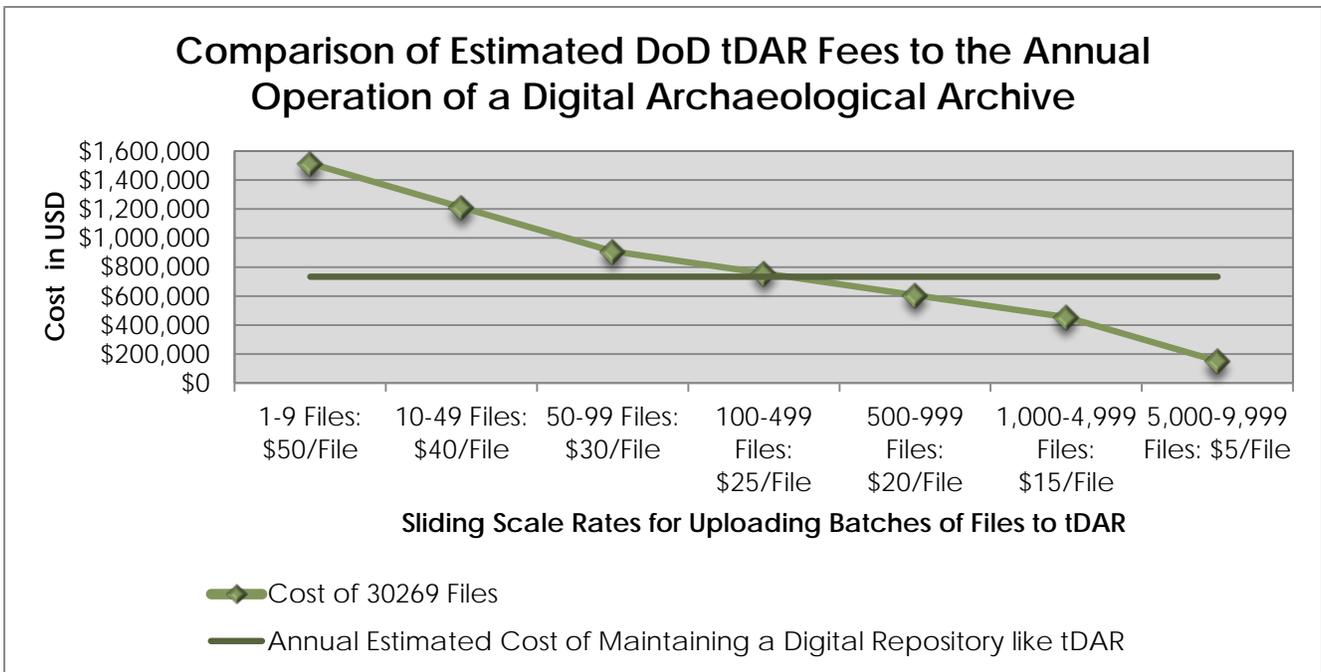


Figure 18: This chart shows how tDAR’s fees for uploading files compare to the cost of maintaining a digital archaeological repository. If tDAR’s fees can be kept at or below the \$25 mark by uploading files in batches of 100 or more, the DoD will either break even or save money by using tDAR instead of establishing its own repository. This chart does not take into account the estimated \$3 million in start-up fees for establishing a digital repository.

until they reach their limit. Such arrangements may work for the DoD if agreements can be negotiated service-wide, at the command level, or with groups of bases in order to obtain low per-upload fee rates.

However, based on the current cultural resource management practices of participants in the ECAMDAR project, it is worth considering what would happen if installations worked with tDAR individually. For example, the Army installations that partner with the MAC Lab for curation do so separately, and these installations, Aberdeen Proving Ground, Ft. Meade, Ft. Detrick, and Adelphi Laboratory Center, each have their own contracting and administrative systems. Each pays the MAC lab separately for annual archaeological curation services. If these four Army installations were to enter into a similar relationship with tDAR, they would not generate enough files each year to qualify for bulk rates, so higher fees would apply.

If the entire DoD were to adopt tDAR while maintaining separate agreements for each installation, such as the Army does with the MAC Lab, higher files fees would need to be considered. In a worst case scenario where all 30,000 files were charged as individual uploads (at \$50/file) the annual cost would be \$1.5 million (Figure 18). However, this scenario is unlikely for three reasons.

First, the installations in the ECAMDAR project illustrate that the highest rates certainly would not apply to everyone. For example, if submitted individually, Ft. Detrick’s 27 files would cost \$40.00/file (\$1,080), while Ft. A. P. Hill’s 1,395 files would cost \$15.00/file (\$20,925) resulting in an

average cost per file of \$15.47/file. Thanks to the sliding scale, even when a few files are submitted at high rates, the average when compared to files submitted in bulk stays pretty low. As Figure 18 shows, the DoD's overall average cost per file would have to exceed \$25.00 for the DoD to save money by running its own centralized digital repository.

The second reason that the DoD would be unlikely to lose money by using tDAR is that there are many ways to form groups within the DoD that would qualify for the lowest rates. For example, region-wide management such as employed by the Naval District Washington could facilitate an MOU between the Navy and tDAR that would lock in a bulk rate. Alternately, the DoD could designate a limited number of CRM firms or curatorial repositories as designated DoD-tDAR liaisons, thereby funneling all files through a few service providers to ensure that the bulk rates would apply each year. As long as most units could find a way to get group rates, either by working together within the DoD or through cooperative agreements with non-Federal CRM firms or repositories, it should be feasible to keep the fees at or below an average of \$25.00/file, making it more economical to partner with Digital Antiquity than to maintain a DoD archive.

The final reason that tDAR would be the most cost-effective option is that establishing and operating an internal digital repository for archaeological data would present significant administrative, financial, and technical challenges for the DoD. While there is no reason to doubt the DoD's ability to meet this challenge, it would probably be easier for the DoD the DoD ability to coordinate one or a few bulk agreements with Digital Antiquity, which would be more economical. Creating a single centralized DoD-run digital archive would require substantial start-up costs (likely to be several millions of dollars), as well as an estimated \$750,000 annual operating budget, while creating a single centralized agreement between the DoD and Digital Antiquity to preserve 30,000 files annually would cost approximately \$150,000.

If the DoD opted not to coordinate internally, either to establish a single archive or to create a single agreement with Digital Antiquity, the use of tDAR by different groups within the DoD would still be more economical than it would be for each division to establish its own archive. As Table 9 shows, the DoD could maintain up to 300 separate agreements with Digital Antiquity for the same price as running a single DoD digital archaeological archive. Table 9 also shows that if the DoD were to establish more than one digital archive of its own, there would be no possibility whatsoever of cost savings when compared to tDAR.

These estimates all suggest that the most cost effective management strategy for long-term preservation and management of the DoD's digital archaeological archives is either a unified DoD-wide agreement with Digital Antiquity or perhaps a set of agreements with individual services or commands that lock in the most economical rates for uploading files.

5.3.3 A Second Look at the Estimates

The amounts used for this cost-benefit study are only estimates, and many variables in the

Table 9: This table compares the cost of using tDAR to curate 30,000 digital archaeological files to the cost of maintaining one or more “in-house” DoD digital archaeological archives. Start-up costs, estimated at approximately \$3 million, are not included in the calculations.

Cost for DoD Use of tDAR				Cost for DoD “In-House” Digital Archive(s)	
# Cooperative Agreements	Files per Batch	Cost per File	Cost for 30,000 Files in tDAR	Number of Repositories	Total Annual Cost
1-6	5000+	\$5	\$150,000	1	\$750,000
7-30	1,000-4,999	\$15	\$450,000		
31-60	500-999	\$20	\$600,000		
61-300	100-499	\$25	\$750,000		
301-600	50-99	\$30	\$900,000		
601-3,000	10-49	\$40	\$1,200,000	2	\$1,500,000
3,001-30,000	1-9	\$50	\$1,500,000		
				4	\$3,000,000

data may impact the number of files generated each year. For example, if the file predictions for the Army were based on the number of sites identified each year instead of an average of the Navy and the Air Force, the resulting estimate would jump significantly (Table 10). However, the Navy and Air Force data suggest that there is not a direct relationship between the number of sites identified and the number of projects undertaken, so even though the Army identified more sites annually, there is not enough data to calculate the relationship between site identification and number of projects. Still, if the Army has far more or fewer archaeological projects each year than the Air Force and Navy, then the estimated number of projects used in Table 8 will be incorrect and the number of files generated by the DoD each year could be higher or lower than the estimated annual total of 30,000. Additionally, the estimate of 30,000 files/year generated by the DoD is based partially on data collected before 2008, and there has been a rapid increase in digitization over the past six years (See Figure 2).

Table 10: This table shows data from the NPS (2014) on the number of sites identified and the number of field investigations conducted. “Field Investigations” are defined in the survey as archaeological studies to identify (Phase I) and evaluate (Phase II) sites. Since the Army recorded zero field investigations from 1998-2008, theoretically they should not have identified any sites, yet 45,062 were recorded. This suggests that the Army did have Phase I studies but did not report them. Ideally, it would be possible to predict the number of field investigations based on the number of sites identified, but the Air Force and Navy figures indicate that increasing the number of field investigations does not necessarily increase the number of sites identified. One possible reason for the discrepancy could be that the Air Force has conducted more Phase II excavations, increasing the number of projects undertaken without identifying new sites. Unfortunately, this means that the number of sites identified cannot predict the number of projects undertaken or the number of digital files expected. For example, if the Army conducted field studies on larger parcels of land, the number of sites found could be high while the number of investigations remained fairly low.

	Total Sites Identified 1998-2008	Total Field Investigations 1998-2008	Average Sites Identified per Field Investigation
Army & Army National Guard	45062	No Data	No Data
Air Force & Air National Guard	5225	1684	3
Navy & Marine Corps	7416	1161	6

For these reasons, it is worth considering what a higher number of files would do to the cost estimates already outlined. The MAC Lab has seen an increase from 6,122 files submitted (including Federal and non-Federal collections) from 2007-2009 to 19,284 files submitted from 2010-2012; a threefold increase. If DoD digital data also experienced such a spike, and the annual number of records under consideration was estimated at 90,000 instead of 30,000, Digital Antiquity would still be cost effective at the \$5.00/file rate. If bulk fees apply and the \$5.00/file rate is used, the DoD would have to generate over 150,000 files annually before it was necessary to pay Digital Antiquity more than it would cost to maintain its own digital archive. This leaves room for the 30,000 annual file estimate to be off by a factor of five and still result in tDAR being the most cost-effective option. If projects are submitted separately at higher rates and the number of files exceeds 30,000 annually then the DoD might see some cost savings by having their own system. However, any savings would accrue only after the system has existed long enough for the cost savings over tDAR to exceed the initial startup costs, estimated at about \$3 million, of establishing a new digital archaeological archive.

Additionally, the number of digital files has jumped in recent years in part because CRM firms have not had to pay fees to submit digital records and they have not received guidelines that mandate the efficient creation and submission of digital data, as discussed in Section 4.2.6. When guidelines are implemented and fees for digital archiving are included in project budgets, the number of files submitted should plateau or decrease. The growth taking place at this time reflects new digital data collection techniques, but there is only so much documentation collected for any given site. Even if future documentation of archaeological sites is 100% digital, there will not be an ever-increasing amount of data intake. Instead, the data collected should rise and fall depending on how much archaeology is done rather than how much data is collected digitally. This means that the DoD may never reach the threshold whereby it would be cost effective to maintain its own digital archaeological archive.

The cost-benefit analysis for the ECAMDAR project is based on estimates, but it indicates that using tDAR to meet its digital curation requirements would be a less expensive means of managing DoD's important digital archaeological data and information than establishing a digital curation center within the DoD, especially when the startup costs for establishing a digital repository are considered.

5.3.4 Considering Other Options

It is typically a bad idea to hire a company's services without doing some comparative research. While there are no existing digital archaeological archives to compare to Digital Antiquity, there could be other options worthy of exploration. To that end, four possible solutions have been outlined for examination here:

- 1) Require existing archaeological repositories to maintain digital archives.
- 2) Establish a digital archaeological archive within the DoD.
- 3) Establish one or more partnerships with non-specialized digital archives such as libraries.
- 4) Adopt tDAR as a digital archive.

Each approach would incur costs, though the general and hypothetical nature of this discussion precludes the use of actual dollar amounts. Instead, each option is compared to a list of necessary attributes for a digital archaeological archive that can ensure the long term preservation and management of the DoD's archaeological records. For every attribute each option already has, only capacity and maintenance costs should be incurred. For every attribute each option lacks, additional costs would be triggered to make the option feasible.

Option 1: Require existing archaeological repositories for physical collections to create and maintain digital archives.

Archaeological repositories generally have professional staff members with a background in archaeology, and they can keep digital files together with the other components of archaeological collections, but substantial funding would be needed for them to become digital archives. The two repositories included in this project are leaders in professional standards and up-to-date facilities for the curation of physical objects and paper records, but neither could address digital archives properly without hiring new staff and adding IT infrastructure.

Many facilities lack the funding they need to maintain even basic physical curation needs like adequate storage space, collections managers, environmental controls and monitoring, etc. Furthermore, some installations are in regions where there is no 36CFR§79-compliant repository that will accept their collections at all, either because they do not exist, or because they are too full to accept new collections. This situation is generally known within the archaeological community as the "curation crisis" (Bawaya 2007; Bustard 2000; Childs 1995, 2004; Kodack and Trimble 1993; Thompson 1999). As the DoD works to ensure that all of their archaeological collections are properly curated, new facilities may be built with integrated digital archives in mind, but this would increase the funds needed to build and maintain repositories that do not yet exist.

Because access to archaeological repositories is not universal, and those repositories that do exist typically have only two of the five attributes a digital archive would need, Option 1 would require a very high level of investment to implement (Table 11).

Option 2: Establish a digital archaeological archive within the DoD for cultural resource management programs.

The DoD undoubtedly has secure hardware and software systems and well-trained IT specialists on staff. The department, therefore, has the ability to create digital data management programs for archaeological data and information that have multiple layers of access. However, according to the survey responses from cultural resource managers attached to the ECAMDAR project, this IT expertise is not currently accessible to the cultural resource managers for purposes of maintaining a digital archive.

Table 11: Overall summary of the attributes needed for archaeological repositories to become digital archaeological archives for the DoD, and the costs that would be associated with adopting this approach.

Necessary Attributes of a Digital Archaeological Archive	Accessible to CRM Programs	Not Accessible to CRM Programs
Expertise in archaeological data	✓	
Digital archivist(s) on staff		✓
Secure hardware/software systems		✓
Multi-layered access capability (ranging from public access to confidential files)		✓
Access to digital files and artifacts/paper records in the same location	✓	
Description of Expenses for a Digital Archaeological Archive	Type of Expense	
Hire a digital archivist for each repository that cares for DoD collections	Ongoing, multiple full-time salaries	
Purchase necessary hardware/software	Periodic investment	
Hire IT staff, including expert programmers, to develop and maintain the hardware/software	Ongoing, multiple full-time salaries	
Develop or purchase a digital data management program	Periodic investment	
Maintain sufficient space within the repository to house the new staff and equipment	Ongoing, infrastructure	

Installations vary greatly in terms of meeting the other criteria. A few have physical archaeological repositories on site while others use outside curation facilities. Depending on the size of the installation and the potential cultural resource management needs, some have archaeologists on staff while others assign cultural resource management duties to architectural historians, historians, or employees trained in the environmental side of resource management.

Thus the DoD may have all of the necessary attributes somewhere in the organization, but at present, these are not working in tandem to archive digital archaeological records. In order to create and maintain a DoD digital archaeological archive, the DoD could pursue either a cooperative effort that unites all DoD files in one system, or it could require different departments, regions, or installations to maintain their own digital archive. Both possibilities would require new programs and staff responsibilities within the DoD and the associated program creation and implementation costs. Based on the startup and annual costs of running the Center for Digital Antiquity, the DoD could expect to spend as much as \$3 million on start-up costs and \$3.65 million in annual operating cost over the next five years to establish one center (see Cost-Benefit Estimates: Doing the Math discussion above). In addition to this expense, the DoD would have to incur all of the costs associated with hiring and/or reorganization and housing of the new center(s).

Costs would also be incurred by the necessity of providing access to digital archaeological records. For purposes of national security, installations typically exercise tight control over their computer systems and data, severely limiting public access to files or even access by other

DoD personal or contractors who are not associated with specific facilities. Maintaining a digital archive that is accessible to researchers outside of the DoD in order to comply with 36CFR§79—and the intent of archaeological resource curation in general—would require a departure from policies that keep DoD data within the DoD. Maintaining a digital archive within the DoD may therefore incur more costs relating to security review and accessibility than adopting a digital archive that exists outside of the DoD (Table 12).

Table 12: Overall summary of the attributes needed for the DoD to establish its own digital archaeological archive, and the costs that would be associated with adopting this approach.

Necessary Attributes of a Digital Archaeological Archive	Accessible to CRM Programs	Not Accessible to CRM Programs	Explanation
Expertise in archaeological data	✓	✓	Some DoD facilities have archaeologists on staff, but many do not
Digital archivist(s) on staff		✓	Digital file preservation expertise may exist within the DoD, but the cultural resource programs in this study do not have access to such services
Secure hardware/software systems	✓		Security may or may not be too stringent to allow legitimate research access to archaeological data
Multi-layered access capability (ranging from public access to confidential files)		✓	The DoD has both confidential records and public ones, but again, the cultural resource programs in this study do not have access to programs that can centrally maintain both publicly available and confidential files
Access to digital files and artifacts/paper records in the same location	✓	✓	Some repositories are DoD facilities (i.e. the RACF), but others are not (i.e. the MAC Lab, universities, etc.)
Description of Expenses for a Digital Archaeological Archive		Type of Expense	
Hire a digital archivist for each installation or several for one central office		Ongoing, multiple full-time salaries	
Assign staff with archaeological background to the project		Ongoing, multiple full-time salaries	
Purchase or appropriate necessary hardware/software		Periodic investment	
Assign IT staff, including expert programmers, to maintain the hardware/software		Ongoing, multiple full-time salaries	
Develop or purchase a digital data management program		Periodic investment	

Option 3: Establish one or more partnerships with non-specialized digital archives such as libraries.

Digital archivists typically have a background in the library sciences that enables them to understand the specialized problems associated with maintaining digital files, and libraries are currently leaders in the long-term management of digital records. Some institutions, such as the Library of Congress and NARA, offer guidance to agencies with regard to file preservation, so it is possible that the DoD could partner with libraries to maintain their digital archaeological data. Models could be developed for submitting digital records to libraries just as artifacts and paper records are submitted to curatorial repositories.

The expenses incurred in this alternative would be in compensating libraries for their services, investing DoD resources in establishing and maintaining relationships with the libraries that accept the data, and maintaining specialized archaeological oversight. Compensation is an unpredictable variable in this scenario; some libraries might need a lot of incentive to partner with the DoD while others, such as NARA or the Library of Congress, might be predisposed to help as fellow Federal agencies. Just as with curatorial agreements, presumably scopes of work would need to be established for handling the DoD collections, and cultural resource managers would have to include maintenance of these partnerships as part of their ongoing duties. The DoD also would have to ensure that someone with specialized knowledge in archaeological collections was involved at the libraries in such a partnership. This would be an additional cost. Non-specialized archives like libraries tend to focus on providing access to information and they are unlikely to have specific archaeological expertise to ensure that the data are handled in accordance with professional archaeological practices (e.g. protection of specific site location information, exclusion of sensitive photos, etc.). The DoD would have to ensure that location information and confidentiality was protected according to each installation’s needs. This could be a relatively affordable option if the DoD could find a single archive willing to act as a centralized repository, minimizing the administrative costs of maintaining multiple partnerships, but it would require research and testing of potential partners, much like the ECAMDAR project has researched and tested tDAR (Table 13).

Table 13: Overall summary of the attributes needed for sending DoD archaeological data to a non-specialized digital archive, and the costs that would be associated with adopting this approach.

Necessary Attributes of a Digital Archaeological Archive	Accessible to CRM Programs	Not Accessible to CRM Programs
Expertise in archaeological data		✓
Digital archivist(s) on staff	✓	
Secure hardware/software systems	✓	
Multi-layered access capability (ranging from public access to confidential files)	✓	
Access to digital files and artifacts/paper records in the same location	✓	
Description of Expenses for a Digital Archaeological Archive	Type of Expense	
Research potential partners and test their capabilities	One-time	
Assign staff with archaeological background to the project	Ongoing, multiple full-time salaries	
Assign contract manager(s) to maintain partnership(s)	Ongoing, partial salary	
Compensate the partner archive(s)	Unknown: Could be a one-time fee or ongoing fees	

Option 4: Adopt tDAR as a digital archive.

Since Digital Antiquity and tDAR are the subject of this project and discussed in other sections of this report, it is not necessary to repeat all of its capabilities here except to say that at this time, it is the only option that already has the necessary attributes for managing the DoD’s digital archaeological records. The DoD would have to spend some staff time up front to

implement tDAR as part of its policies and procedures. Cultural resources staff would have to use some of their time managing their tDAR assets when changes are needed (i.e. staff changes require a change in authorized users). Some DoD or CRM contractor staff time would need to be devoted to training in the use of tDAR and as the tDAR program improves over time some refresher training would be useful. However, most of the costs of using tDAR for current and future digital data could be included as part of the cost of undertaking archaeological projects. The costs of uploading files to tDAR is a one-time fee (Appendix B, Part 7), so this cost can be covered as part of project costs. No additional charges will be incurred for the ongoing management and migration of the files (Table 14).

Table 14: Overall summary of the attributes offered by tDAR as a digital archaeological archive for the DoD, and the costs that would be associated with adopting this approach.

Necessary Attributes of a Digital Archaeological Archive	Accessible to CRM Programs	Not Accessible to CRM Programs
Expertise in archaeological data	✓	
Digital archivist(s) on staff	✓	
Secure hardware/software systems	✓	
Multi-layered access capability (ranging from public access to confidential files)	✓	
Access to digital files and artifacts/paper records in the same location	✓	
Description of Expenses for a Digital Archaeological Archive	Type of Expense	
Change DoD archaeological policy and procedures to include the use of tDAR	One-time, salary (staff time)	
Include tDAR fees in project budgets	One-time, project-by-project	
Assign cultural resource managers or collections managers as designated tDAR contacts	Ongoing, partial salary (some staff time is needed to manage tDAR assets)	

5.3.5 Comparison

Option 1 and Option 2 above would require significant investment and staffing that would need to be maintained long-term. The creation of new departments within existing facilities (DoD or otherwise) is expensive. In this case, the creation of new systems also falls under the category of reinventing the wheel. tDAR gives archaeological repositories access to the data associated with their collections, and it offers the DoD access to the data and control over who can see it. Additionally, the DoD has typically preferred to avoid building DoD programs that are not directly mission driven when it is feasible and cost-effective to adopt partnerships with specialized service providers such as Digital Antiquity. It would therefore not be cost effective for either repositories or the DoD to initiate a duplicate effort.

Option 3 represents the possibility that one or more libraries might be willing to handle DoD data in a manner similar to tDAR. While lacking archaeological specialization, this could be an option, but it is one that has never been tested. There is no way to know at this point whether any libraries would be interested in the partnership, and if so, what they would charge. A cost

would therefore be incurred in researching the option and establishing partnerships and protocols. Option 4 would not require that investment.

5.3.6 Cost-Benefit Conclusion

There is a significant cost associated with doing nothing to preserve digital archaeological files, so it is in the DoD's best interest to protect its investment in archaeology by adopting a cost-effective strategy now. The DoD has already established partnerships for the institutional management of artifacts and associated documentation, eliminating the redundancy that would exist if many installations established their own curation programs (Futato 1996). While these cooperative agreements are typically undertaken regionally or State by State to keep collections near their place of origin, digital records offer the opportunity for further cost savings by adopting a single centralized repository that would be accessible everywhere. At this time, adopting tDAR as the repository for the DoD digital archaeological records is the most cost-effective option.

5.4 Question 4: Why Should the DoD Create a Partnership with Digital Antiquity and Use tDAR Instead of its Own Internal IT Resources and Staff?

The ECAMDAR project has evaluated tDAR as a digital archaeological repository for the DoD, but this project has not technically evaluated the DoD as a potential digital archive for archaeological records. That is because the authors of this study cannot presume to understand all of the internal systems and capabilities of the DoD. It is therefore possible that within the DoD there is some kind of system that may serve as a long-term archive. However, this study has surveyed enough installations to know that if the DoD does have a digital archive, cultural resource managers do not currently have access to it (Appendix C).

The feedback surveys gathered for this project indicate that each installation varies in its management of cultural resources data. For the most part, it appears that each program is responsible for implementing its own system, and some are more organized than others. The programs cited many problems that frustrate digital preservation efforts:

- **Insufficient server space:** "The installation lacks sufficient server space to maintain digital files and backup files. The IT response has been to request that files be moved to CD/DVD; however, the cost of discs and associated storage issues (e.g., archival lifespan of discs and software compatibility of files) make this a poor option."
- **Staff turnover:** "We do not have an official filing system or library. Therefore maintenance of records and reports is dependent upon individuals. When those individuals move on, their files are either abandoned or boxed and sent to the National Archives. We have lost many past cultural resources this way."
- **Lack of key personnel:** "We have not had anyone actively managing our Cultural Resources Program for 3 years. Position remains vacant."

- **Inability to share data:** “Use of external hard drives has limited access to other personnel. Currently, only the assigned user of the hard drive can access it, so when I leave this position, those files are lost. Limited cloud space prevents long-term storage.”
- **Limited IT Support:** “IT support includes location (with buffered zone) and status/determination of site only.”

None of the systems described in the surveys include steps that meet the criteria of a digital archive. At most installations, files are saved and backed up, much like they are at curatorial repositories, but they are not necessarily migrated, monitored for corruption, or maintained in an accessible centralized repository (Appendix C).

In order for the DoD to maintain a digital archive that will protect its digital files in perpetuity as required for archaeological data, the DoD would need to initiate a new program, either by hiring additional staff and purchasing the necessary IT infrastructure, or reallocating current IT assets and using them to target the needs of cultural resource programs. In either case, the DoD would have to maintain its own offices, specialized staff, computer systems, etc. on a long-term basis. As described in Section 5.3.1, the DoD would potentially have to assume a minimum startup cost of approximately \$3 million, plus annual costs, to establish a digital archaeological repository, while trying addressing these obstacles that are intrinsic in the current IT system.

Furthermore, the new DoD program would need to be connected to servers that allow public accessibility, because archaeological records should not be stored in such a way that no one can discover that they even exist. Many DoD installations restrict access to data stored on their computers in ways that either ban public sharing of files, or require a lot of time and energy get permission to distribute files to the public. For example, the inability to use USB ports on Ft. Lee computers motivated the RACF to adopt CDs as the primary storage medium for archaeological records, and as a result, some data has already been lost (Case Study #2). Since archaeological documents should already undergo security screens before they are submitted to SHPO offices, it should not be necessary for them to have to undergo additional scrutiny every time someone outside of the DoD wants access.

As this project has outlined, some archaeological records do require confidentiality, but most were generated according to laws that were adopted because the public has an interest in its cultural heritage, even if the physical manifestation of that heritage is on DoD land. Public access to archaeological information is actually even more important when DoD security restricts public access to the sites themselves. Anything that improves the safe dissemination of DoD archaeological information is a public good.

The findings of this project suggest that the DoD should adopt tDAR instead of attempting to archive their own archaeological records for the following reasons:

- 1) tDAR already has an appropriate archive ready for immediate use and the DoD does not. In fact, both the Air Force and the Army Corps of Engineers already are using tDAR. Waiting for the DoD to establish a system of its own will likely lead to unnecessary file losses.
- 2) Spending one-time fees to archive digital records with tDAR is cheaper than building and maintaining one or more internal DoD archiving systems. Based upon the estimates developed for this assessment, the DoD could expect to spend between \$150,000 (\$5/file bulk rate) and \$1.5 million (\$50/file for each file separately) per year in fees to tDAR (Figure 18). The cost of starting a new DoD archive would be approximately \$3 million, plus \$750,000 in annual maintenance per digital repository.
- 3) Using tDAR as a system outside of the DoD poses no additional threat to information security or confidentiality. Only files that have already been screened for external distribution to SHPOs should be involved, and the confidentiality of site location information is maintained.
- 4) tDAR's system offers specialized archaeological expertise that current DoD IT professionals do not have.
- 5) tDAR can be used now by *all* DoD installations, customizing its format according to individual facility needs. A hypothetical digital archive formed by the DoD would need to be established for different branches, regions, and installations, or formed centrally through cooperation between different parts of the DoD. In either case, implementation would take time.
- 6) tDAR is inclusive and allows centralized storage and access cultural resource information from an unlimited number of landowners, not just the DoD. Internal DoD storage of archaeological records would keep them separated from all other cultural resources, decentralizing access to information.
- 7) 100% of the installation PoCs surveyed want to continue using tDAR, would consider writing tDAR into future scopes of work, and would support an effort to scan old records for inclusion in tDAR. While some respondents were reluctant to say whether tDAR would work for the whole DoD, none said that the DoD should NOT use tDAR, and most were willing to say that it should be used by the whole DoD. tDAR therefore has the support of the current DoD base and facility cultural resource managers who participated in this project.

In summary, the ECAMDAR project has concluded that the DoD is not currently maintaining its own digital archaeological records in compliance with archaeological collections management regulations. In order to do so, the DoD would need to invest significant resources in establishing a specialized program. Even if the DoD did invest the necessary resources at great expense, the resulting system would still keep DoD cultural resource information separate from non-DoD records, forcing researchers and the American public to seek out different sources in order to access information.

The capabilities of tDAR have been tested by ECAMDAR using DoD data in order to determine whether any effort on the part of the DoD to create its own archive is necessary or advisable. Based on the results of this study, there is no need for the DoD to create its own system because it can save money, maintain security, and protect its investment in archaeology by using the system that tDAR has already developed.

6. Recommendations

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The ECAMDAR project has demonstrated that the DoD's digital archaeological records represent a significant investment of public funds that currently are not being managed to prevent loss. This project has tested tDAR as a partner repository for the DoD's digital archaeological data and the results of the test are positive. tDAR is therefore recommended as a digital archive for the long-term management and preservation of the DoD's digital archaeological records.

6.1 Implementation

Using tDAR as a repository for DoD digital archaeological records can be accomplished through the implementation of new policies. 36CFR§79 offers guidance for securing professional curatorial services, entering partnerships with repositories, and drafting purchase orders or memoranda of understanding to facilitate such partnerships. These regulations took effect in 1990—well before the exponential increase in digital data collection over the last decade—but computer-generated files were included in the regulation as associated documentation requiring in-perpetuity curation. 36CFR§79 can therefore be used as a guiding regulation for securing the appropriate curation of digital archives as well as non-digital collections.

36CFR§79 emphasizes the need to keep artifacts and all associated documentation together, but the ECAMDAR project has demonstrated that proper care and maintenance of artifacts and paper records is different than professional archiving of digital data. Fortunately, digital records are relatively mobile and can be stored remotely without compromising accessibility. It is therefore not necessary to have the same curatorial repository be responsible for both kinds of data, as long as the repository with the physical collections can access the digital collections. It is therefore recommended that the DoD should adopt a two-pronged approach to archaeological curation that complies with 36CFR§79 while accounting for the different needs of analog data (artifacts, photo prints, paper, etc.) and digital data. Logistically, implementation of this recommendation will be different for existing digital archaeological data as opposed to data generated by new archaeological projects.

6.1.1 Submitting Data for New Projects

For new projects, the DoD can implement policies that ensure that resulting digital data is properly archived. Archaeologists should be given guidance for processing digital data, and submission of the data to tDAR should be included in project budgets and SOWs (Figure 18). Appendix D offers the following guidance to facilitate the process:

- 1) *Language for SOWs*. When archaeologists are hired to conduct investigations for the DoD, the SoW for the project should include requirements for uploading digital records to tDAR. Appendix D, Part 1 offers sample language for SOW requirements for digital curation, though each installation should customize the wording of their SOWs to ensure that the resulting tDAR content meets their particular needs.
- 2) *Digital Materials Requirements Form*. The purpose of this form is to offer installations a streamlined way to describe their digital curation requirements, including which digital materials should be generated, which materials should be confidential, and how the materials should be organized for ease of redaction. This form may be referenced in SOWs to further describe requirements when finalizing projects with CRM firms. See Appendix D, Part 2.
- 3) *Digital Curation Resource Guide*. This document offers advice to those processing digital data for tDAR. Recommendations about file naming, photo culling, and best-practices methods for getting organized will help archaeologists prepare data with tDAR in mind. See Appendix D, Part 3.
- 4) *Sole source justification*. Some installations may not be able to include tDAR in project budgets without either getting multiple bids for digital archiving or providing a sole source justification. See Appendix D, Part 4.

Individual programs can decide who should actually upload the files depending on how different sites manage their collections. Some installations may want to control the entire process for security reasons. Other programs may prefer to have archaeological repositories or CRM firms include tDAR data entry in their service contracts, especially if this helps lock in bulk rates (Figure 19). This will largely depend upon the operational relationships that have already been established. Regardless of who is responsible for the final tDAR entries, the guidelines provided in Appendix D can be modified to fit within any installation's chosen workflow.

The important thing about including tDAR in new projects is not where it fits into the archaeological workflow, but that it is included at all. Additional costs will be incurred for completing archaeological projects, but it is better to spend a little more to protect the project data than it is to risk losing the entire project investment by not caring for the resulting information. Furthermore, the tDAR uploading fees and the standards defined for processing digital archaeological data should motivate archaeologists to submit only "clean" and necessary data so that resources are not wasted on the careless collection of digital files.

6.1.2 Addressing the DoD Digital Backlog

The existing backlog of digital archaeological data collected as part of DoD undertakings will require work that cannot be facilitated through a policy change. Instead, this data has suffered neglect and intervention is needed. tDAR has proven that it can successfully migrate and import most old files, but it is not as easy as generating new files according to a preset standard.

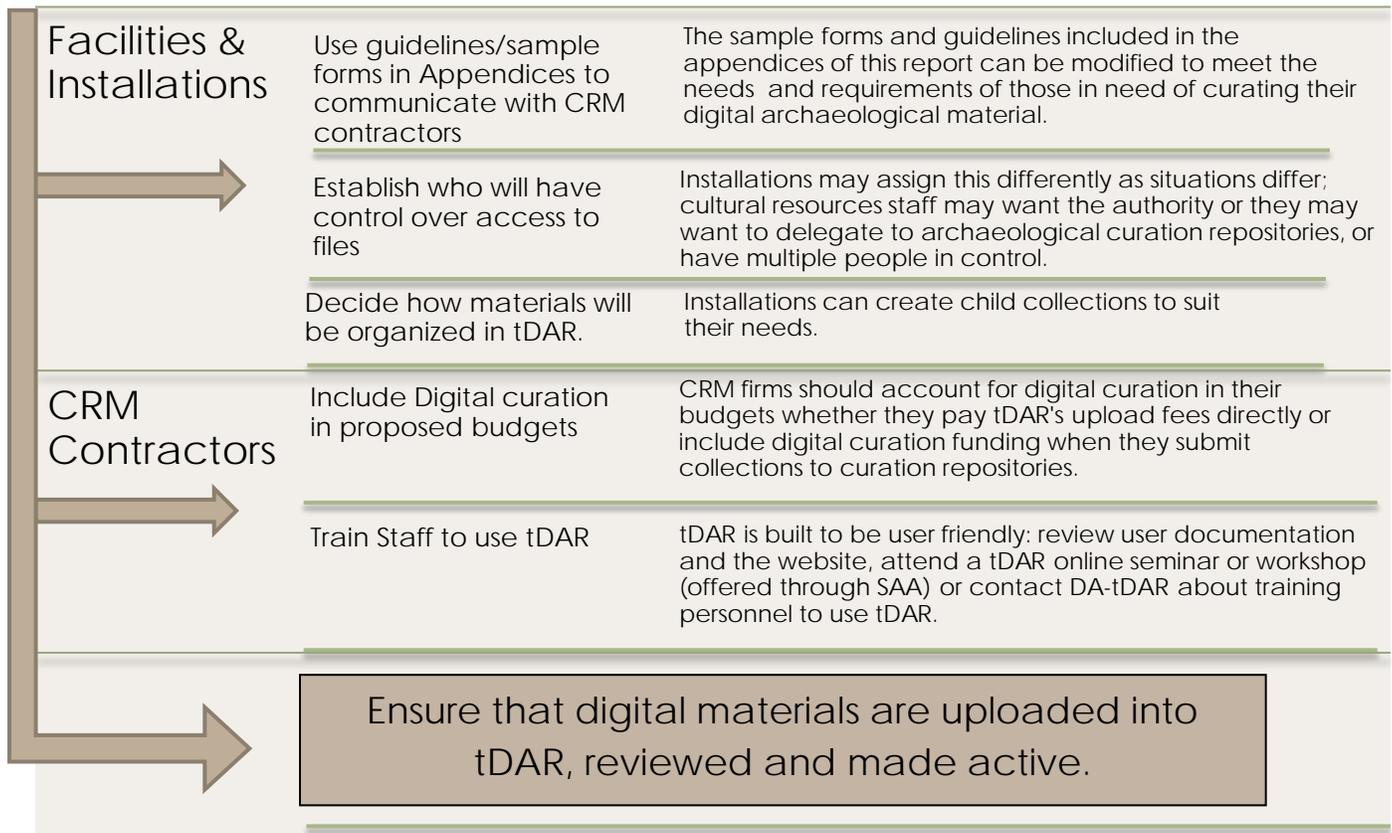


Figure 19: Installations and CRM contractors only need to integrate some simple steps to insure that digital archaeological materials are preserved.

The DoD has been working for decades to address the curation crisis that exists in not having adequate facilities for artifact curation, but many collections remain in limbo because some regions have no good curation options. Now there is a digital curation crisis as well. Although a repository is available for digital data that can work for any location, it may be difficult to locate digital files associated with projects that have yet to find a permanent curation facility. It is likely that these files exist on CDs in orphaned collections left with CRM firms, tucked away in offices or closets, or otherwise warehoused by installations that do not have access to 36CFR§79-compliant facilities. Digital files in such collections are at the greatest risk because there may not be anyone going through boxes to find CDs and back up the data they contain. The short life of most CDs makes it that much more essential that proper curation be secured for these collections so that the associated digital documentation is not lost.

For DoD units that have their collections in 36CFR§79-compliant repositories there should be systems in place that take digital media into account, either by backing up the data or by filing CDs with associated paper documents. These facilities should be able to access their

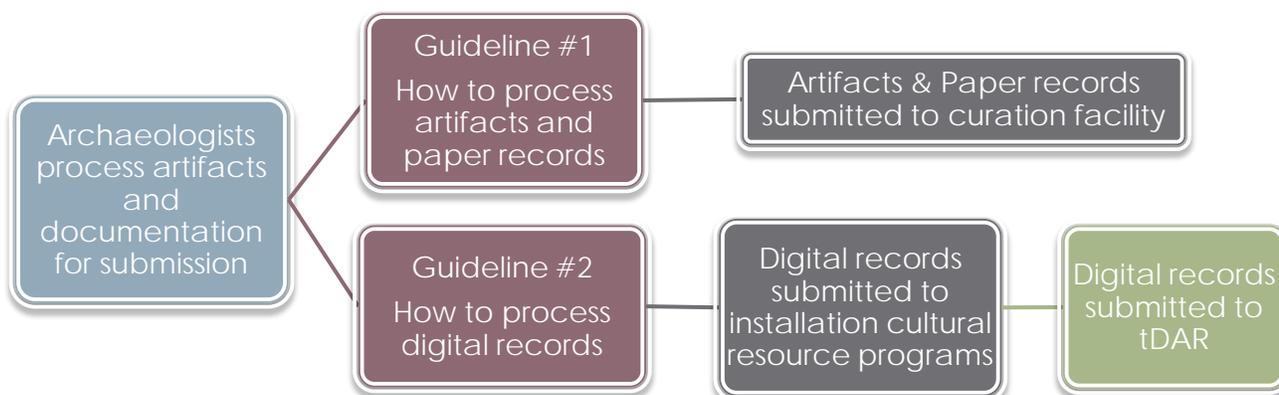
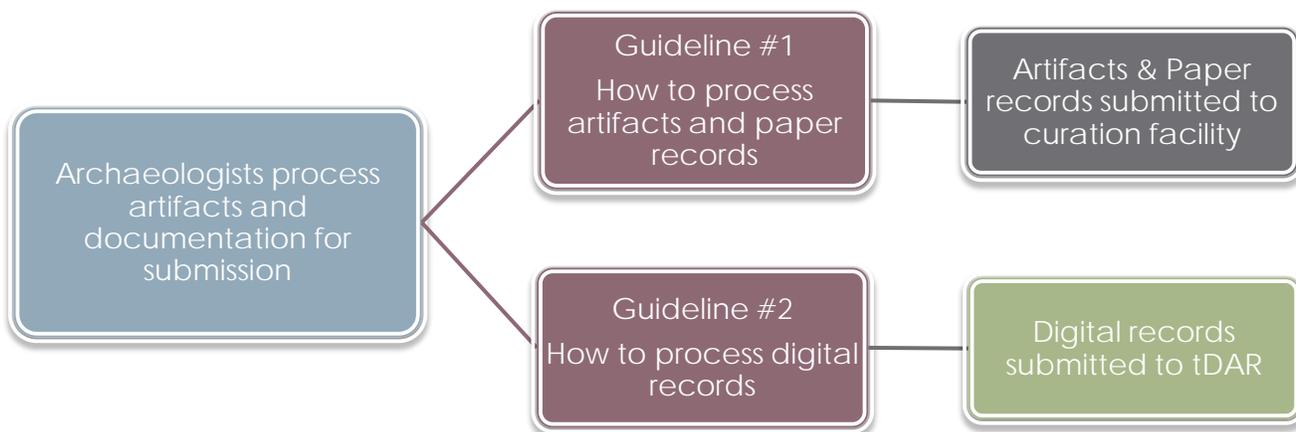
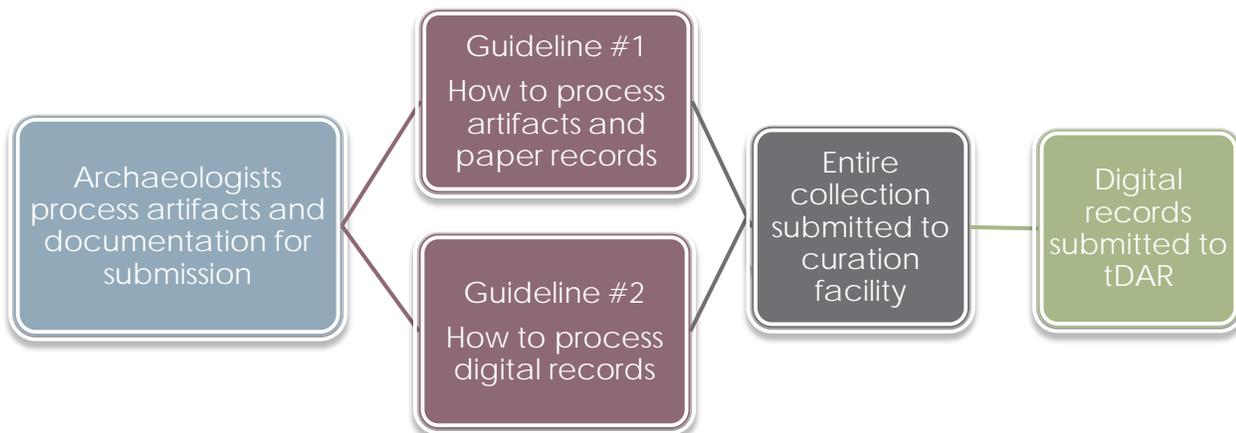


Figure 20: A two-pronged approach to archaeological curation would adopt different guidelines for digital records as opposed to artifacts and paper records. This would facilitate submission of digital data to tDAR by different parties, depending on the installation's preference. Some installations may add tDAR management to the duties of the curatorial repository (top workflow), others may require CRM firms to send the data to tDAR directly (middle workflow), and still others may want to have DoD cultural resource managers upload the digital files to allow additional internal screening for security and confidentiality (bottom workflow).

digital files as a first step in preparing them for tDAR, but funding will need to be secured before they can be uploaded.

As a first step, the ECAMDAR team recommends that the DoD include digital materials in annual data calls. Just as cubic feet of artifacts and linear feet of paper archives are tracked, digital materials should also be tallied annually. Each installation should report on the following:

- 1) ***Number of digital files curated as associated documentation:*** The number of files is important because each individual file requires its own metadata, migration, and monitoring. One file that is 10MB in size will require far less attention than 120 files that together take up 10MB of storage space.
- 2) ***Total storage (KB, MB, or GB) needed for the records:*** The total storage space needed is important for planning. tDAR's charges are based on storage space when users upload files and metadata.
- 3) ***Formats (Optional):*** The primary reason for including formats (jpg, tif, doc, pdf, etc.) in data calls is one of raising awareness. If people answering data calls cannot recognize some file formats, that is a red flag that brings the issue of digital data management to the forefront where it can be made a priority. This level of detail is more arduous to collect, however, and may not have as great an impact on planning as the number and size of files, so it is probably best left as optional instead of required information.

When this information is not readily available, installations may need a multi-part approach to digital data management that includes both a survey/inventory of existing files, as well as the entry of the files into tDAR. It tends to be difficult to obtain funding to revisit old collections even if the need is urgent, so the following suggestions are offered as strategies for funding digital data surveys and tDAR data entry:

- ***Gather justification documents:*** Installations should gather the information needed to justify the expense of assessing, migrating, and uploading old data. This includes:
 - ***36CFR§79.5(a):*** This specific section of the Federal regulation emphasizes that preexisting collections are the responsibility of the owner agency, that agencies must monitor repositories caring for preexisting collections, and when collections are not being properly managed and preserved, the agency must take steps to secure a repository that is able to meet the long-term needs of the collection.
 - ***Branch-specific regulations:*** Different departments within the DoD have generated their own guidance for complying with archaeological curation mandates (Table 4). These should be cited in project proposals.
 - ***Sole-Source Justification:*** Since tDAR is currently the only option in the U.S. for professional management of digital archaeological data, the justification can be made that they are a sole-source (Appendix D, Part 4). This may be needed to facilitate purchase orders since multiple bids cannot be obtained.

- *Keep an updated scope of work & quote on hand:* Having a scope of work, and a quote for services from tDAR to go with it, will allow programs to keep digital data management projects in the queue of work to be done. The project may have to be submitted several years in a row before it is funded, but it is essential to keep trying until the digital data are properly archived.
- *End of year funds:* Many Federal programs reach the end of a fiscal year and discover that they have some money left in the budget that they had not expected to have. If a scope of work and quote is already on file, these may be submitted to catch the end of year funds and complete the digital archive project.
- *Look out for grants:* Managing preexisting data should be a one-time expense if tDAR is adopted for new projects. Grants may therefore be a way to secure funding for preexisting digital data.
- *Put an intern on it:* If programs have access to interns or students, they might be assigned the task of gathering digital archaeological data and surveying the file formats and content. This will help prepare data for the upload process even if funds are not yet available to pay tDAR's uploading fees.
- *Establish partnerships:* Installations and their curation repositories may look into partnering with educational organizations or job-training programs. An excellent example that already exists is the Veteran's Curation Program (VCP), which puts veterans to work processing the DoD's archaeological collections while offering training in organizational and technical skills such as scanning, photography, and database management (Veteran's Curation Program 2014). Such a program could include training in file migration, metadata collection, and digital data organization so that files could be prepared for upload to tDAR.
- *Creative Mitigation:* SHPOs increasingly accept projects known as "alternative" or "creative" mitigation and entering digital data in tDAR could be such a project. The idea would be to let an adverse effect move forward without a traditional archaeological excavation; instead the funds that would have paid for that excavation could go to making digital data more accessible via tDAR. Collections-based work can often be justified in lieu of the creation of new collections if the result is increased accessibility and research value.

Retroactively addressing the management needs of neglected digital files is a challenging prospect, but worth the investment to prevent information loss. Fortunately, if programs can implement the use of tDAR, the ECAMDAR project has demonstrated that the DoD can stop information losses that result from neglecting digital records.

7. Conclusion

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In order to keep up with changing technology in the practice of archaeology, the DoD must adopt both a forward-thinking policy change and a view to preservation of past project data. The ECAMDAR project has shown that tDAR can be pivotal in preserving the DoD's existing and future digital archaeological records.

Implementation can be accomplished following the precedents set by 36CFR§79, the curation options projects conducted by the USACE St. Louis District, and successful DoD archaeological curation partnerships. Regulations encourage partnering with appropriate repositories so that Federal agencies can access archaeological expertise through cost-effective cooperative agreements instead of costly infrastructure and staffing (See section 2.2). Digital data preservation is a relatively new problem requiring a different kind of archaeological repository, but the solution for this next-generation curation crisis is the same as the solution for the curation of physical archaeological collections; formulate partnerships with affordable non-profits that specialize in archaeological curation.

The primary drawback to this kind of partnership is the loss of control over information. This is a crucial consideration for the DoD, which has more stringent security requirements than most other Federal agencies and must be vigilant in policing content released on the internet. A primary focus of the ECAMDAR project was therefore tDAR's ability to address security and confidentiality. The finding of the project is that as long as installations monitor archaeological data before it is released to SHPOs, and work with tDAR to implement their preferred confidentiality and redaction standards, tDAR does not represent a security risk to the DoD.

There are many advantages to using tDAR as described in detail above. In addition to its essential function as an archive that preserves digital information in-perpetuity, tDAR offers an unprecedented level of access to DoD digital archaeological records, which facilitates research and efficient installation cultural resource management. Additionally, tDAR is flexible enough to ingest data from different installations, regions, and curatorial repositories.

tDAR's unique position as the sole digital archaeological archive in the U.S. makes it the only existing repository that is able to manage the DoD's digital archaeological records immediately. This may cause some concern to the DoD since it is wise to worry about monopolies and the potential fees they can impose. However, as this report describes, the Center for Digital Antiquity, which develops and maintains tDAR, is part of Arizona State University, a public institution of higher education and public service which is not in a position

to undertake price gouging. On the contrary, a cost-benefit analysis comparing partnership with tDAR to partnership with a non-specialized digital archive, or the development of a digital archaeological archive within existing archaeological repositories or within the DoD, found that tDAR is the most cost-effective option available to the DoD.

There are benefits of having tDAR as the only digital archaeological repository for the DoD. The present system of having each installation implement its own cultural resource data management allows for inconsistent data management, redundant staff efforts at each installation, and great risk of information loss with staff turnover. The centralized nature of tDAR offers the opportunity to avoid these issues by implementing a DoD-wide policy so that everyone knows what to do with digital archaeological data and how to access it.

This report therefore finds that tDAR is the best possible curatorial partner for the DoD's digital archaeological data as of October 2014. Policy changes should be drafted to require the inclusion of tDAR in future DoD archaeological projects as soon as possible, and every effort should be made to enter existing DoD digital data in tDAR as well.

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2014 Cultural Resources firms John Milner Associates, Inc. (JMA), New South Associates, Inc. (NSA), and Statistical Research, Inc. (SRI), seek OEF/OIF veterans to work within the Veterans Curation Program (VCP) laboratories they manage under contract to the U.S. Army Corps of Engineers.

<http://www.veteranscurationprogram.org/home-page/4554769335>, accessed 2 October 2014.

Vogt-O'Conner, Diane

1999 Is the Record of the 20th Century at Risk? *CRM* 22(2): 21-24.

Appendix A:

Federal Laws and Regulations for Archaeological Curation

The Federal laws and regulations pertaining to archaeological curation have been compiled, summarized, and interpreted prior to the initiation of the ECAMDAR project. For purposes of describing the legal framework for archaeological curation, this appendix presents two documents:

- Part 1: An excerpt from the Commander's Guide To Archaeological Curation – Workbook, Defense Legacy Project 00-107: Legal Framework and Requirements for Curation (pages 4-9), and
- Part 2: Federal Laws and Regulations Requiring Curation of Digital Archaeological Documents and Data, by Cultural Heritage Partners, PLLC

The first of these documents summarizes legal requirements and regulations for archaeological curation specifically for the DoD. The second document is a legal analysis of the laws as they pertain to digital archaeological records. Together these documents offer the legal basis for requiring in-perpetuity curation of the DoD's digital archaeological records. Full citations for each source are included with the excerpts.

Legal Framework and Requirements for Curation

Federal legislation requiring curation or preservation of archaeological resources includes:

- National Historic Preservation Act of 1966
- Sec. 101(a)(7)(A) states that "the Secretary (of the Interior) shall promulgate, or revise, regulations...for curation, documentation, and local government certification ensuring that significant prehistoric and historic artifacts, and associated records, subject to section 110 of this Act, the Act of June 27, 1960 (16 U.S.C. 469c), and the Archeological Resources Protection Act of 1979 (16 U.S.C. 470aa and following) are deposited in an institution with adequate long-term curatorial capabilities." See 36 CFR Part 79 below.
National Environmental Policy Act of 1969
Sec. 101 (b)(4) specifies that it is the "continuing responsibility of the Federal Government to use all practicable means...and resources to the end that the Nation may - preserve important historic, cultural and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice; ..." This language may allow installations who are receiving funding allocated for NEPA compliance activities, to pay for archaeological collections rehabilitation and curation.
- Archeological Resource Protection Act of 1979
When necessary, an ARPA permit is required to conduct archaeological research on federal lands. The permit requires that any archaeological resources that are excavated or removed from public lands remain the property of the United States, and as such, these resources and copies of associated archaeological records and data will be preserved by a suitable university, museum, or other scientific or educational institution.
- Native American Graves Protection and Repatriation Act of 1990
NAGPRA requires consultation with affiliated tribes. The conditions under which collections are curated may be an issue that needs to be discussed during consultation. NAGPRA also requires that an inventory, summary, and publication of findings for those collections that fall under NAGPRA be made by all federal agencies.
- 36 CFR Part 79 Curation of Federally-Owned and Administered Archeological Collections (1991)
 - (a) All federally owned or managed collections, including both pre-existing and new collections, should be placed in an appropriate repository that has the capability to care for the long-term curation of collections.
 - (b) A "suitable" repository must demonstrate that it has the facilities, written curatorial policies, and operating procedures that satisfy 36 CFR Part 79 requirements.
 - (c) Installation commanders must sign an agreement with each repository outlining the conditions for curation of the collection.

- (d) If a collection was recovered from Indian lands, written consent is needed from the Indian landowner and the Indian tribe having jurisdiction over the land, before depositing the collection in a suitable repository.
- (e) Collections being deposited must be processed according to the chosen repository's standards.
- (f) Collections and services must be reviewed/inspected periodically by the federal agency.
- (g) It is the installation commander's responsibility for maintaining records of agreement with repositories where collections are located, along with a catalog of the collections and copies of the reports. Note: In the absence of an installation commander, as in the case of bases either closed and/or realigned, the responsibility is delegated up to the Major Command for that closed/realigned base.

DoD-wide guidance consists of:

Note: Military history collections guidance are not included here since archaeological collections fall outside each service's military museums' jurisdiction.

- Department of Defense Instruction 4715.3 (Environmental Conservation)(11/11/96)
The Instruction's purpose is to "implement policy, [and] assign responsibility (Section A. Purpose)" for managing natural and cultural resources, and states the DoD's commitment to identifying and curating archaeological materials in a manner that complies with legally mandated requirements (D.3.a). It also stipulates that "All DoD facilities and installations shall...plan, program, and budget to achieve, monitor, and maintain compliance with all applicable...regulatory requirements..." (D.1.b). Within the Procedures Section of the Instruction, it states that "Before disposing of DoD properties, the DoD Component with responsibility for the property shall: (1) Identify all significant natural and cultural resources" and (3) "Ensure that 'museum objects and documents' are identified and preserved." (F.1.k.1.(1)(3)).

Service-wide guidance includes:

- **U.S. Air Force**
 1. 13 May 1992 letter from CEV to All Air Force Major Commands Concerning Air Force Curation of Archeological and Historical Data, Signed By Col. Peter Walsh, Director of Environmental Quality, Office of the Civil Engineer
The two page letter emphasizes the need to curate archaeological collection according to the guidelines in 36 CFR Part 79, that repositories where these collections are located need to meet the same guidelines, that archaeological materials and the associated documentation should be curated in the same facility, and that use of the collections for research and ritual activities is permitted.
 2. Air Force Instruction 32-7065 (6/13/94)
Each Major Command should have a complete and current Cultural Resources Management Plan (CRMP). Field identification studies for archaeological resources

should be conducted using the Secretary of the Interior's Standard for Identification. The Instruction does not address curation as part of the CRMP.

3. HQ Air Mobility Command, Curation Guidelines for Archeological Collections (Draft)
The guidance first defines basic collection management terms such as associated records, collection, and material remains. Criteria for choosing a repository are presented along with the standards that the repository should follow to properly care for collections. The guidance ends with suggestions for processing both material remains and associated documents to ensure that they will be available in the future.

- **U.S. Army**

1. Army Regulation 200-4 (1/8/98)

The regulation describes general policy requirements for archaeological resources and historic properties that all Army component agencies need to address as part of their environmental compliance programs. Curation is specifically addressed in section (2-7) on compliance with 36 CFR Part 79. *Installation commanders* are responsible for compliance with the requirements of 36 CFR Part 79. AR 200-4 recommends against establishing curation facilities on post. Any requests to do so, must be accompanied by a cost analysis that demonstrates the cost effectiveness of on-post curation versus existing professional curation facilities. Procedures to reduce the amount of archaeological materials collected in the future should be incorporated into Integrated Cultural Resource Management Plans (ICRMPs) and other management documents.

2. Department of the Army PAM 200-4 (1/8/98)

The pamphlet is a companion to AR 200-4 and restates the regulation's guidance for curation (Chapter 3-8), but emphasizes that collections must not be stored in inappropriate facilities, that installation personnel should inspect repositories for adherence to 36 CFR Part 79, and that curation must be cost effective. A "no collecting" policy is stressed for initial identification studies, thus archaeological materials are described in the field but not collected. This is intended to reduce the volume of materials to curate.

- **U.S. Army Corps of Engineers**

Note: USACE tailors federal laws and regulations affecting the curation of archaeological collections to its civil works program through Engineering Regulations (ER) and Engineering Pamphlets (EP). Military activities follow the requirements set forth by Army Regulations (AR) and are not generally applicable to the Corps civil works program. Army requirements are discussed above.

1. ER 1130-2-540 (November 15, 1996), Environmental Stewardship Operations and Maintenance Guidance and Procedures, Chapter 6, Cultural Resources Stewardship
Chapter 6 "establishes the policy for the management and protection of cultural resources at operating civil works water resources projects for which the U.S. Army Corps of Engineers is responsible." Section 6-2 describes the function of the MCX-CMAC as managing "Corps-wide curation needs assessments and design services." A Curation Field Review Group was previously established by the Director of Civil Works and provides comments on the MCX-CMAC Corps-wide curation programs.

2. EP 1130-2-540 (November 15, 1996), Environmental Stewardship Operations and Maintenance Guidance and Procedures, Chapter 6, Cultural Resources Stewardship
Chapter 6 “establishes guidance for management of collecting, preserving and curating archeological and historical materials at civil works resource projects . . .”
Section 6-4 provides guidelines for access and use of Corps collections. Section 6-5, *Guidance for Collection Management*, includes standards for processing and placing collections into collections management centers as well as standards to be followed by the centers in providing curation services. The section concludes with the funding mandates for the care of archaeological collections.
- **U.S. Navy and U.S. Marine Corps**
 1. SECNAVINST 4000.35 (8/17/92)
The Instruction provides overall policy guidance for cultural resources but does not specifically mention curation. It does not reference 36 CFR Part 79.
 2. OPNAVINST 5090.1B, Environmental and Natural Resources Program Manual, CH1 (2/2/98), Chapter 23 (Historic and Archeological Resources Protection)
Every Archaeological Resources Protection Act permit holder must ensure that all artifacts are properly curated (23-4.4). The Commander, Naval Facilities Engineering Command (COMNAVFACENGCOM) issues ARPA permits for Navy lands and is also responsible for the “disposition of archeological collections (23-6.2).” All shore installation commanding officers shall “provide for storage and professional curation of salvaged archaeological resources [and] provide for storage of records that might accrue in carrying out legal compliance activities (23-6.6.k).”
 3. Marine Corps Order P5090.2A, Environmental Compliance and Protection Manual (7/10/98), Chapter 8 (Historic and Archaeological Resources Protection)
Curation of archaeological resources and records is mentioned as one of the responsibilities of an installation’s Commanding General or Commanding Officer (Chapter 8, Section 301, No. 11) for compliance actions.

Citation:

U.S. Army Corps of Engineers, St. Louis District
2005 *Commander’s Guide to Archaeological Curation – Workbook*. Defense Legacy Project 00-107, Mandatory Center of Expertise for the Curation and Management of Archaeological Collections. Electronic document, <http://www.denix.osd.mil/cr/Policy/Laws-Executive-Orders-Regulations-DoD-Policy-and-Guidance.cfm>, accessed 6 October 2014.

Part 2: Federal Laws and Regulations Requiring Curation of Digital Archaeological Documents and Data, by Cultural Heritage Partners, PLLC. Reproduced in its entirety.

Citation:

Cultural Heritage Partners, PLLC
2012 Federal Laws and Regulations Requiring Curation of Digital Archaeological Documents and Data. Prepared for Arizona State University. Electronic document, <http://www.tdar.org/wp-uploads/www.tdar.org//2013/05/2013-CHP-Legal-Analysis-of-Fed-Req-for-Curation-of-Dig-Arch-Docs-Data-.pdf>, accessed 6 October 2014.



CULTURAL HERITAGE PARTNERS, PLLC
innovation for preservation

Federal Laws and Regulations Requiring Curation of Digital Archaeological Documents and Data

Cultural Heritage Partners, PLLC

Prepared for: Arizona State
University

October 25th, 2012

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This report by Cultural Heritage Partners, PLLC describes and analyzes federal requirements for the access to and long-term preservation of digital archaeological data. We conclude that the relevant federal laws, regulations, and policies mandate that digital archaeological data generated by federal agencies must be deposited in an appropriate repository with the capability of providing appropriate long-term digital curation and accessibility to qualified users.

Federal Agency Responsibilities for Preservation and Access to Archaeological Records in Digital Form

Federal requirements for appropriate management of archaeological data are set forth in the National Historic Preservation Act (“NHPA”), the Archaeological Resources Protection Act (“ARPA”), the regulations regarding curation of data promulgated pursuant to those statutes (36 C.F.R. 79), and the regulations promulgated by the National Archives and Records Administration (36 C.F.R. 1220.1-1220.20) that apply to all federal agencies. We discuss each of these authorities in turn.

Statutory Authority: Maintenance of Archaeological Data

Archaeological data can be generated from many sources, including investigations or studies undertaken for compliance with the NHPA, ARPA, and other environmental protection laws. The NHPA was adopted in 1966, and strongly supports historic preservation activities and programs, including archaeology. The NHPA requires that archaeological data be: 1) maintained permanently in appropriate data bases, 2) made available to potential users, and 3) deposited in an institution with adequate long-term curatorial capabilities, including the ability to ensure access to and long-term preservation of archaeological digital documents and data.¹

The NHPA mandates:

“[e]ach Federal agency that is responsible for the protection of historic resources, including archaeological resources pursuant to this Act or any other law shall ensure... records and other data, including data produced by historical research and archaeological surveys and excavations are permanently maintained in appropriate data bases and made available to potential users pursuant to such regulations as the Secretary shall promulgate.”²

The NHPA also directs the Secretary to:

¹ See generally 16 U.S.C. 470a.

² 16 U.S.C. 470h-4(a)(2).

“promulgate, or revise, regulations... ensuring that significant prehistoric and historic artifacts and associated records, subject to Section 110 of this Act, the Act of June 27, 1960 (16 U.S.C. 469c), and the Archaeological Resources Protection Act of 1979 (16 U.S.C. 470aa and following) are deposited in an institution with adequate long-term curatorial capabilities.”³

The term “associated records” is defined broadly in the accompanying regulations and includes digitally recorded data such as “computer cards and tapes, computer disks and diskettes.” These regulations are described in more detail in the following section of this report.

ARPA protects archaeological resources and sites on public (federal) lands and Indian lands. It also calls for the preservation of objects and associated records in a suitable repository once recovered from a site. ARPA was enacted in 1979 in recognition of the fact that archaeological resources are an irreplaceable part of America’s heritage and they are increasingly endangered because of the escalating commercial value of some kinds of artifacts.⁴ ARPA also speaks to the need for access to and preservation of the results of archaeological investigations. It establishes that:

“the archaeological resources which are excavated or removed from public lands will remain the property of the United States, and such resources and copies of associated archaeological records and data will be preserved by a suitable university, museum or other scientific or educational institution.”⁵

In the spirit of generating public and professional awareness of and interest in the archaeological records, ARPA then goes on to stipulate that “[e]ach Federal land manager shall establish a program to increase public awareness of the significance of the archaeological resources located on public lands and Indian lands and the need to protect such resources.”⁶

ARPA then imposes a qualified duty upon the Secretary of the Interior to expand the archaeological data base and encourage mutual access to archaeological records among private individuals and professional organizations:

“...the Secretary shall, to the extent practicable and consistent with the provisions of this chapter, make efforts to expand the archaeological data base for the archaeological resources of the United States through increased cooperation between private individuals referred to in paragraph (1) and professional archaeologists and archaeological organizations.”⁷

This language from ARPA clearly shows the statutory requirement of expanding, preserving and requiring the accessibility of U.S. archaeological records derived from public lands and, read

³ 16 U.S.C. 470 a(a)(7)(A).

⁴ *Archeology Law and Ethics*, National Park Service, <http://www.nps.gov/archeology/public/publicLaw.htm> (last visited Oct. 25, 2012).

⁵ 16 U.S.C. 470cc(b)(3).

⁶ 16 U.S.C. 470ii(c).

⁷ 16 U.S.C. 470jj. The referenced individuals in paragraph 1 are “private individuals having collections of archaeological resources and data which were obtained before the date of the enactment of this chapter (October 31, 1979).”

together with the NHPA and more recently promulgated regulations, even more clearly demonstrates the affirmative duties the law imposes upon federal agencies and their agency heads to expand, preserve and make accessible archaeological records.

Regulatory Authority: Adequate Long-Term Curatorial Services

The Secretary of the Interior, under the authority granted by the NHPA, has promulgated regulations pertaining to the curation of federally owned and administered archaeological collections. In 1990, these regulations, which apply to the activities and undertakings of all federal agencies, were published in final form as “36 C.F.R. 79: Curation of Federally-Owned and Administered Archaeological Collections.” Under these regulations, collections include both “material remains” (*e.g.*, artifacts, specimens, etc.) recovered as part of an archaeological investigation, as well as the “associated records” generated by and describing the investigation and analysis of the archaeological project. The scope of applicability of these regulations is extraordinarily wide both as to the records covered and the duties associated with those covered records. Section 79.3(a) states:

“[t]he regulations in this part apply to collections, as defined in §79.4 of this part, that are excavated or removed under the authority of the Antiquities Act (16 U.S.C. 431–433), the Reservoir Salvage Act (16 U.S.C. 469–469c), section 110 of the National Historic Preservation Act (16 U.S.C. 470h-2) or the Archaeological Resources Protection Act (16 U.S.C. 470aa-mm).”⁸

Directly on point regarding the curation of digital data, it goes on in Section 79.3(a)(2) to include in its coverage:

“[d]ata that are generated as a result of a prehistoric or historic resource survey, excavation or other study are recorded in associated records, as defined in §79.4 of this part. Associated records that are prepared or assembled in connection with a Federal or federally authorized prehistoric or historic resource survey, excavation or other study are the property of the U.S. Government, regardless of the location of the resource.”⁹

As the owners of these public records, federal officials are responsible to ensure their long-term preservation and availability for educational, scientific, and other appropriate uses, as described generally in Section 79.10.

Section 79.3 of the regulation concludes by imposing a sweeping duty upon federal agencies to ensure that repositories preserve, maintain, and curate digital data derived from investigations instigated by the agencies:

“[a]ny repository that is providing curatorial services for a collection subject to the regulations in this part must possess the capability to provide adequate long-term curatorial services, as set forth in §79.9 of this part, to safeguard and

⁸ 36 C.F.R. § 79.3(a).

⁹ 36 C.F.R. § 79.3(a)(2).

preserve the associated records and any material remains that are deposited in the repository.”¹⁰

A review of these duties reveals the depth of responsibilities that these regulations impose upon federal agencies and agency heads in the area of adequate long-term curatorial services. According to the 36 C.F.R. § 79.5,

“[t]he Federal Agency Official is responsible for the long-term management and preservation of preexisting and new collections subject to this part. Such collections shall be placed in a repository with adequate long-term curatorial capabilities . . . appropriate to the nature and content of the collections.”¹¹

The regulations further specify the “standards to determine when a repository possesses the capability to provide adequate long-term curatorial services,” including the ability to “. . . catalog, store, maintain, inventory and conserve the particular collection on a long-term basis using professional museum and archival practices,”¹² as well as “provide access to the collection.”¹³ Qualified repositories must further comply with a lengthy list of other capabilities as appropriate to the nature of the collection (see generally 36 C.F.R. § 79.9).

With respect to digital records, the regulations specifically require “[s]toring a duplicate set of records in a separate location; or [e]nsuring that records are maintained and accessible through another party.”¹⁴ Section 79.10 refers to the use of collections and requires the “Federal Agency Official shall ensure that the Repository Official makes the collection available for scientific, educational, and religious uses...”¹⁵ The regulations specify a depth and breadth of defined records that only begin in Section 79.4(a)(2) with the following:

“[a]ssociated records means original records (or copies thereof) that are prepared, assembled and document efforts to locate, evaluate, record, study, preserve or recover a prehistoric or historic resource. Some records such as field notes, artifact inventories and oral histories may be originals that are prepared as a result of the field work, analysis and report preparation. Other records such as deeds, survey plats, historical maps and diaries may be copies of original public or archival documents that are assembled and studied as a result of historical research. Classes of associated records (and illustrative examples) that may be in a collection include, but are not limited to: (i) Records relating to the identification, evaluation, documentation, study, preservation or recovery of a resource (such as site forms, field notes, drawings, maps, photographs, slides, negatives, films, video and audio cassette tapes, oral histories, artifact inventories, laboratory reports, computer cards and tapes, computer disks and diskettes, printouts of computerized data, manuscripts, reports, and accession, catalog and inventory records).”

¹⁰ 36 C.F.R. § 79.3(e).

¹¹ 36 C.F.R. § 79.5.

¹² 36 C.F.R. § 79.9(a).

¹³ 36 C.F.R. § 79.9(b)(9).

¹⁴ 36 C.F.R. § 79.9(b)(6)(ii) and (iii).

¹⁵ 36 C.F.R. § 79.10(a).

See 36 C.F.R. § 79.9¹⁶ for the full and rather extensive set of defined archaeological records encompassed by federal regulations.

The Law on Records Management by Federal Agencies

Federal law imposes an affirmative duty upon the heads of federal agencies to establish safeguards against the destruction of digital archaeological records not otherwise scheduled for destruction. As machine readable materials, digital archaeological records meet Section 3301 of 44 U.S.C. Chapter 33's definition of "records":

"records" includes all books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics, made or received by an agency of the United States Government under Federal law or in connection with the transaction of public business and preserved or appropriate for preservation by that agency or its legitimate successor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the Government or because of the informational value of data in them."

Section 3105 protects against unscheduled destruction of these records in that:

"[t]he head of each Federal agency shall establish safeguards against the removal or loss of records he determines to be necessary and required by regulations of the Archivist. Safeguards shall include making it known to officials and employees of the agency-- (1) that records in the custody of the agency are not to be alienated or destroyed except in accordance with sections 3301-3314 of this title, and (2) the penalties provided by law for the unlawful removal or destruction of records."

Congress has enacted statutory rules for the retention, management and disposal of federal records (see 44 U.S.C. Chapters 21, 29, 31, and 33). Federal agencies¹⁷ are responsible for establishing and maintaining a records management program that complies with NARA and GSA regulations and guidance.¹⁸

The associated records from archaeological investigations conducted in compliance with the NHPA and ARPA meet the definition of "federal records" at 44 U.S.C. 3301 and federal agency records management programs must apply to the associated records. "Records" or "Federal records" is defined in 44 U.S.C. 3301 as quoted at the beginning of this section.

The National Archives regulations require that "[a]gencies must create and maintain authentic, reliable, and usable records and ensure that they remain so for the length of their authorized retention period."¹⁹ In the case of associated archaeological records, that retention

¹⁶ 36 C.F.R. § 79.9 (b)(1) and 36 C.F.R. § 79.9 (b)(6).

¹⁷ "Federal agency" means "any executive agency or any establishment in the Legislative or Judicial branches of the Government (except the Supreme Court, Senate, the House of Representatives, and the Architect of the Capitol and any activities under his direction)." 44 U.S.C. 2901(14).

¹⁸ 36 C.F.R. § 1220.10(b).

¹⁹ 36 C.F.R. § 1220.32.

period is set by the NHPA, which mandates that the associated record be permanently maintained.²⁰

The National Archives regulations also require that agencies protect records against technological obsolescence²¹ and, at 36 C.F.R. § 1236.28, specify requirements for maintenance of electronic records storage media for permanent records. Even more importantly, 36 C.F.R. § 1236.14 mandates in many respects a higher duty of care in the curation of digital records than the law might otherwise demand for more traditional physical records, given the established fact that many types of digital records degrade and ultimately become unusable as records. To wit:

“[a]gencies must design and implement migration strategies to counteract hardware and software dependencies of electronic records whenever the records must be maintained and used beyond the life of the information system in which the records are originally created or captured.”²²

Because federal agency heads know or should know that digital archaeological records degrade and ultimately become unusable, the law implies a duty on the part of federal agency heads to curate and preserve digital archaeological records not otherwise scheduled for destruction in formats and repositories that ensure that they will not degrade and become unusable.

Policy Authority: Mandated Use of Industry Standards

Increasingly, archaeological records and data are being recorded electronically. Legal and regulatory mandates require that these electronic data be curated effectively so that they are accessible for current appropriate uses and subject to long-term preservation for future availability and use. Up-to-date digital curation methods and techniques need to ensure that the requirements are met effectively. However, in most of the repositories that currently store digital archaeological data, the digital storage media that contain digital data (*e.g.*, computer disks and magnetic tapes) are the focus of curation rather than the information encoded as discrete bits of data.²³ Such a curating method focusing on digital storage media fails to meet the standard

²⁰ 16 U.S.C. § 470h-4(a)(2).

²¹ 36 C.F.R. § 1236.14. “To successfully protect records against technological obsolescence, agencies must:

- (a) Determine if the NARA-approved retention period for the records will be longer than the life of the system where they are currently stored. If so, plan for the migration of the records to a new system before the current system is retired.
- (b) Carry out upgrades of hardware and software in such a way as to retain the functionality and integrity of the electronic records created in them. Retention of record functionality and integrity requires:
 - (1) Retaining the records in a usable format until their authorized disposition date. Where migration includes conversion of records, ensure that the authorized disposition of the records can be implemented after conversion;
 - (2) Any necessary conversion of storage media to provide compatibility with current hardware and software; and
 - (3) Maintaining a link between records and their metadata through conversion or migration, including capture of all relevant associated metadata at the point of migration (for both the records and the migration process).
- (c) Ensure that migration strategies address non-active electronic records that are stored off-line.”

²² 36 C.F.R. § 1236.14.

²³ Departmental Consulting Archeologist, *Secretary of the Interior’s Report to Congress on the Federal Archeology Program, 2004-2007*, Archeology Program, National Park Service, Washington, D.C., 2010, at 50–53, <http://www.nps.gov/archeology/SRC/reportPdfs/2004-07.pdf>; see also Joshua Watts, *Policies, Preservation, and Access to Digital Resources: The Digital Antiquity 2010 National Repositories Survey*, Reports in Digital Archaeology #2, Sept. 2011, at 6–7, 10–11, 17–18, 20–25, available at http://www.digitalantiquity.org/wp-uploads/2011/07/20111215_Final.pdf; S. Terry Childs & Seth Kagan, *A Decade of Study into Repository Fees for Archaeological Collections*, Studies in Archaeology and Ethnography #6, Archeology Program, National Park Service, Washington D.C., 2008, at 7–8, available at <http://www.nps.gov/archeology/pubs/studies/study06A.htm>.

expressed in the NHPA for three reasons. Archaeological data are at risk because the physical digital media is subject to degradation,²⁴ because the physical nature of digital media renders the data inaccessible to the vast majority of potential users,²⁵ and because the digital format of the information may become unusable due to software and hardware advances.

First, digital media are inadequate for long-term preservation because removable magnetic and optical media (*e.g.*, magnetic tapes, floppy disks, compact disks and digital video disks) deteriorate over time. In his report to Congress, the Secretary of the Interior acknowledged that digital media are not archival and “many begin to degrade in less than a decade,” adding, “[w]e are on the verge of permanently losing significant amounts of carefully collected data.”²⁶ Irreplaceable archaeological data are at risk because magnetic and optical media gradually, but inevitably, ‘rot.’²⁷ Because of this inevitable deterioration, removable magnetic disks and optical media are not an adequate permanent means of storing digital data even though a curating facility may carefully package digital media and place that media securely on a shelf in a repository.

Second, removable digital media and individual computer hard drives are inaccessible to a vast majority of qualified researchers because the media is available only within the repository.²⁸ Researchers or others with legitimate interests who are seeking access to archaeological data must first submit a request to the curating institution for copies of the data.²⁹ The curator must then search, locate, access, and extract the data from the media. This method also presumes interested researchers have knowledge that pertinent information exists and where it is held. It has been established that, while many collections are laudable for the quality of their content, metadata, and preservation techniques, they often remain obscure, unknown, and therefore inaccessible to their intended user populations.³⁰ It is not at all difficult to extrapolate on this basis that there is a large volume of archaeological data produced annually that is not used efficiently and effectively because interested persons are often unaware of data already obtained and reported.

²⁴ Barry M. Lunt, Ryan Sydenham, Feng Zhang & Matthew R. Linford, *Digital Data Preservation: The Millennium CD and Graceful Degradation*, Brigham Young University, at 1, http://fht.byu.edu/prev_workshops/workshop07/papers/3/Digital-Preservation.pdf (last visited Oct. 25, 2012). ²⁵

Julian Jackson, *Digital Longevity: the Lifespan of Digital Files (compiled for R&D in Digital Asset Preservation)*, Digital Preservation Coalition, <http://www.dpconline.org/events/previous-events/306-digital-longevity> (last viewed on Oct. 25, 2012).

²⁶ See Departmental Consulting Archeologist, *supra* note 23, at 51.

²⁷ See Lunt et al., *supra* note 24.

²⁸ See Departmental Consulting Archeologist, *supra* note 23; Watts, *supra* note 23.

²⁹ See, *e.g.*, State of California Resources Agency, *Guidelines for the Curation of Archaeological Collections*, May 7, 1993, at 11, available at <http://www.ohp.parks.ca.gov/pages/1054/files/guide93.pdf>; South Carolina Institute of Archaeology and Anthropology, *Curation, Loan and Access Policy*, Feb. 2005, at 15, available at <http://www.cas.sc.edu/sciaa/pdfdocs/cm2005.pdf>.

³⁰ Robert A. Schrier, Syracuse University, *Digital Librarianship and Social Media: The Digital Library as a Conversation Facilitator*, D-Lib Magazine, July-August 2011, available at <http://www.dlib.org/dlib/july11/schrier/07schrier.print.html>.

Third, archaeological records and data physically stored on digital media become inaccessible as hardware and software technologies advance, making older technology obsolete.³¹ The Blue Ribbon Task Force on Sustainable Digital Preservation and Access wrote in February 2010 that:

“[t]he pace of innovation in data-intensive research is so rapid that there is always the risk stewardship practices embraced today will be superseded by new ones tomorrow. Strategies and best practices should be flexible enough to adapt rapidly to changes in technology, selection criteria and data uses.”³²

English Heritage’s Management of Research Projects in the Historic Environment Technical Guide to Digital Archiving and Digital Dissemination advises that:

“[i]f data is not in a format that can be stored or migrated effectively then this may mean that primary data – i.e. data which was only collected in a digital format – is lost. In the case of archaeological sites which have been excavated, then there will be no way of repeating the collection of the information.”³³

Inaccessible data is essentially lost, contributing to the factors that make using digital storage media an inappropriate method of curating data.

The nature of digital storage media, which is subject to degradation, accessible only within the repository, and in danger of obsolescence makes it an inadequate means of curating digital data under the professional standards Congress expressed in Section 112(a)(2) of the NHPA and ARPA.³⁴

By implementing adequate data migration and using metadata, digital repositories fulfill the long-term preservation and access standards for curating institutions established by the federal archaeological curation regulations and the National Archives regulations. Data migration is the process of copying digital data from one format to another making certain data can be read by current versions of software.³⁵ This process prevents data loss by rescuing the data before it becomes stranded and inaccessible on outdated media and in obsolete formats.

³¹ Jeff Rothenberg, RAND Corporation, *Ensuring the Longevity of Digital Information*, Council on Library and Information Resources, Feb. 22, 1999, at 2, available at <http://www.clir.org/pubs/archives/ensuring.pdf>.

³² The Final Report of the Blue Ribbon Task Force on Sustainable Digital Preservation and Access, *Sustainable Economics for a Digital Planet: Ensuring Long-Term Access to Digital Information*, National Science Foundation, Andrew W. Mellon Foundation, Library of Congress, UK Joint Information Systems Committee, National Archives and Records Administration, and the Council on Library and Information Resources, Feb. 2010, at 56, available at http://brtf.sdsc.edu/biblio/BRTF_Final_Report.pdf.

³³ English Heritage, *Management and Research Projects in the Historic Environment – MoRPHE Technical Guide 1 Digital Archiving and Digital Dissemination*, May 2006, at 5, available at <http://www.english-heritage.org.uk/publications/morphe-technical-guide-1/morphetechnicalguide1.pdf>.

³⁴ 16 U.S.C. 470h-4(a)(2) and 16 U.S.C. 470jj.

³⁵ *Data Migration*, Wikipedia: The Free Encyclopedia, http://en.wikipedia.org/wiki/Data_migration (last visited Oct. 25, 2012); see also *Ensuring the Integrity, Accessibility, and Stewardship of Research Data in the Digital Age*, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine of the National Academies Press, Washington, DC, 2009, at 8–9, 109–13, 120, available at http://www.nap.edu/openbook.php?record_id=12615&page=R1; Blue Ribbon Task Force, *supra* note 32, at 10–12, 73–79, 98–105.

Appropriate digital repositories facilitate access to stored data by assigning metadata to digital records. Tagging documents with metadata enables researchers to search and locate relevant information efficiently, thereby maximizing accessibility.³⁶ Appropriate digital repositories implement data migration processes and collect metadata necessary to ensure the long-term preservation of, and access to, data thereby meeting the federal curation and records management standards.

Conclusion

We at Cultural Heritage Partners, PLLC, have completed our conduct of due diligence in reviewing and analyzing federal access and preservation requirements as they apply to digital archaeological data. We have established that the NHPA and ARPA require that archaeological data be maintained permanently in appropriate data bases, made available to potential users, and deposited in an institution with adequate long-term curatorial capabilities. We have noted the government-wide regulations (36 C.F.R. § 79) to meet the statutory requirement of “adequate long-term curatorial services.” We have documented the policy demands of Congress and the federal agencies in insisting that repositories that maintain digital archaeological data meet industry standards of long-term preservation and access for curating institutions as mandated by the NHPA and ARPA and the National Archives regulations. We put particular emphasis on the duty that federal law imposes on federal agency heads to establish safeguards against the deterioration or destruction of archaeological records. Read together, we conclude that the relevant federal laws, regulations, and policies mandate that digital archaeological data generated by federal agencies must be deposited in an appropriate repository with the capability of providing appropriate long-term digital curation and accessibility to qualified users.

Cultural Heritage Partners, PLLC is a Washington, D.C.-based law firm that focuses on cultural resource management and cultural heritage issues. More information available at www.culturalheritagepartners.com

³⁶ Jeff Santilli, *Using Metadata Effectively in OS X*, Gigaom (Feb. 1, 2007), <http://gigaom.com/apple/using-metadata-effectively-in-os-x/>.

Appendix B:

Digital Antiquity and tDAR Policies and Information

This appendix includes tDAR policies and information that are accurate as of 30 September 2014. For the most up-to-date version of these documents, visit <http://www.tdar.org/> unless otherwise specified.

Part 1: tDAR Metadata Categories

Part 2: tDAR Terms of Use

Part 3: tDAR Contributor's Agreement

Part 4: tDAR Access Permissions

Part 5: DA-tDAR Digital Curation Redaction Policy

Part 6: File Formats Accepted by tDAR

Part 7: Pricing Information for tDAR

Part 1: tDAR Metadata Categories

tDAR is updated frequently. This list of metadata categories used by tDAR is up to date as of 30 September 2014. For further information on the metadata fields used in tDAR, view the complete Data Dictionary at <https://dev.tdar.org/confluence/display/TDAR/Data+Dictionary>.

tDAR Metadata Fields

General Fields

Field Name /Field Group	Resource Types	Description
Basic Information (High-level information about the nature, type, and location of the resource.)		
Title	ALL	A descriptive (or formal) title for the project or information resource. For maximum utility, full titles should be used instead of acronyms. Poor titles include "dataset," "coding sheet."
Year Created	ALL	Four digit year - If your resource does not have a date published, please use the year the image was taken, or document was created.
Description	ALL	A brief summary or abstract (200-300 words) of the project or information resource (or alternative process) from which the data collection arose
Project Name	All except for projects.	The project to which the resource belongs
Status	ALL	A piece of administrative metadata that controls the resource's status within the archive. Options are: ACTIVE DRAFT (not available to public) FLAGGED (has issue) DELETED
Publisher	All except for projects (thesis / dissertation & presentation)	The name of the document publisher
Publisher Location	All except for projects (thesis / dissertation & presentation)	The location of the publisher

Field Name /Field Group	Resource Types	Description
Author / Creator (Names of individuals and institutions who contributed to the resource. This category repeats as a group of fields.)		
Person		
First Name	ALL	The first name of the creator - Middle names and initials should also be included here
Last Name	ALL	The last name of the creator
Email	ALL	The last known contact email for the creator
Affiliated Institution	ALL	The last known institutional affiliation for the creator
Role	ALL	The role that the creator performed for the resource (see Resource Creator Roles for list and definitions)
Institution		
Institution Name	ALL	The name of the institution
Role	ALL	The role that the institution performed for the resource (see Resource Creator Roles for list and definitions)
Identifiers - Item Specific or Agency Identifiers (This category repeats as a group of fields)		
Identifier Name	All except coding sheets and ontologies	Name of any agency or project identifier
Identifier Value	All except coding sheets and ontologies	A list of the specific identifiers known for the resource
Investigation Types		
Keywords	ALL	A list of the investigation types relevant to the resource. Select the investigation types that most closely correspond to the nature of the effort that produced the project or information resource.
Site Information (The names, types, and other information about the sites.)		
Site Name	All except coding sheets and ontologies	A list of the site names associated with the resource - If the project or information resource is primarily focused on one or a few sites, list relevant site names or numbers (e.g., AZ Q:4:13(ASM); Hinkson Site) that would help a user locate the digital object.

Field Name /Field Group	Resource Types	Description
Site Type	All except coding sheets and ontologies	A list of the site feature types associated with the resource
Additional Keywords	All except coding sheets and ontologies	A list of user-submitted site type keywords not found in the controlled fields
Material Types		
Keywords	All except coding sheets and ontologies	A list of the artifact material types collected or analyzed for a project or specifically reported, analyzed, assayed, or otherwise described for an information resource.
Cultural Terms (Keywords listing the past societies associated with artifacts and features mentioned in the resource.)		
Cultural Term	All except coding sheets and ontologies	A list of the archaeological "cultures" associated with the resource
Additional Cultural Terms	All except coding sheets and ontologies	A list of user-submitted cultural keywords not found in the controlled fields
Temporal Coverage (The time period spanned by the resource.)		
Coverage Dates	All except coding sheets and ontologies	
Date Type	All except coding sheets and ontologies	The kind of date - This will determine if negative dates (e.g. - 1150) are interpreted as B.P. or BCE.
Start Date	All except coding sheets and ontologies	Earliest date affiliated with the resource - Only integer values are allowed
End Date	All except coding sheets and ontologies	Latest date affiliated with the resource - Only integer values are allowed
Description	All except coding sheets and ontologies	A description listing any pertinent information for the dates
Temporal Terms	All except coding sheets and ontologies	A list of temporal terms relevant to the resource

Field Name /Field Group	Resource Types	Description
General Keywords		
Keyword	All except coding sheets and ontologies	A list of any useful keywords not found in other categories (i.e., not covered by investigation type, site type, site name, culture, material, temporal or geographic terms) that would assist a user in identifying the project or information resource as one of interest.
Spatial Terms (A description of the geographical area covered by the resource.)		
Geographic Keyword	All except coding sheets and ontologies	A list of geographic terms that would help a user identify the project or information resource as one of interest
Coordinates	All except coding sheets and ontologies	Identify the approximate region of this resource by clicking on "Select Region" and drawing a bounding box on the map. Note: to protect site security, tDAR obfuscates all bounding boxes, especially bounding boxes smaller than 1 mile. The 'edit' view will always show the exact coordinates.
Latitude (max)	All except coding sheets and ontologies	Maximum latitude of area related to the resource
Latitude (min)	All except coding sheets and ontologies	Minimum latitude of area related to the resource
Longitude (max)	All except coding sheets and ontologies	Maximum longitude of area related to the resource
Longitude (min)	All except coding sheets and ontologies	Minimum longitude of area related to the resource
Resource Provider		
Resource Provider	All except coding sheets and ontologies	The institution authorizing tDAR to ingest the resource for the purposes of preservation and access.
Individual & Institutional Roles (The names of individuals and institutions affiliated with the resource. This category repeats as a group of fields.)		
Individual		
First Name	All except coding sheets and ontologies	First name of the affiliated person - Middle names and initials should also be included here

Field Name /Field Group	Resource Types	Description
Last Name	All except coding sheets and ontologies	Last name of the affiliated person
Affiliated Institution	All except coding sheets and ontologies	The last known institutional affiliation for the affiliated person
Email	All except coding sheets and ontologies	The last known contact email for the affiliated person
Role	All except coding sheets and ontologies	The role that the affiliated people performed for the resource (see Resource Creator Roles for list and definitions)
Institutional		
Institution Name	All except coding sheets and ontologies	The name of the affiliated institutional
Role	All except coding sheets and ontologies	The role that the affiliated person performed for the resource (see Resource Creator Roles for list and definitions)
Source & Related Comparative Collections (Collections of artifacts, documents, and other information referenced in the resource.)		
Source Collection	All except coding sheets and ontologies	A list of the source collections drawn from a published or unpublished work - If the information resource or project analyzes, depicts, or reports on a collection of artifacts or other materials, provide the source collection's accession numbers or other information identifying the specific collection
Related Comparative Collection	All except coding sheets and ontologies	A list of the comparative collections drawn from a published or unpublished work. If the information resource includes identifications that rely on a comparative collection, e.g., of fauna or ceramic types, provide information identifying the comparative collection
Notes (Notes that help clarify certain aspects of the resource. For example, a "Redaction Note" may be added to describe the rationale for certain redactions in a document. This category repeats as a group of fields.)		
Note Type	All except coding sheets and ontologies	The type of note

Field Name /Field Group	Resource Types	Description
Note	All except coding sheets and ontologies	

Access Rights (A list of users who can edit a document or related metadata. This category repeats as a group of fields.)

First Name	All except coding sheets and ontologies	First name of the user - Middle names and initials should also be included here
Last Name	All except coding sheets and ontologies	Last name of the user
Email	All except coding sheets and ontologies	The last known contact email for the user
Institution Name	All except coding sheets and ontologies	The last known institutional affiliation for the user
Permissions	All except coding sheets and ontologies	The level of permission granted to the user

Document Fields

Field Name / Field Group	Document Types	Description
Basic Information (High-level information about the nature, type, and location of the resource.)		
Document Type	All	Identifies the type of document
Book Title	Book Chapter/Section	Title of the book where the document appears
Journal Title	Journal Article	Title of the journal where the document appears
About Your Document (Identifier numbers, length, and origin information about the document)		
DOI	ALL	"Digital Object Identifier." The unique identifier for an electronic document
ISSN	All but other	International Standard Serial Number, an eight-digit number assigned to many serial publications

Field Name / Field Group	Document Types	Description
ISBN	Other	International Standard Book Number, a unique numeric commercial book identifier
Language	ALL	Select the language in which the document is written
URL	ALL	"Uniform Resource Locator" (web address)
Edition	Book/Report, Book Chapter/Section, Other	The edition of the book or larger resource where the document appears
Series Title	Book/Report, Book Chapter/Section, Other	The title of the series in which the document appears
Series Number	Book/Report, Book Chapter/Section, Other	The series number of the resource in which the document appears
Volume	Journal Article, Other	The volume in which the document appears
Issue Number	Journal Article, Other	The issue number of the resource in which the document appears
Start Page	Book Chapter/Section, Journal Article, Other	The page where the document begins
End Page	Book Chapter/Section, Journal Article, Other	The page where the document ends
Institution Name	Thesis/Dissertation	The institution affiliated with the thesis/dissertation
Department	Thesis/Dissertation	The institution department affiliated with the thesis/dissertation
Conference	Conference/Presentation	Name of the associated conference
Conference Location	Conference/Presentation	Location of the associated conference
Copy Location	ALL	Actual physical location of a copy of the document, e.g. an agency, repository, or library

Image Fields

Field Name / Field Group	Resource Type	Description
Basic Information (High-level information about the nature, type, and location of the resource.)		
Storage Location	Images	Actual physical location of a copy of the image, e.g. an agency, repository, or library

Coding Sheet/Ontology Fields

Field Name / Field Group	Resource Type	Controlled Vocabulary	Description
Category & Sub-Category	Coding Sheet/Ontology	YES	Identifies the category or subcategory of the data the coding sheet/ontology refers to

Geospatial Fields

Field Name / Field Group	Resource Type
Spatial Reference System ID / Projection	Geospatial
Currentness and Update Information	Geospatial
Map Source	Geospatial
Scale	Geospatial

Sensory Data Fields

Field Name / Field Group	Description
Basic Information (High-level information about the nature, type, and location of the resource.)	
Object / Monument Number	The ID number or code, if applicable, of the object or monument
Survey Information (Description of the survey event that resulted in the sensory data.)	
Survey Begin	Beginning date of survey
Survey End	Ending date of survey
Conditions	The overall weather trend during survey
Scanner Details	The details of the instrument(s) with serial number(s) and scan units
Company Name	The details of the scan company and scan operator name
Data Resolution	The estimated data resolution across the monument or object
Count of Scans	The total number of scans
Turntable Used	Indicates if a turntable was used for this survey
Planimetric Map	The image name, if applicable

Field Name / Field Group	Description
Filename	
Control Data Filename	The control data filename, if control data was collected
RGB Capture Information	Information about how the RGB (color photograph) information was collected - specify whether the imager was an integrated or external unit, and the nature of any additional lighting system used, if applicable
Description of Final Datasets for Archive	A list of the datasets that will be archived (include file names if possible)
Scan Information (Information about the name and nature of the scan file and any transformations applied to the resource.)	
Filename	The name of the scan file. A suggested filename for original raw scans for archiving is in this format: ProjectName_scan1.txt
Object/ Monument Name	The name of monument or object being scanned
Date	The date that the object/monument was scanned (mm/dd/yyyy format)
Resolution	The fixed resolution or data resolution at specific range
Number of Points	The number of points generated in scan
Transformation Matrix	The name of the transformation matrix used in Global Registration. Suggested file name: ProjectName_scan1_mtrx.txt
Matrix Applied	Indicates if a transformation matrix has been applied to the archived scan
Scanner Technology	
Scan Notes	Additional notes related to this scan
Image Information (This section specifies information about reference images included with this resource. The category repeats as a group of fields.)	
Name	The filename of the reference image
Description	Description of the image
Registration Information (Description of methods and filenames used to align the points)	
Dataset Name	The filename for the dataset. A suggested naming structure for registered dataset for archiving is: ProjectName_GR.txt
Registration Method	A brief description of the methods used to register the point cloud

Field Name / Field Group	Description
Registration Error	The total RMS error from global registration in scan units
Number of Points in File	The total number of points in final registered point cloud
Mesh Information - Pre-Mesh	
Dataset Name	The filename. A suggested naming convention for the polygonal mesh dataset is *ProjectName_origmesh
Number of Points in File	The total number of points in the edited premesh point cloud
Processing Operations	
Point Editing Summary	A description of major editing operations (i.e. overlap reduction, point deletion, etc.) that have been performed on the dataset
Mesh Information - Polygonal Mesh Metadata	
Dataset Name	The filename. A suggested naming convention for the polygonal mesh dataset is *ProjectName_origmesh
Number of Triangles	The total number of triangles in the mesh file
Adj. Matrix	The transformation matrix filename, if applicable
Processing Operations	A list of any processing operations performed on the Polygonal Mesh
Additional Processing Notes	Additional notes about the mesh
Mesh Information - Decimated Polygonal Mesh Metadata/TriangleCounts	
Mesh Name	The file name. A suggested naming convention for the decimated polygonal mesh dataset is ProjectName_decimesh_50pcnt for decimated mesh e.g. by 50%
Number of Original	The total number of Decimated Triangles
Number of Decimated	The total number of Decimated Triangles
Processing Operations	A list of any processing operations performed

Terms of Use

These are the terms of use to be followed by tDAR registered users.

Knowledge gained through the efforts of many researchers is shared through tDAR (the Digital Archaeological Record) in order to encourage and facilitate archaeological and related research, and to provide easier and wider access to information about archaeology and archaeological resources. Unless otherwise specified with respect to a particular file, use of this information is subject to the conditions of a Creative Commons Attribution 3.0 Unported License (as partially described in points 1. and 2. below) which applies whether or not the data or other information provided by tDAR are legally subject to copyright.

Users acknowledge and agree that they will only copy or distribute tDAR content or use it in derivative works or otherwise (e.g., to publish or otherwise distribute an argument based on analyses of these data) under the following conditions:

1. Users must accompany all uses and applications of this content with proper citation and attribution (as provided on the tDAR metadata page).
2. For any redistribution of tDAR content, users must clearly include proper citation and attribution information and make clear to others the license terms of this work.
3. Users must not use tDAR content in ways that could be reasonably expected to lead, directly or indirectly, to damage to the archaeological record.
4. Users acknowledge that neither The Center for Digital Antiquity nor its sponsors and associates guarantee the accuracy or usability of the content and further agree that they may not hold any of these parties liable for any direct or consequential damage arising from their use of tDAR or its content.
5. Users are responsible for ensuring that their use of tDAR and its content is consistent with applicable law.

Contributor's Agreement

These are the rules contributors agree to when they deposit files in tDAR.

The contributor is the person or institution responsible for the files and metadata contributed to tDAR.

The Center for Digital Antiquity (Digital Antiquity) supports an "open access" approach to sharing of archaeological information. Accordingly, the contributor recognizes that the files and metadata contributed to tDAR can be shared with tDAR users. There are, however, certain situations in which Digital Antiquity believes information should be treated as confidential or otherwise restricted, as further addressed in this Contributor's Agreement.

A. Authority, Appropriateness, and Accuracy

The contributor certifies that the contributor has the authority to make the contributed files and metadata available in tDAR under all applicable laws, including the laws and regulations of the country, state, or municipality where any sites described in the data or metadata are located.

The contributor agrees to add only content consistent with Digital Antiquity's Accession Policy.

The contributor is responsible for the accuracy of the files and metadata contributed to tDAR. Digital Antiquity is not responsible for the accuracy or completeness of files or metadata in tDAR.

B. License, Copyright, and Re-use

The contributor acknowledges that all active metadata records in tDAR are publicly accessible and their use is unrestricted.

The contributor acknowledges that Digital Antiquity makes tDAR files available under the Creative Commons Attribution 3.0 Unported License (<http://creativecommons.org/licenses/by/3.0/>) unless contributor explicitly specifies, in the metadata or file, other terms for the distribution of the file.

C. Confidential and Embargoed Information

The contributor recognizes that the files and metadata contributed to tDAR can be shared with tDAR users.

Because all active metadata records in tDAR are publicly accessible, Digital Antiquity will make reasonable efforts to obfuscate from public view any highly precise, mapped site locations contained in the contributor's metadata. Site location data in the file(s) uploaded will not be modified by Digital Antiquity, except when arrangements are made to have Digital Antiquity staff create redacted versions of the file(s).

The contributor agrees to make a reasonable effort to designate as “confidential” any contributed file that would be reasonably expected to endanger in situ archaeological sites if it were made publicly available. The contributor assumes any liability for improper disclosure of information that contributor should have, but did not, designate as confidential.

If the contributor marks an uploaded file as “confidential,” Digital Antiquity will take reasonable efforts to ensure that access to that file is limited to the contributor and other registered tDAR users designated by the contributor or by a proxy assigned by the contributor.

If the contributor marks an uploaded file as “embargoed,” Digital Antiquity will take reasonable efforts to limit access to that file for a period of four years from the date of upload to the contributor and other registered tDAR users designated by the contributor or by a proxy assigned by the contributor.

D. Users’ Terms of Use

The contributor acknowledges that Digital Antiquity requires users to agree to its Terms of Use prior to downloading any file, but that Digital Antiquity cannot guarantee the enforcement of those terms.

E. Resolution of Issues Concerning tDAR Content

Digital Antiquity is concerned about the security of site locations, copyright violations, inappropriate content, appropriate control over records, culturally sensitive information, and related issues regarding tDAR files and metadata.

The contributor acknowledges that:

1. Issues concerning content may arise either through internal reviews or from external reports that Digital Antiquity receives;
2. Digital Antiquity will review all such issues raised and that during such review, files and associated metadata may be withdrawn from public access;
3. In attempting to resolve issues, Digital Antiquity will attempt to solicit comment both from the reporter of the issue and from the contributor, using the contributor’s most recent email address on file with Digital Antiquity;
4. Having reviewed the issue, Digital Antiquity will, at its sole discretion, determine the appropriate resolution which may include the removal or redaction of materials from tDAR; and,
5. Under no circumstances will Digital Antiquity refund any deposit fee or assume any cost or liability incurred by the contributor related to contributing or distributing the contested information.

From time to time the Board of Directors of the Center for Digital Antiquity at its discretion will add to or modify its Policies and Procedures.

Part 4: tDAR Access Permissions

This table includes tDAR Access Permissions as of 30 September 2014. For an up to date version visit <https://dev.tdar.org/confluence/display/DEV/Access+Rights+Matrix>

tDAR Action	Visitor	User	User With Assigned Permissions				Owner
			View All	Modify Metadata	Modify Record	Group Admin	
View Metadata: Active Resources	Yes	Yes	Yes	Yes	Yes	Yes	Yes
View Metadata: Draft Resources	No	No	Yes	Yes	Yes	Yes	Yes
View Metadata: Deleted Resources	No	No	No	No	No	No	No
Edit Metadata: Active Resources	No	No	No	Yes	Yes	Yes	Yes
Edit Metadata: Draft Resources	No	No	No	Yes	Yes	Yes	Yes
Edit Metadata: Deleted Resources	No	No	No	No	No	No	No
Edit Metadata: Modify User Assignments	No	No	No	No	Yes	Yes	Yes
Collection: Add/Remove Users and Resources	No	No	No	No	No	Yes	Yes
Edit Creator Information	No	No	No	No	No	No	Yes*
Files: view public files listing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Files: download public files	No	Yes	Yes	Yes	Yes	Yes	Yes
Files: view restricted files listing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Files: download restricted files	No	No	Yes	Yes	Yes	Yes	Yes
Files: view deleted files listing	No	No	No	No	No	No	No
Files: download deleted files	No	No	No	No	No	No	No

*Only the creator's own information.

DA-tDAR Redaction Policy

When requested by clients as part of our digital curation services, Digital Antiquity curators make the effort to identify potentially confidential, sensitive or private-personal content that clients might decide should be redacted. Confidential content is defined as information, usually very specific locational information that, if made publically available, poses a reasonable risk of leading to the vandalism or destruction of the archaeological resource. Sensitive content is defined as information that may be offensive or inappropriate, such as images of human remains or other culturally sensitive materials. Private-personal content is the rarest, and can include personal (non-work) phone numbers or addresses. Curators will redact identified confidential and private-personal-information using the Redaction Tool in Adobe Acrobat IX Pro and upload both a redacted and non-redacted copy (which will be marked as confidential) to a draft resource page, to be reviewed by the client.

The Center for Digital Antiquity encourages making archaeological data and information accessible when possible. Most files that have been contributed to tDAR are publically accessible. As of mid-August, 2014, of the 6,989 document files contributed to tDAR, only 478 (about 7%) have been marked as 'confidential.'

In the case of redacted figures (typically maps), the whole map usually is selected and redacted. Identifying captions are left where possible in order for readers to more easily understand the information that has been redacted. In cases where the confidential information is in tables or text, such as UTM coordinates or private-personal information, only the problematic numbers or text is redacted, leaving a black box where the text was originally.

Our standard recommendation is for the nonredacted file to be uploaded to the resource page and marked as confidential and therefore not accessible by registered users unless they are identified specifically by the agency, office or individual that 'owns' the tDAR record. The redacted file is also uploaded to the resource page and marked as public. A 'Redaction Note' and a 'File Description' are included in the tDAR metadata record to indicate that the file has been redacted. Resources containing files that are marked as confidential are required to include a 'Contact', who can be contacted by individuals requesting access to a 'confidential' file. Potentially sensitive information is not removed, but a warning of this potential content is added to the resource page and brought to the attention of the client.

DA curators make every effort to identify potentially confidential, sensitive or private-personal content. However, it is the responsibility of the client/contributor to review the files, and any recommendations that we provide, and confirm that they are suitable to be made publically available in tDAR. Digital Antiquity strives to preserve archaeological data and make it as accessible as possible, while protecting our valuable archaeological resources.

Part 6: File Formats Accepted by tDAR

tDAR is constantly being improved for usability and to insure it is consistent with current digital practice. This list of file formats accepted by tDAR is up to date as of 30 September 2014. For a current version, visit <https://www.tdar.org/why-tdar/contribute/>

File Formats Accepted by tDAR

Datasets:

- Comma Separated Values (.csv)
- Tab Separated Values (.tab)
- Microsoft Excel (.xls, .xlsx)
- Microsoft Access (.accdb, .mdb)

Documents

- PDF Documents (.pdf)
- Microsoft Word (.doc, .docx)
- Rich Text Documents (.rtf)
- Plain Text Documents (.txt)

Images

- Tagged Image File Format (.tiff, .tif)
- Graphics Interchange Format (.gif)
- JPEG Image (.jpg, .jpeg)
- Bitmap Image (.bmp)
- PICT Image (.pict)
- Portable Network Graphics (.png)

Geospatial data

- Shapefiles
- Georectified images (GeoTIFF & GeoJPG)
- Geodatabases

Virtual

- Remote Sensing Files
- 3D Scan
- LiDAR

Part 7: Pricing Information for tDAR Projects

tDAR is updated frequently. The rates and project examples are current as of 9 October 2014. For the most updated rates, see <http://www.tdar.org/about/pricing/>

Rates

Item/Service	Cost
1-9 Files	\$50 / file
10-49 Files	\$40 / file
50-99 Files	\$30 / file
100-499 Files	\$25 / file
500-999 Files	\$20 / file
1,000-4,999 Files	\$15 / file
5,000-9,999 Files	\$5 / file
Data Curation	\$40 / hour
Consultation	\$90 / hour
Programming	\$95 / hour

* Each file comes with 10 MB of space

Example Projects

Small Projects

Monitoring Report: 1 file (1 document), 4.4MB, \$50

Thesis / Dissertation: 3 files (1 document, 2 data sets), 1.4MB, \$150

Medium Projects

CRM Survey Results: 16 files (4 documents, 1 data set, 11 images), 87MB, \$640

Site Testing Project: 10 files (3 documents, 7 data sets), 2.2MB, \$400

Architectural Documentation: 111 files (1 document, 100 images), 1079MB, \$2,775

Large Projects

Data Recovery / Excavation Project: 64 files (22 documents, 42 images), 228MB, \$1,920

Legacy Archiving Project: 151 documents, 2585MB, \$6,475

Multi-Year Survey Project: 50 files (25 documents, 24 images, 1 data set), 357MB, \$1,500

Survey, testing and data recovery: 761 files (46 documents, 695 images, 20 data sets), 8780MB, \$15,000

Frequently Asked Questions about Pricing in tDAR

I am not sure how to budget for digital archiving of my upcoming project. What do you recommend?

We encourage you to look at some of our example projects on the pricing page—these include a range of real examples of project types (e.g. Monitoring, Survey, Data Recovery), the number of digital files they generate, and the cost to archive each in tDAR. You may also browse “projects” in tDAR to see the range of materials other users have archived to get a sense of where your project might fit. Once you’ve generated a rough estimate of the number of documents, data sets, images and other sensory data you might upload, use our pricing calculator to calculate upload costs.

What if I need to pay via a purchase order?

Please contact us and we will help you produce an invoice that can be used to obtain a purchase order from your institution or business.

What if I have files larger than 10 MB?

Like Dropbox or other services, the total space purchased is pooled across all your files, not dedicated to a specific file. In order to purchase additional storage for large files contact us.

Why is this more expensive than Dropbox or Google Drive?

The costs involved with digital archiving are different from those of simple file storage. Digital Antiquity, a not-for-profit organization, is committed to the long-term preservation of your data. This includes not only maintaining the files that you submit, but ensuring they're usable in the future.

Is there a fee to access files?

No, tDAR records and associated metadata can be viewed by anyone accessing tDAR, but one must register and agree to our Terms of Use in order to view or download a file. There is no charge for registering as a tDAR user.

How long do I have to use my space?

Digital Antiquity advocates purchasing space in increments approximating what might be used within a year.

How does pricing work for GIS Files?

Some GIS files, like Shapefiles are priced differently, due to how they work. Shapefiles, and geo-rectified images often require more than one actual file to work properly. Pricing for these files works as follows: each image, or Shapefile is treated as a single file within tDAR. Thus, if a user uploaded "untitled.shp", "untitled.dbf", "untitled.prj", and "untitled.shp.xml" the combination of these four files would be treated as a single file for pricing. If, the file was larger than 10 MB, it would still require additional space to cover the MB used.

** 1GB is 1024 MB all calculations are approximate*

Appendix C:

User Survey Results

The following tables represent feedback results from a two-part survey written by Sara Rivers Cofield and Jodi Reeves Flores. Part 1 of the survey asked installation PoCs about their current management strategies for archaeological records, while Part 2 of the survey asked the same PoCs for feedback about tDAR once their data had been uploaded for review. Ten people responded to the surveys, though counts sometimes reflect multiple answers to a question or questions left blank.

The following installation PoCs responded to the survey, and results were compiled by Rivers Cofield:

- Darsie, Julie: NAVFAC Washington
- Gallihue, Mark: U.S. Army Garrison, Aberdeen Proving Ground
- Glodek, Jerald: Fort George G. Meade
- Hickey, Kimberly: Naval Support Activity Annapolis
- Hoch, Alfred "Lynn": Fort Detrick
- Krake, James: U.S. Army Garrison Adelphi Laboratory Center
- Mullins, John: Fort A. P. Hill
- Roberts, Katherine: Quantico
- Smolek, Michael: Naval Air Station, Patuxent River
- Wright, Thomas: Naval Support Facility, Indian Head

Digital Data Management Background

Response Options	Response Percent	Response Count	Comments & Explanations
Question 1: Does your installation's cultural resource management program have protocols for long-term digital file access, preservation, and migration?			
Yes	20%	2	<ul style="list-style-type: none"> • Reports are saved as PDF files and photographs and paperwork are saved in archival format (TIF). All files are copied onto archival discs and curated. • It is an NEC requirement to have a 12 month tape backup of all files that are located on the file server, Quantum I0000
No	80%	8	None
Question 2a: Does your CRM program have access to IT support for the management of the digital archaeological data and information at your facility?			
Yes	50%	5	<ul style="list-style-type: none"> • Not sure how to utilize IT support • Network drives are backed up by NEC and assists Army with all data management needs/issues.
No	50%	5	None
Question 2b: If so, is the IT support staff aware of and diligent about the problem of the long-term preservation of digital files?			
Yes	20%	2	None
No	50%	5	None
N/A	30%	3	None
Question 3: Have you lost any of your CRM program's digital files because of changes in hardware or software?			
Yes	22%	2	<ul style="list-style-type: none"> • Some of the older files can no longer be opened (software not available). Some files have been lost during server changes and migration to a Sharepoint Intranet system. • We have had several regular CD-Roms (not the archival gold kind) that have stopped working in less than five years. This is not a hardware/software issue so much as a deterioration of the media form.
No	44%	4	<ul style="list-style-type: none"> • I have been scanning files and saving on CDs and external storage
Don't know	33%	3	None
Question 4: Please add anything else you think we should know about IT and digital data management at your installation that relates to the documentation of cultural resources.			
<ul style="list-style-type: none"> • We have not had anyone actively managing our Cultural Resources Program for 3 years. Position remains vacant. • The installation lacks sufficient server space to maintain digital files and backup files. The IT response has been to request that files be moved to CD/DVD; however, the cost of discs and associated storage issues (e.g., archival lifespan of discs and software compatibility of files) make this a poor option. • CRMs do not normally control the installation GIS where all digital archaeological info stored on post is maintained. • We do not have an official filing system or library. Therefore maintenance of records and reports is dependent upon individuals. When those individuals move on, their files are either abandoned or boxed and sent to the National Archives. We have lost many past cultural resources this way. • Use of external hard drives has limited access to other personnel. Currently, only the assigned user of the hard drive can access it, so when I leave this position, those files are lost. Limited cloud space prevents long-term storage. • IT support includes location (with buffered zone) and status/determination of site only. 			

Access to CRM Information

Response Options	Response Percent	Response Count	Comments & Explanations
Question 1: Do you have copies of the CRM reports relating to your installation?			
Yes (All)	55%	6	None
Don't know	18%	2	None
Some	18%	2	None
None	0%	0	None
Other	9%	1	<ul style="list-style-type: none"> • Yes, but there <u>could</u> be something missing • I believe that I have 95% of files, letters, reports
Question 2: Does your installation have a system for keeping CRM reports (digital or hard copy) on hand and organized?			
Yes	70%	7	<ul style="list-style-type: none"> • Online, CDs, nothing very organized. • We put them into bookshelves. We are getting short of file space. • Hard copies are kept on shelves and digital copies are kept as PDF files. PDF copies can be accessed directly from a server folder or can be opened through links in a searchable database and in GIS. The ICRMP includes the searchable database and associated reports. • But within y: drive folders that are executed by each ICRMP Manager as they come and leave. • No system was in place prior to the current CRM being assigned in 2009, therefore, since managing the program the CRM has consolidated all CRM reports into one location with a log of reports.
No	30%	3	<ul style="list-style-type: none"> • Don't believe there have been any issues.
Question 3: Do you have copies of images, data sets (spreadsheets, databases, etc.) or other information other than reports generated by CRM at your facility?			
Yes	60%	6	<ul style="list-style-type: none"> • Building use (ID'd for demo, explosive history, contamination potential, maintenance needs), archeological status, maps, potential effect assessments, letters, consultations, historic building plans. • The CRMS copy me on important correspondence and information, but I do not have anything that pre-dates my working here. • Photographs, GIS maps and data, resource databases, background information documents/reports, oral history recordings, public presentation files. • Other Environmental Division Programs
No	40%	4	<ul style="list-style-type: none"> • But I do have a few photos of artifacts and incidental info left over from the previous CRM
Question 4: Has construction or development at your installation ever been hindered by the loss of or limited access to CRM information?			
Yes	0%	0	None
No	100%	10	None
Question 5: Have cultural resources at your installation ever been adversely impacted because of the loss of or inadequate access to documentation of past CRM work?			
Yes	30%	3	<ul style="list-style-type: none"> • When I had to go to Iraq there was no trained CRM here. My absence coincided with the major construction. • An archaeological site (previously determined as not eligible for

Response Options	Response Percent	Response Count	Comments & Explanations
			inclusion in the National Register of Historic Places, but recommended for avoidance) was disturbed when shapefiles for the site were lost/ misplaced during server migration. <ul style="list-style-type: none"> Archeological sites have been impacted through erosion and disturbances due to Midshipmen activities that disregard attempts to protect sites (their mission has priority).
No	70%	7	None

Security

Response Options	Response Percent	Response Count	Comments & Explanations
Question 1: Are the products of your CRM projects reviewed to ensure that they do not contain information that is a threat to your installation's security?			
Yes	80%	8	<ul style="list-style-type: none"> For new reports dealing with processes, the information is routed through the Tenant Command's PAO for approval. Regular review by CRMs. Any projects that have taken place in restricted areas that may involve sensitive information are reviewed by the Public Affairs Officer. Documents are read by force protection personnel; we are obligated to address their concerns. Photos submitted to the SHPO are reviewed by security as well. Security office reviews project documentation with potential for security threats. Products are reviewed by Public Works for the presence of active facilities or training details and are submitted to Public Affairs for additional review.
No	20%	2	None
Question 2: Please check any of the following documents you think might contain information that should be redacted for purposes of installation security (do not include security of site location information as that is a given; this is about DoD operations at the installation):			
Field Records	10%	1	None
Maps	50%	5	None
All Photos	0%	0	None
Only Photos of [fill in the blank]	30%	3	<ul style="list-style-type: none"> Gates, fences, occupied buildings, security-related infrastructure Process equipment/ internal building photos Training and active facilities
Reports	0%	0	None
Artifact Inventories	10%	1	None
Photo Logs	0%	0	None
Other	30%	3	<ul style="list-style-type: none"> Need to see if our security office has any concerns with maps, etc. Location maps and geographic coordinate information Building numbers if information is posted on a website

tDAR Feedback

Response Options	Response Percent	Response Count	Comments & Explanations
Question 1: Were you familiar with tDAR before becoming involved in this project?			
Yes	30%	3	None
No	70%	7	None
Question 2: Do the security measures and ability to control access to materials in tDAR meet your needs?			
Yes	100%	10	<ul style="list-style-type: none"> • Future access to records should be coordinated with the Navy.
No	0%	0	None
Question 3: Is the organization of the tDAR collection for your installation useful?			
Yes	90%	9	None
No	10%	1	None
Question 4: What other capabilities would you like tDAR to have?			
<ul style="list-style-type: none"> • Not sure • Storing and organizing past Section 106 consultations. • Have a field that includes when the MHT (or other state regulating authority) concurred or not with the findings detailed in the reports. • Looks pretty good right now. Need more time using it to make recommendations. • It would be helpful to have reports in order to provide context, background information, and methodology. • Not sure if we can sort specific reports into a file that would be accessible to the public or is it all or nothing? 			
Question 5: How do you see using the materials in tDAR in the future?			
<ul style="list-style-type: none"> • Research/Archive • Likely to use to help answer researchers' questions • For informational purposes and data calls. • To make site information available to contractors and consulting parties on Federal undertakings. • Consolidated location for all reports/info to be available to future personnel managing CR at a facility (especially those managing CR, but do not have archeological background/privileges to obtain previous reports, i.e. archeological investigations located at MHT only accessible to certified archeologist). Unfortunately, the process of regionalizing the Navy and the numerous changes in command has allowed some older reports to go missing. • Learning more about previous projects • Getting an idea of what others are doing & how • Obtaining reports that the installation does not have a copy of. Ability to share with other regional bases. 			
Question 6: As you manage the archaeological information and data for your installation, how can tDAR assist with the preservation and access of your archaeological materials?			
<ul style="list-style-type: none"> • Organizing the material/storage • Maybe if there was a way to link installation GIS to tDAR • Access to stored/archived material. • Continued migration of files to up-to-date formats. • Making accessibility easier for other personnel (i.e. future CRMs). • Readily available files without searching thru paper • Can specific file locations be established to group information from specific sites? Looking for a method that would reference various surveys/studies on the same site. 			

tDAR Feedback (continued)

Question 7: Based on the projects you have reviewed in tDAR, please choose one that you find particularly useful or valuable to have in the system and explain what you consider to be so exceptional about it.

- We have 2 collections that are both very useful to have housed on the system.
- The earliest surveys at FAPH are the most interesting; especially the MAAR survey from 1983. There are many sites that have not been re-visited since then and current work at some of these sites would benefit from having the curated project information available online. Kimberly: Phase II Investigations, "Porter's Folly" (Site 18AP77), NSA Annapolis, USNA – summary of project description and resulting determinations
- Blossom Point Farmhouse (2002.029) has good background historical information
- Need more time to research & evaluate
- Tommy: The information on the Posey site has reports that IH does not have on file. They are only referenced in the main report.

Question 8: Based on the projects you have reviewed in tDAR, please choose one that you find LEAST useful or valuable to have in the system and explain why it falls short of expectations.

- None are less useful than the others, in my opinion
- Need more time to research & evaluate
- Not sure yet.

Future Directions

Response Options	Response Percent	Response Count	Comments & Explanations
Question 1: Would you like to see new CRM projects entered in tDAR in future?			
Yes	100%	10	None
No	0%	0	None
Question 2: Would you consider including tDAR in the scope of work and budget for future CRM projects?			
Yes	100%	10	None
No	0%	0	None
Question 3: Do you think tDAR would be useful for DoD-wide CRM digital data management?			
Yes	64%	7	None
No	0%	0	None
Don't know	18%	2	None
With Qualifiers	18%	2	<ul style="list-style-type: none"> • DoD would benefit most from the use of tDAR (or similar system) at a curation facility level. DoD/component headquarters could benefit by having access to tDAR information for Congressional reporting requirements; but I do not think DoD is in a position to manage CRM data from any centralized location higher than a curation facility. • Regular Phase I /II not that important. Indian burials Phase III actions – MOU/MOA's with SHPO's might be a good addition.
Question 4: Would you support a follow-up Defense Legacy project to scan records from old projects for inclusion in tDAR?			
Yes	100%	10	None
No	0%	0	None

Priorities for Future Scanning and tDAR Use

Please fill out the following table to let us know what you think should be included in a scanning project:

Type of Record	Scan for public access (redacting as needed)	Scan for limited access	Do not scan	Don't Know
Field notes	2	6	0	1
Artifact catalogs	5	5	0	0
Artifact distributions	2	7	0	0
Photos of artifacts	5	5	0	0
Photos of excavations	2	7	0	1
Photos of the landscape	3	7	0	0
Photo logs	3	6	0	1
Site/Distribution Maps	2	8	0	0
Installation Maps	0	9	1	0
Background research	6	4	0	0
Reports	6	4	0	0
Survey data	3	7	0	0
Write in: No one had write-ins				

Please rate the following digital records according to how important you think it is that they be **preserved** through a venue like tDAR:

Type of Record	High Priority	Medium Priority	Low Priority	Don't Know
Field notes	2	5	1	2
Artifact catalogs	6	4	0	0
Artifact distribution data	6	3	0	0
Photos of artifacts	7	2	1	0
Photos of excavations	4	4	2	0
Photos of the landscape	3	5	2	0
Photo logs	4	4	2	0
Site/Distribution Maps	5	4	1	0
Installation Maps	2	4	4	0
Background research	4	5	1	0
Reports	6	4	0	0
Survey data	4	5	0	1
Write in: No one had write-ins				

Please rate the following digital records according to how important you think it is that they be **accessible to the public (and redacted as needed)** through a venue like tDAR:

Type of Record	High Priority	Medium Priority	Low Priority	Don't Know
Field notes	1	2	6	1
Artifact catalogs	5	3	2	0
Artifact distribution data	2	7	1	0
Photos of artifacts	3	6	1	0
Photos of excavations	0	5	5	0
Photos of the landscape	0	4	6	0
Photo logs	0	4	5	1
Site/Distribution Maps	2	4	4	0
Installation Maps	0	3	7	0
Background research	3	6	1	0
Reports	5	5	0	0
Survey data	1	5	3	1
Write in: No one had write-ins				

Please rate the following digital records according to how important you think it is that they be **accessible to a 'need-to-know' audience** through a venue like tDAR:

Type of Record	High Priority	Medium Priority	Low Priority	Don't Know
Field notes	5	2	2	1
Artifact catalogs	6	2	2	0
Artifact distribution data	6	3	1	0
Photos of artifacts	6	3	1	0
Photos of excavations	4	3	3	0
Photos of the landscape	4	3	3	0
Photo logs	5	2	2	1
Site/Distribution Maps	5	4	1	0
Installation Maps	3	4	3	0
Background research	5	4	1	0
Reports	6	3	1	0
Survey data	6	2	1	1
Write in: No one had write-ins				

Appendix D:

Materials to Aid in Implementation

Part 1: Example of scope requirements for digital curation

Part 2: Digital Materials Requirements Form

Part 3: Digital Curation Resource Guide

Part 4: Sole Source Justification

Part 1: Example of Scope Requirements for Digital Curation

1. [Name of entity conducting the archaeological work] shall deposit all copies of digital data listed as deliverables for this project in [location of description of digital project deliverables in RFP, scope of work, contract, etc.], in tDAR, the Digital Archaeological Record repository (www.tdar.org).
2. [Name of entity conducting the archaeological work] shall thoroughly document all digital data with archaeological, administrative, and technical metadata, using the tDAR metadata creation and file upload web pages available at: <http://www.tdar.org/why-tdar/contribute/>.
3. [Name of agency/office] will not consider the project complete until the project's digital records in tDAR have been reviewed by [name of agency official and/or position title].
4. Any file containing information that is "confidential," for example as defined in Section 9 of the Archaeological Resources Protection Act (16 U.S.C. 470hh), or "restricted," as defined in consultation with [Name of agency/office] during the execution of this project shall be deposited in its complete form and marked in tDAR as confidential and shall also be deposited in a redacted, public form, with redactions of all confidential information identified.

Digital Curation Resource Guide

Digital Management and Curation Resources

Guides to Good Practice (<http://guides.archaeologydataservice.ac.uk/>)

Caring for Digital Data in Archaeology: A Guide to Good Practice (Available from <http://www.oxbowbooks.com/oxbow/caring-for-digital-data-in-archaeology.html>)

tDAR Help & Tutorials (<http://www.tdar.org/about/help/>)

Management and Curation Process

It is important to use consistent names and confirm how the client wants their name and administrative information (contractor numbers, etc.) entered into tDAR. It can also be helpful to consider what approach will guarantee the requirements of the client efficiently. For example, sensitive location information can be included as appendices of a report so that it can be more easily redacted. To guarantee that the digital materials produced can be preserved and are of acceptable quality, reference the resources listed above. Be sure to document internal policies, preferred file types, naming and organization schemes, and any other steps that can be applied to future archaeological projects. Feel free to use this document as a starting point for documenting the management and curation process.

Managing Digital Data

1. Develop an organizational and labeling scheme for digital files
 - a. Properly label files w/ creation date, project, content (ex: Project#_Site#_Content)
 - b. Clearly label file folders ('Project#_Site#_SurveyPhotos' is much more useful than 'Photos')
2. Include these **basic** materials as final products for the investigation:
 - a. Final report as PDF (do not send older versions to the repository or curator)
 - b. Artifact catalog as a dataset (such as a Microsoft Excel file instead of a PDF—this will make the data more useful in the future.
 - c. Survey / excavation photographs: include only those with archaeological/historical content (no floating photo boards or sand bags). Where there are multiple files of a profile/feature/etc. select the best representative photo(s).
 - d. Include a finalized Photo Log that matches the photos submitted for curation. Culled images should either be deleted from photo logs or marked clearly to indicate that they were deliberately excluded.
3. Additional Materials: The Facility or Installation you're working with may ask for other digital materials to be curated.

- a. Other datasets. This can include files that contain artifact distribution data, specific data on fauna, etc. Make sure columns of data are well labelled; if codes are utilized include a...
 - b. Coding Sheet. Coding sheets are separate resources in tDAR that can be applied to multiple datasets. If you use the same codes for catalogs, inventories and other data, consider uploading a Coding Sheet and applying it to your Data Sets in tDAR.
 - c. Field notes. You can also upload field notes as a document to tDAR. Ideally, these should be scanned and saved as a PDF
 - d. In addition to Documents, Data Sets, Images and Coding Sheets, tDAR accepts Ontologies, GIS and Scan Data. For more information see: <http://www.tdar.org/why-tdar/contribute/>
4. Ensure that the final version of the file you save is accepted by tDAR (<http://www.tdar.org/why-tdar/contribute/>)

Curating Digital Data

1. Review client's guidelines
2. Organize your Data in tDAR (<https://dev.tdar.org/confluence/display/TDAR/Organizing+Your+Data>)
 - a. Create project page (this can be useful for inheriting project metadata to resources. Include a project description (such as from report abstract)
 - b. If instructed by client, create a collection for the materials and/or add the materials to existing collections
3. Create a resource page to upload the file. The type of resource will depend on the data/ file type (<http://www.tdar.org/why-tdar/contribute/>).
 - a. **Metadata:** Include important administrative information included in the "Digital Materials Requirement Forms" as well as descriptive information from the project and resource. For example, list the materials included in an artifact catalog under "Material Types".
 - b. **Report & Appendices:** If redaction is required, upload the original file and mark it as "confidential" then upload a redacted copy of the file and mark it as "public"; another approach is to put confidential information in a separate file as an appendix and mark that as "confidential".
 - c. **Catalog(s) & Datasets:** Fill out dataset metadata as appropriate – use coding sheets and ontologies as needed.
4. Add in-depth metadata to each page (you can inherit general metadata from the project). Make sure to refer to any specific requirements from the client listed in the Digital Requirements Form. This form will use most of the essential administrative metadata.
5. Save files as a draft, for review by client if needed and/or required.
6. Mark the resource pages as 'Active' in tDAR after the review process is complete.

WHY SHOULD DEPARTMENT OF DEFENSE INSTALLATIONS USE tDAR?

The Digital Archaeological Record (tDAR) is a digital archive and repository housing digital data from archaeological investigations and research. tDAR was developed and is maintained by the Center for Digital Antiquity (DA), an approved university center at Arizona State University in Tempe, Arizona (<http://www.digitalantiquity.org/>). Users of tDAR can search for digital documents, data sets, images, GIS files, and other data sources from archaeological projects throughout the country. tDAR users can deposit data, documents, and images into the digital repository, facilitating access and sharing of digital data for project management, collaborative research, and synthetic studies. Users depositing data into tDAR can also restrict access to their digital materials housed in tDAR in order to protect archaeological resource locations and culturally sensitive information. tDAR also ensures that information contained in digital files will be preserved and accessible in the future as new digital technologies replace current digital platforms. Digital Antiquity staff has worked with several Federal agencies and DoD installations on the curation of digital archaeological data. These agencies and installations have identified two primary benefits to using a digital repository like tDAR: 1) helping agencies fulfill their stewardship responsibilities, and 2) increasing project and program efficiencies.

FEDERAL STEWARDSHIP RESPONSIBILITIES

Given the ever increasing amount of digital data generated by Federally-required archaeological investigations (Petrovic et. al 2011), there is a growing need to curate digital archaeological data within secure repositories where these data can be readily accessed by managers, their archaeological contractors, and where appropriate, project stakeholders, researchers and the public. Currently, most digital data, such as field records, images, laboratory records, data sets resulting from field and laboratory analyses, and Geographic Information System (GIS) maps, are stored on CDs or other stand-alone digital media and then placed within a curatorial facility or Federal, state, or local historic preservation office. That is, these digital records are treated in the same way as paper records and artifacts. As has been demonstrated by recent research and studies (Gravel 1986; Hedstrom 1998; Mallinson 1986; Spitz et al 2010; Task force on Archiving of Digital Information Members 1996), CDs and other digital media degenerate over time, are not readily accessible to users, and will eventually become obsolete as digital data collection and management platforms change over time. One only needs to look at the definition of "associated records" in 36 C.F.R. 79: *Curation of Federally-Owned and Administered Archaeological Collections*, published in final form in 1990, to see the changes in digital technology. This definition includes "...computer cards and tapes, computer disks and diskettes..." It is critical, therefore, that digital archaeological data

be placed within a repository that can guarantee the preservation of these data for the future.

DoD installations can use tDAR to fulfill their legal responsibilities to curate and manage their archaeological data, as required by the National Historic Preservation Act, the Archaeological Resource Protection Act, the regulations regarding the curation of data promulgated pursuant to these statutes (36 C.F.R. 79), and the regulations promulgated by the National Archives and Records Administration (36 C.F.R. 1220.1-1220.20). Specifically tDAR:

- Implements the policies and procedures necessary to effect the long-term preservation of digital Federal records, pursuant to 36 C.F.R. Part 79. These policies and procedures include:
 - Regularly and systematically checking the files in the repository to ensure that no deterioration has occurred
 - Taking actions to remedy deterioration if it is detected
 - Periodically migrating and/or refreshing digital files to provide for their long-term accessibility and preservation
 - Provides a record backup system that ensures important data are not lost because they are difficult to access or are in a format no longer supported by an agency.
 - Has the ability to curate and manage digital project data such as reports, data sets, photographs and other graphic images, GIS, and LiDAR and other remote sensing data.
 - Ensures the cross-referencing between physical collections and digital records
 - Allows the designation of digital data as “restricted access” or “confidential.” Metadata for restricted files are still visible to all tDAR users, but specific files are marked “confidential” to control access. Agencies can designate approved professionals and stakeholders access to these files.

As noted in the National Institute of Standards and Technology's *Cloud Computing Synopsis and Recommendations*, the use of a “cloud” resource such as tDAR does not require large up-front acquisition costs to build a computing storage infrastructure. Further, “the reduction of up-front costs reduces the risks for pilot projects and experimental efforts, thus reducing a barrier to organizational flexibility or agility.” Further, by using programs like tDAR, agencies and organizations “may avoid excessive costs from over-provisioning, i.e., building enough capacity for peak demand and then not using the capacity in non-peak periods” (U.S. Department of Commerce, Special Publication 800-146, ES-1, May 2012).

INCREASING PROJECT AND PROGRAM EFFICIENCIES

Several Federal and state agencies, especially State Historic Preservation Offices (SHPOs), have electronic archaeological resource databases. Digital repositories like tDAR do not represent an additional, redundant program, but enhance these existing databases. For

example, tDAR's contents include archaeological information that typically is not maintained within existing agency or SHPO databases, such as very large data files (e.g., GIS, LiDAR and other remote sensing data), digital photographs, electronic field notes and mapping, and artifact analyses and data sets. tDAR users have the ability to search reports, data sets, images and other types of files using key words and maps, a feature not often found in agency databases.

Given this structure and functionality, agencies can use tDAR as a tool to streamline and expedite archaeological investigations, reduce project costs and schedules, and increase overall efficiencies in conducting Federally-required archaeological studies. For example, it is often difficult for archaeological managers to locate and then search for specific archaeological information within files and records housed in existing agency databases. These information categories include archaeological inventory reports; documents and associated records used to make National Register evaluations of archaeological sites, and the reports and associated datasets, maps, and other records from archaeological data recovery projects. These record searches are especially difficult when the information needed is housed in databases maintained by other states and agencies. These searches are critical to the review of past work in a project location and vicinity, as they serve as the foundation for developing targeted and efficient field investigations and subsequent analyses and evaluations. Ready access to these types of digital records also helps archaeological managers build upon past work, and thus avoid redundancies and errors in conducting future investigations.

In addition, efforts to maintain and update an electronic archaeological database can be difficult due to several factors, such as shifting agency priorities, available funding for maintaining and updating databases, and the ability to train staff to maintain and update databases and then keep the trained personnel. These problems can be eliminated through the use of repositories such as tDAR. Digital Antiquity staff, for example, can receive and manage new digital information to be placed in an installation's archaeological database housed within tDAR. Contractors working for installations can submit these digital records directly to tDAR, following protocols and procedures developed jointly by an agency and Digital Antiquity.

In summary, tDAR can:

- Assist in meeting an installation's mission;
- Reduce the cost for meeting the mission associated with the identification, evaluation, and management of archaeological resources;
- Serve as a tool to improve project effectiveness and efficiency as more agencies and their contractors depend on electronic data;
- House information on archaeological collections and records, resulting in:
 - Searchability across agencies and jurisdictional boundaries;
 - Reassurance of information security;

- o Reassurance of physical perpetuity.

For additional information on tDAR and how tDAR could assist you in fulfilling your mission and historic preservation statutory responsibilities, you can contact Francis P. McManamon, Executive Director, at fpm@digitalantiquity.org.

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