1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

The Minnesota Department of Transportation's (Mn/DOT) Deep Test Protocol (DTP) project is a comprehensive effort to systematize and prioritize the methods that can be used to identify deeply buried archaeological deposits that occur below the surface and cannot be discovered by methods ordinarily employed for site discovery. The project is the logical outgrowth of deep testing investigations that have a long history in Minnesota. Early efforts during the first half of the twentieth century focused less on discovery and more on excavation. For example, the buried components of the Anderson site (21AN0008; Wilford 1934, 1937), whose surface expression has been known since the nineteenth century, was found not by professionals, but rather by road-workers during a construction project in the 1920s. A small area of this buried and/or stratified site was examined as part of this project. Most other efforts to find buried sites remained haphazard until the current era of cultural resources studies brought about by federal and state legal requirements including Section 106 of the National Historic Preservation Act and its implementing regulations (36 CFR § 800), Section 4(f) of the Department of Transportation Act, the National Environmental Policy Act, and Minnesota Statute Chapter 138 (Minn. Stat. § 138).

Many of the important deeply buried and stratified sites in the Minnesota and Red River valleys have been discovered during cultural resources studies from the 1970s to the present. As cultural resources managers have became increasingly aware of the presence and significance of deeply buried archaeological sites, investigations of such sites have become a regular and increasingly important component in identification surveys throughout North America. In part, the increased use of deep testing for buried cultural deposits also reflects the multi-disciplinary interaction between archaeologists and earth scientists and the growth of the discipline of geoarchaeology.

While the probability of finding significant, deeply buried archaeological deposits is relatively low (Benn 2001), the costs for failing to discover and/or properly evaluate buried sites are high. For this reason, site identification and evaluation usually precede construction by at least several months or even years so that anticipated impacts to significant archaeological resources can be avoided, appropriately managed, or mitigated. The failure to discover buried archaeological deposits, only to find them once construction begins, can result in additional costs due to construction delays and archaeological excavation under conditions and schedules that result in higher costs, as well as the loss of important archaeological data.

Late discovery, particularly during construction, can also damage relations with interested parties including Native American tribes, environmental groups, and politicians (e.g., Blakey 1998; *New York Times* 1993; *Seattle Times* 2005). Furthermore, such oversights can result in the loss of federal funding or permitting, or lawsuits against state or federal agencies. Such situations contribute to the attitudes of those who believe cultural heritage protection regulations hinder development, which in turn undermines the faith in the Section 106 review process. Failure of the deep test process, particularly when it is less than a good faith effort, provides credibility to the notion that cultural resources considerations are not worth the impact they have on important projects and raises questions in the public mind concerning the legitimacy and reliability of the

CRM process. For these reasons, the Mn/DOT DTP will provide clear, concise, and reasonable guidelines to identify buried archaeological sites, and, when a site is not found, define a process that provides for a legally and scientifically defendable rationale for the decisions that are made.

While deep testing for buried sites is becoming a more important part of the site identification process across the country, protocols for its enactment are only now being developed and, given their needs, state agencies such as Mn/DOT are leading the way in their development. Review of current deep testing protocols across the country reveal that they are often idiosyncratic or reflect the particular training or biases of agency archaeologists or the archaeologists belonging to a given state's professional organization instead of being based on comparatively tested methods and procedures. As a result, agencies in many states have issued vague and basic statements of principal concerning deep testing and are only now beginning to provide important leadership and direction to the professional archaeological community (Monaghan and Lovis 2005). Minnesota is a leader in recognizing the importance of mapping landform sediment assemblages (LfSAs) in three-dimensions as part of Mn/Model, thereby addressing the contexts in which deeply buried archaeological sites may be preserved and in funding research to develop a scientifically based methodology to identify buried sites in these contexts. Looking at the broader picture, the Mn/DOT DTP project is an important study that also can have a positive impact on deep testing projects far beyond Minnesota.

In many states, the physical locations of where to deep test are either unknown or only loosely expressed as "floodplains" or other "depositional" settings and landforms, the extent of which are seldom geographically known (Monaghan and Lovis 2005). In Minnesota, maps are available for many, but not all, parts of the state that accurately depict the landforms that have the potential to include buried archaeological deposits, as well as the depths and probability of buried sites. These were prepared as part of the Mn/Model project (Hudak et al. 2001) and have proved invaluable for understanding and managing buried archaeological resources in Minnesota, as well as serving as a model for other buried site predictive frameworks (Monaghan and Lovis 2005). Hopefully, mapping of archaeologically important terrain and landforms will continue to be undertaken as LfSA mapping is expanded. The success of this project is due in no small part to the LfSA framework.

In lieu of a deep test protocol, however, the decisions to deep test and what method(s) to use have been inconsistent. As a consequence, deep testing in Minnesota, as noted by Monaghan and Lovis (2005), has produced variable results that range from excellent, very successful, and visionary to less than adequate. For example, some projects have ignored deep testing as a separate and distinct undertaking within the identification process, relying instead on standard archaeological site discovery techniques and shovel testing a little bit deeper along floodplains.

The successful projects employed methods including coring, trenching, and augering (Butler 1993; Dobbs and Mooers 1991; Florin 2004; Justin and Peterson 1990; Summit Envirosolutions 2003). These are clear attempts to address the complexity of site discovery at a variety of depositional landforms and many of the best of these efforts have also employed earth scientists or geoarchaeologists as part of a multidisciplinary research team. The outcome of such projects was to place the deep test process firmly within a geomorphological or geoarchaeological framework rather than a strictly archaeological milieu. Not surprisingly, projects like these have also been among the more successful and have articulated clear notions of the importance of employing a geomorphological and geoarchaeological framework early in the buried site evaluation process (Foth & Van Dyke 1995; Hajic 1993; Kluth and Kluth 2000; Olson and Tate 1994). The work carried out in this project also supports the importance of early and integral involvement of earth science or geoarchaeological specialists in the deep test process.

The goal of this project is to formulate a protocol that provides clear and concise guidelines to explore for, identify, and evaluate buried archaeological deposits. To achieve this goal, the DTP project sought and presents herein the necessary comparative data from which the guidelines have been developed. As such, the DTP project is the most comprehensive project yet to compare the costs and outcomes of various methods commonly used to discover and evaluate buried archaeological sites in the context of Section 106 review.

Just what entails deep testing or even what constitutes a deeply-buried archaeological site is somewhat unclear. At its most simplistic, deeply buried archaeological deposits generally refer to cultural material that extends beyond the limits of hand excavated shovel tests. In this work we refer to the deep test process in Minnesota as the discovery of any cultural material that occurs below the surface and cannot be discovered by methods ordinarily employed for site discovery and that has been buried by either natural or cultural processes (Monaghan and Lovis 2005). Thus, deep testing usually focuses on alluvial, colluvial, or eolian landforms that have been active during the late Wisconsinan and Holocene (i.e., post-12 thousand years before present [kyBP]). We believe that the association of deep testing with landscapes that have been buried within developing Holocene or late Wisconsinan landforms by geological and sedimentological processes requires that earth science methods and theory be integral to the deep test procedures. In fact, the primacy of a multidisplinary approach that integrates earth and archaeological sciences is the principal philosophical approach advocated in this study.

1.2 PROJECT DESIGN AND GOALS

The Mn/DOT DTP project is designed to compare the relative costs and outcomes of various methods for discovering buried archaeological sites. These methods include geophysical (remote sensing) survey (magnetometry, resistivity, and ground penetrating radar [GPR]), a two-step coring and augering procedure, and backhoe trenching. Details of these methods, their strengths and weaknesses, and reasons why they were chosen are discussed in Chapters 3.0 and 4.0. These methods were selected because they are among the most commonly used techniques to find buried cultural resources and because they have distinct differences in the potential severity of impact to archaeological sites. These range from non-intrusive geophysical survey, to minimally intrusive small-diameter coring, to highly intrusive backhoe trenching. Since minimizing impacts to archaeological sites is a commonly held goal in the profession, we address what level of disturbance is necessary to successfully discover buried archaeological deposits. We also address the real and intangible costs of not discovering buried cultural material when it is actually present, discovering buried sites that prove insignificant and/or lack integrity, and testing in locations that have no archaeological sites.

The types of outcomes in the buried site discovery process mentioned above can broadly be grouped as *false-positives* and *false-negatives*. False-negative outcomes arise if a deep testing method was not able to accurately evaluate the subsurface for the presence of buried archaeological material, was not correctly applied, or was adequate but missed the buried cultural deposits. The cost of such an error, particularly if significant sites are found during construction, can result in delays and cause problems, as noted above. False-positive outcomes typically arise as a consequence of methodological misinterpretations, particularly related to remote sensing surveys, and are most common with methods that are least invasive. For example, geophysical survey may identify a subsurface anomaly that can be interpreted as cultural but that in reality is natural. This situation is common and several real-world examples are presented in Chapters 5.0 to 10.0. Costs related to false-positive outcomes are less dramatic than false-negative and are usually confined to unnecessary site excavations, project delays, and/or unnecessary project redesign. Given the economic consequences of these outcomes, however, the protocol aims to eliminate, or at least minimize, both false-positive and false-negative results.

Geophysical survey, coring/augering, and backhoe trenching were applied independently to six test locales throughout Minnesota. A diverse set of locations was intentionally selected to investigate and compare the effectiveness and sensitivity of the deep test methods in a variety of common depositional and archaeological settings. The selection of the test locales for the Mn/DOT DTP project was based on criteria established in consultation with a steering committee assembled by Mn/DOT that included archaeologists and a geographer from Mn/DOT, as well as the Minnesota State Archaeologist and the Minnesota State Historic Preservation Office's National Register Archaeologist. Details of the archaeological and geological backgrounds of Minnesota and the test locale vicinities are discussed in Chapter 2.0. The specific rationales and criteria for selecting these locations are discussed in Chapters 3.0 and 4.0. The results at the Clement, Fritsche Creek II, Hoff Deep, City Property, Anderson, and Root River test locales are presented in Chapters 5.0 to 10.0. The Anderson and Fritsche Creek II test locales include known, buried archaeological sites (21AN0008 and 21NL0063, respectively), but the remainder of the locales had not previously been investigated for buried archaeological material. However, landform-sediment assemblages of each of the locales was mapped for Mn/Model ([LfSA] Hudak and Hajic 2001), and each locale had at least a moderate potential for preserving buried archaeological material that might have been deposited there. Specifically, the selected test locales include floodplain, levee, alluvial/colluvial fan, and eolian (dune) settings, the most common settings where deeply buried sites are expected to occur.

Within each test locale, a parcel of land was selected and gridded using survey equipment, then the various deep testing methods were applied to the gridded testing area in the order of increasing subsurface impact. The specific order of testing was required because ground disturbances affect the results of these surveys, particularly remote sensing and coring. First, a research team applied the three different geophysical (remote sensing) survey methods (magnetometry, resistivity, and GPR), followed by a second, independent team that undertook the two-step coring and augering process. Finally, a third team employed backhoe trenching methods. Field costs for each of the methods were tallied and separate reports outlining what was learned during the deep test process were prepared. To the extent possible, the results for each method were prepared without knowledge of what the results were for the other methods. Using these data, the relative costs, normalized to an average per acre rate, and absolute successes in discovering buried archaeological resources (i.e., whether or not buried archaeological resources were discovered) were determined.

1.3 DEEP TESTING PROTOCOL AND ARCHAEOLOGICAL SIGNIFICANCE

Although the main goal of the deep testing protocol is to identify buried archaeological deposits, an effective protocol also should recommend a method or methods that will provide sufficient information to address the National Register of Historic Places (NRHP) significance of identified resources. The goal of federal cultural heritage protection is to identify sites and properties determined to be *significant*. Significant sites must meet one or more of the National Register Criteria of Evaluation established by the Secretary of the Interior. These criteria are set forth in 36 CFR § 60.4, which in part states:

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and
>
> A. that are associated with events that have made a significant contribution to the broad patterns of our history; or
> B. that are associated with the lives of persons significant in our past; or
> C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
> D. that have yielded, or may be likely to yield, information important in history or prehistory.

In practice, most archaeological sites that are determined significant, particularly prehistoric sites, typically satisfy National Register Criterion D.

Buried sites are an often poorly understood component of the archaeological record. They occur in environments that resulted in their burial within various types of sedimentary sequences and, consequently, dramatically decrease their archaeological visibility (Anderson and Semken 1980; Benn 1986; Bettis and Benn 1984; Bettis et al. 1991; Johnson 1986; Monaghan and Hayes 1998, 2001; Monaghan and Lovis 2005; Nolan and Hickson 1993). Given the environmental contexts in which they occur, they frequently are an underrepresented component of prehistoric settlement systems that may provide additional information regarding the occupational history of a region. Yet, like surface and near-surface sites, the determination of significance is first dependent on the specific regional and/or local prehistoric context in which the site can be placed and interpreted.

Eligible sites must also possess sufficient integrity to convey its significance in terms of its prehistoric context(s). For buried sites, the evaluation of site integrity requires information about how and when the site formed; whether it is in a primary depositional context; what natural processes are responsible for site burial; and how artifacts, features, midden accumulations, and other archaeological phenomena may have been altered by both human and natural processes. To answer these questions requires not just archaeological knowledge but also knowledge of the earth sciences including soil formation processes, depositional processes (alluvial, colluvial, and eolian), and geochronology, among others. Evaluation of buried sites, then, is fundamentally a multidisciplinary task.

Having considered the issues of site types, formation processes, and significance during the formulation of the protocol, we believe we have selected site discovery methods that best establish whether archaeological deposits retain integrity and can place the cultural deposits within the regional and local archaeological, stratigraphical, chronological, and geomorphological frameworks. The protocol contains guidelines that not only facilitate the discovery of buried archaeological deposits, but also provide the minimal data necessary to assess site integrity. Therefore, we believe that establishing a chronological age for any buried archaeological site, either stratigraphically or through chronometric dating, placing the newly discovered cultural deposits into their proper depositional context, and developing a taphonomic framework for the site are integral to this protocol. These issues are discussed in detail throughout this document.

1.4 DEEP TESTING PROTOCOL AND A MULTIDISCIPLINARY FRAMEWORK

The multidisciplinary framework advocated throughout this document, and especially in Chapter 12.0, has been successfully applied elsewhere in the Great Lakes region. Where applied, it has often resulted in the recognition of entirely new and unknown suites of information about the historic and prehistoric past (Lovis and Monaghan 2005). Importantly, these types of collaborative projects have also led to a more detailed understanding of the long-term and short-term geological processes responsible for the formation of the landforms, how they were occupied and utilized by past cultures, and how these relationships changed through time (Hambacher et al. 2003; Monaghan and Hayes 2001; Monaghan and Lovis 2005). Moreover, LfSA maps, such as were created for Mn/Model (Hudak and Hajic 2001), require regular feedback to improve their reliability. Well-designed deep testing is a cost-effective way for Mn/DOT to incorporate new data into these maps.

The Mn/DOT DTP project demonstrates that, by using a multidisciplinary approach, deep testing can yield significantly more information than was commonly collected in the past, and that this additional data need not actually increase the cost of deep testing. In fact, as discussed in the cost/benefit analysis in Chapter 11.0 and the presentation of the protocol in Chapter 12.0, the added efficacy of a multidisplinary approach can actually save money. We believe that a properly formulated deep test protocol can alter the objective of buried site discovery and evaluation from one centered principally on idiosyncratic descriptive applications in project-specific contexts towards one aimed at interdisciplinary research focused on addressing regional-level questions. This subtle alteration meets management needs for site discovery and evaluation by underscoring the fact that buried cultural resources are best understood within the frameworks of local site formation and depositional processes. Additionally, to evaluate the NRHP significance of buried sites, they must also be placed within the larger context of long-term, regional patterns in evolving depositional, settlement, and subsistence systems. Pursuing these goals is not just good archaeological practice, but also is faithful to the spirit of cultural heritage preservation guidelines.