

APPLIED TECHNOLOGY IN ARCHAEOLOGICAL INVESTIGATION

**Prepared for Review by the US ARMY Environmental Center
Aberdeen Proving Ground, Maryland
(Contract No. DAAMO1-96-M-0030)**

Prepared For:

U.S. ARMY Environmental Center
Aberdeen Proving Ground, MD

Prepared By:

Joel W. Grossman, Ph.D.
Grossman & Associates,
Inc New York, New York

January 1997 (Revised 11/2025)

TABLE OF CONTENTS

Executive Summary	
Scope	i
Baseline Premises and Assumptions	ii
Methodological and Technical Recommendations	iii
Generic Recommendations	vii
 I. Preface and Scope: 1	
A. Basic Systems Elements	3
B. “Mid-Tech” vs “High Tech”	5
 II. Limitations of Traditional “ Random” or Probabilistic Site Identification and Definition Testing	7
A. Historical and Theoretical Antecedents: 7	
B. The Problem of Regional “Predictive” Survey Models	12
C. Non-Random Target Specific Survey and Testing Strategies:	19
 III. Geographical Information Systems (GIS) in Archaeology:	21
A. Basic Principals and Applications	21
B. GIS as a Framework for “Non-Random” Target Specific Testing	24
C. GIS and Desktop Image Analysis	30
D. A GIS Framework for Regional Impact Analysis	33
 IV. Terrestrial Geophysical Remote Sensing:	39
A. Rationale and Applicability	39
B. Limits of Site Specific Terrestrial Remote Sensing	41
C. Terrestrial Remote Sensing for the Program Manager	44
D. Geophysical Hardware Systems:	46
1. Conductivity	46
2. Proton and Cesium Magnetometers	47
3. Ground Penetrating Radar	49

V.	High Speed Mapping and Data Control	51
	A. Computer Transit: High Speed Mapping	52
	B. Photogrammetric Computer Based Documentation	54
	1. The Rolleimetric Single Camera Photogrammetric System	54
	2. The Standard Medium Format Mamiya Recording System	56
	C. Concurrent Laboratory Processing and Data Control	58
	1. The Logistical and Fiscal Rationale	58
	2. The Concurrent Laboratory As A Management Tool	60

CASE STUDIES

CASE I	Loiza, Puerto Rico: Computer Transit Impact Analysis and Conductivity Based Remote Sensing for the Target Specific Excavation of a Prehistoric Caribbean Coastal Site	63
CASE II:	The GIS and Archaeological Discovery of Gibbon's 1830's -era Greenhouse Complex, Drew University, Madison, New Jersey	70
CASE III:	The Use of GIS and 3-D Paleo-environmental Terrain Modeling to Reconstruct Prehistoric and Historic Sensitivity and Impacts to the Now Inundated New Jersey Meadowlands	78
CASE IV:	The Application of Staged Historic GIS Map Analysis, Geophysical Survey, and Subsurface Testing to Target Buried Civil War Era Gas Holders at the Saratoga Springs Power Plant, Saratoga Springs, New York.	88
CASE V:	The Magnetometer Based Discovery of R.P. Parrott's Buried Civil War Rifled Cannon Proofing Grounds at the West Point Foundry, Cold Spring, New York.	95
CASE VI:	The Archaeology of a Buried Colonial Port: Defining Boundaries and Targeting Excavation with Ground Penetrating Radar	107

REFERENCES AND ADDITIONAL READING

I.	Archaeological Survey: Methods and Theory.	120
II.	Geophysical Survey and Terrestrial Remote Sensing	124
III.	GIS and Archaeology	129

APPLIED TECHNOLOGY IN ARCHAEOLOGICAL INVESTIGATION

**Prepared for Review by the US ARMY Environmental Center
Aberdeen Proving Ground, Maryland
(Contract No. DAAMO1-96-M-0030)**

By Joel W. Grossman, Ph.D. (PI & PA) - 1997

Executive Summary

Scope:

These discussions and archaeological cases argue for the incorporation of key methodological adjustments and adaptations in the cultural resource compliance process for U.S. Army installations. The goal is to provide a set of tools and procedures to streamline, render more cost effective, and more precisely address the survey and planning needs of the Army Environmental Center and the National Advisory Council on Historic Preservation. At the same time, the parallel aim of this protocol is to meet the primary mandate of continued military preparedness and training at DOD facilities within the United States. The premise of this report is that the expeditious application of available technology, both in the field and in the laboratory, can provide the capacity to better identify, evaluate, and if necessary, document archeological resources, with both enhanced speed and precision.

The six case studies of federal compliance projects have been selected to illustrate the role and use of a range of applied technology solutions to problems of definition and data control within restricted time frames of federally mandated survey and planning projects which were affected, or in some cases stopped, by the unexpected discovery of significant prehistoric or historic remains. In each example, a series of applied technology solutions using readily available commercial systems were implemented to facilitate rapid and precise levels of definition, concurrent data control and data feedback. These approaches provided the scientist and agency project manager with the necessary tools and information to expedite the completion of the primary undertaking while at the same time maintaining adherence to the mandates and standards of the federal section 106 and 110 guidelines of the National Historic Preservation Act. This study draws from this pool of demonstrably effective procedures and technologies to propose the incorporation of comparable approaches to meet the survey and compliance needs of the U.S. Army. Each of the examples illustrates a range of applied technology solutions at both the regional and site-specific levels of investigation. Each demonstrates the use of applied technology to provide enhanced levels of definition for rapid decision making in a restricted timeframe.

As a prelude to the discussion of the rational and implications of these applied technology solutions, a brief discussion of the key elements and potential of each of the approaches will be defined below as two groups, or levels, of interdependent technologies and applications. The first addresses issues of site identification and evaluation strategies in the context of in large-scale

regional survey coverage. The second involves resource or site-specific definition and documentation in the context of field survey and testing procedures which are commonly undertaken as part of the survey process. In each instance, the focus will be on how and why the applied technology procedures are implemented. Where appropriate, limitations in the utility and applicability of each system will be discussed.

The first set of applications focus on the nature and applicability of desktop computer based Geographical Information Systems (GIS) and low altitude air photography, paleo-topographic reconstruction of past environmental conditions, concurrent computer data base management systems as the recommended baseline framework for both large scale regional and more localized project sensitivity studies. When applied, the primary planning goals of these systems and approaches were to identify, define, evaluate, and where possible, mitigate any impacts with avoidance through redesign versus excavation, or data recovery. However, as illustrated for several project examples, in some cases, the federal agency endeavor can not be moved, nor the identified resources avoided. Only when avoidance through redesign was not possible was mitigation through data recovery undertaken.

For situations where avoidance was not possible, or where subsurface testing is required, a specific set of technologies for site-specific levels of definition were implemented to provide concurrent and dynamic data control, of what were in effect, rapidly changing field conditions and perceptions of the resource. This second set of applied technology procedures; involve the use of commercially available systems for site or structure-specific definition, evaluation, and documentation. These technologies include three classes of terrestrial remote sensing systems (conductivity, magnetometers, and Ground Penetrating Radar [GPR], high resolution computer transit recording systems referred to as Total Stations or Electronic Distance Meters (EDM), computerized single camera 3-D photogrammetric recording systems, and finally the role of concurrent on-site archaeological laboratory systems.

The six case studies illustrate the successful and effective utility of using logistically critical alternatives to traditional recording procedures through the application of a variety of non-contact, high resolution, 3-D measurement and documentation systems. In addition to providing increased accuracy and speed, these recording procedures have resulted in increased levels of data control, and when necessary, due to the presence of contaminants or buried ordinance, with reduced human contact and exposure for the field archaeologists. For each class of applied technology, their use and application is illustrated through reference to past survey and data recovery projects where their implementation played a role in providing both enhanced levels of data control, and quantifiable increases in the efficiency and cost control of each project at the managerial and decision-making level.

In addition to being cost effective, these applied technology definition and documentation procedures have successfully provided timely solutions to planning problems and conflict resolution resulting from the unexpected and/or politically sensitive definition and avoidance of impacts to a wide range of prehistoric and historic period cemetery and burial sites. Several of these case studies involved the last-minute discoveries in costly, and politically high-profile undertakings. In these settings, the “mid-tech” applied technology procedures provided rapid definition and evaluation strategies which were then utilized to define design alternatives which expedited the completion of all projects, generally on budget and on schedule.