GIS for Cultural Resources Management

A Predictive Model for the Sacramento River Flood Control Project

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I. Background
II. Problem
III. Cultural Resources Regulatory Guidance
IV. Model
V. Analysis and Anticipated Results
VI. Conclusion
The Sacramento River Flood Control Project Extent
- The levee system was originally built by farmers and laborers over 100 years ago, using whatever soils and materials were available at the time.
- Many encroachments throughout the levee system.
- The system is at risk (evidence of past failures and...
The Sacramento River Flood Control Project
- Build and repair older and deteriorating levee systems

- Restore parts of the region to natural biodiverse landscapes

- Several projects and initiatives through Federal, State and local agency initiatives
**The Feasibility Planning Process**

**S**: Specific  
**M**: Measurable  
**A**: Attainable  
**R**: Risk Informed  
**T**: Timely

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**SCOPING**  
Alternatives Milestone  
Vertical Team concurrence on array of alternatives

**ALTERNATIVE FORMULATION & ANALYSIS**  
TSP Milestone  
Vertical Team concurrence on tentatively selected plan

**FEASIBILITY-LEVEL ANALYSIS**  
Civil Works Review Board  
Release for State & Agency Review

**CHIEF’S REPORT**  
Chief’s Report

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**Agency Decision Milestone**  
Agency endorsement of recommended plan

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**SMART Feasibility Study Process 18-36 Months**

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F Credit: http://planning.usace.army.mil/toolbox/smart.cfm?Section=1&Part=3
National Historic Preservation Act

California Environmental Quality Act

Assembly Bill (AB) 52

Regulations for Cultural Resource Management
National Register of Historic Places Program:

State Historic Preservation Officers (SHPO)

“The National Register of Historic Places is the official list of the Nation's historic places worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service’s National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America’s historic and archeological resources.”
Site CA-COL-247, ~5,970 BP

Windmiller Pattern Sites, ~3,800 to 2,700 BP

Berkeley Pattern Sites, ~2,800 to 1,000 BP

Augustine Pattern Sites, ~1,000 to 600 BP

History of People in the Region
The Key to Tribal Territories is a diagrammatic map of tribal boundaries and does not represent a precise set of boundaries for a particular group.

Credit: http://library.csus.edu/services/inst/California%20Native%20Americans.html#top
GIS is perfect for the spatial nature of Cultural Resources Management (CRM)

- Assists in visual recognition of patterns and distributions of cultural findings
- Mapping shows the disbursement of findings for a much easier method of data analysis (historically, data were stored in charts)

Cultural Resources Predictive Models

- A predictive model allows for an early indication of likelihood of site occurrence
- Graphical nature allows for visual analysis of statistical significance based on physical geography
History of CRM Modeling in Sacramento District

The Common Features
Archaeological Sensitivity Equations
and Buried Site Model

Produced 2013

Based on project-defined need and location

Aimed to provide a prediction for finding sites around proposed levee project alternatives

Credit: (Griffin 2013, p22)
- Focus on a large geographical area (approximately 880 square miles, 0.5 mile buffer of levee system, bypasses and weirs)

- The new model will incorporate some of the input variables used in Common Features model

- Use grid cells vs. points

- Use elevation dataset
Archaeological Predictive Model Workflow

Spatial Database Construction

Data Extraction

Univariate Statistical Testing

Model Mapping

Accuracy Assessment
Independent Variables

Historic Vegetation

Geologic Units

Elevation (LIDAR)

Historic Waterways

Credits: Griffin 2013, Lidar map created by author
Multiple regression equation

\[ L = a + b_1x_1 + b_2x_2 + b_3x_3 + \ldots + b_kx_k \]

\( L \) = the dependent archaeological value  
\( a \) = a constant  
\( b_1...b_k \) = the regression coefficient  
\( X_1...x_k \) = independent variable value

Logistic regression equation

\[ p = \frac{1}{1 + e^{(1-L)}} \]

\( p \) = the calculated probability of the presence of a site  
\( L \) = calculated value based on the regression equation

Source: (Wheatley and Gillings 2002, p174)
The Logistic Model

Credit: Warren and Asch, 2000 p9)
Mapping the results of the predicted probability of occurrences should look something like this...except it will be for the **Sacramento Valley** and not **New Zealand**.

This map was created as a result of J.R. Leathwick’s Model and was featured in Science & Research Internal Report 181, titled *Predictive models of archaeological site distributions in New Zealand*. Methodologies used are similar to the proposed methodologies for this project.
- Show a correlation between historic environmental characteristics and the probability of culturally significant findings

- Assist the Cultural Resources Section in the development of a viable model for site prediction

- Assist planners under SMART planning guidelines to make better decisions earlier on and at a cost savings to the taxpayer

- Probit regression module
May 2016
Completion of Project Proposal

Summer 2016
Compile and Process Model Inputs

Fall 2016
596b, Complete Project

October 2016
Project Presentation (NSGIC, NWGIS)
Joe Griffin, Senior Archaeologist - USACE Cultural Resources Section

Dr. Larry Gorenflo, Dept. of Landscape Architecture, PSU - Advisor

Dr. Justine Blanford and all Instructors from the MGIS program

Family and friends
Kvamme, Kenneth L.


Leathwick, J.R.

US Army Corps of Engineers (USACE), Sacramento District


Warren, Robert E. and David L. Asch

Wescott, Konnie L. and Joe Brandon

Wheatley, David, and Mark Gillings

References cont.
Questions

Thank you