

GIS for Cultural Resources Management

A Predictive Model for the Sacramento River Flood Control Project



Credit: USACE, Sacramento District

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Geography 596a, Spring 2016
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I. Background

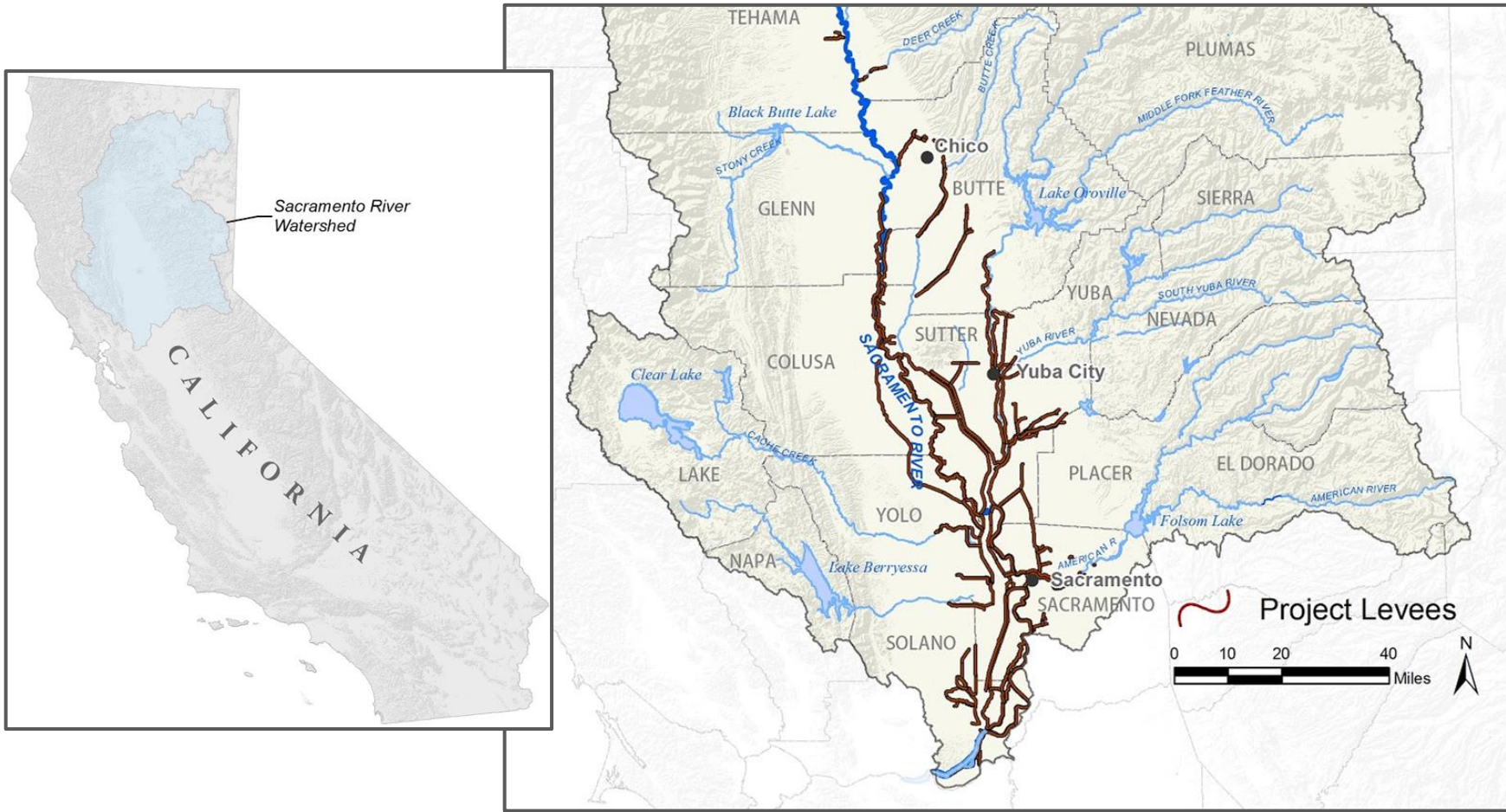
II. Problem

III. Cultural Resources Regulatory Guidance

IV. Model

V. Analysis and Anticipated Results

VI. Conclusion

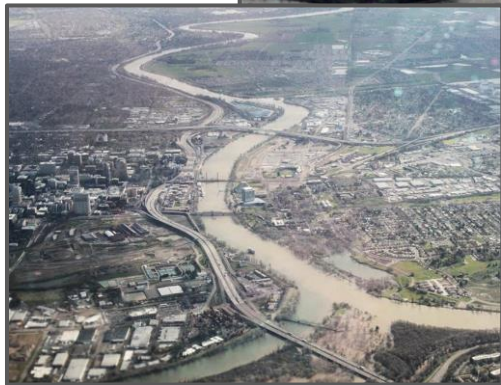


Map created by author.

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



Map created by author, Photo credits: Mayensphotblog, Moulton Weir 1997, Yolo Bypass OneDeltaOneScience.

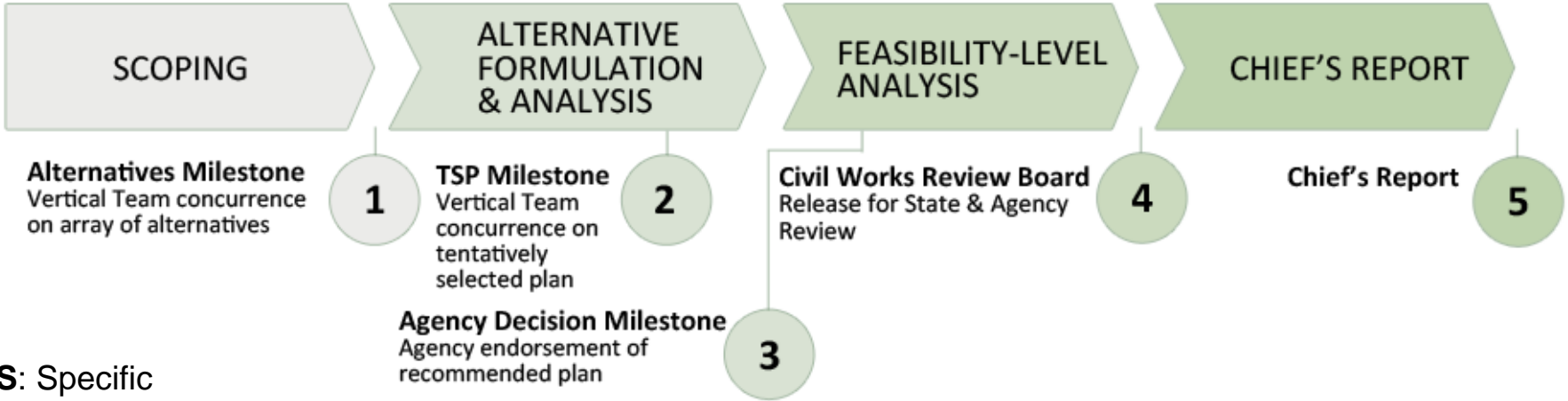
The Sacramento River Flood Control Project

- 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



Credit: USACE, Sacramento District

SMART Feasibility Study Process 18-36 Months



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

FCredit: <http://planning.usace.army.mil/toolbox/smart.cfm?Section=1&Part=3>



National Historic Preservation Act

California Environmental Quality Act

Assembly Bill (AB) 52

National Register of Historic Places Program:

State Historic Preservation Officers (SHPO)

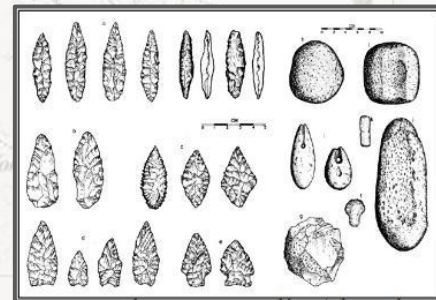
"The National Register of Historic Places is the official list of the Nation's historic places worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service's National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources."

STATE
HISTORIC
PRESERVATION
OFFICE





Site CA-COL-247, ~5,970 BP

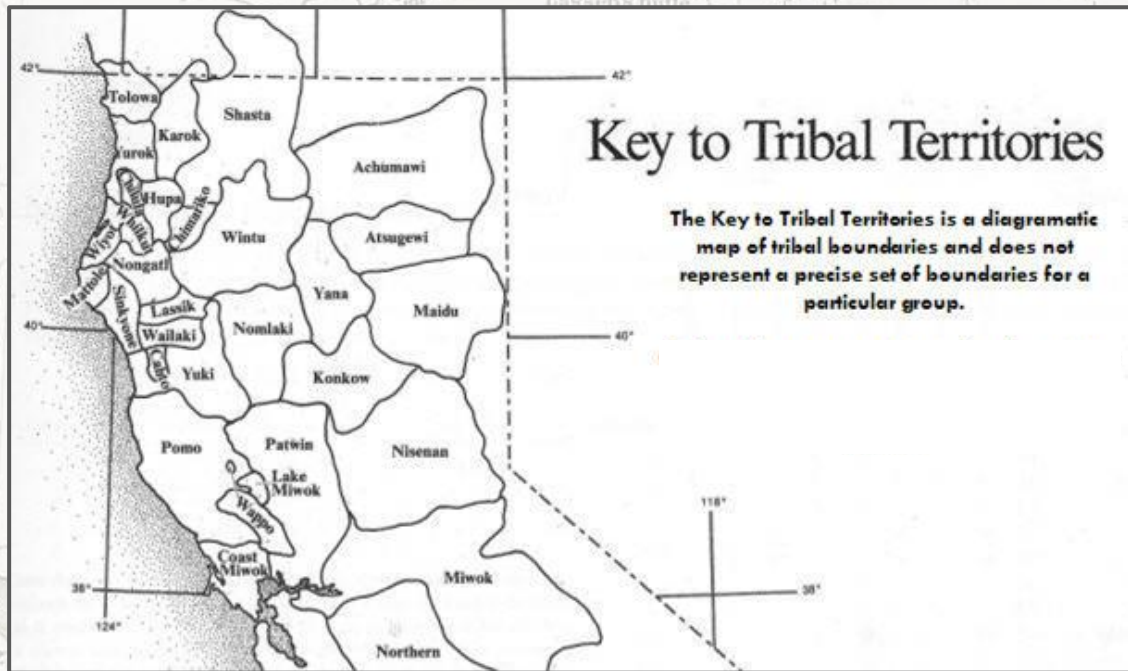


Windmilller Pattern Sites, ~3,800 to 2,700 BP

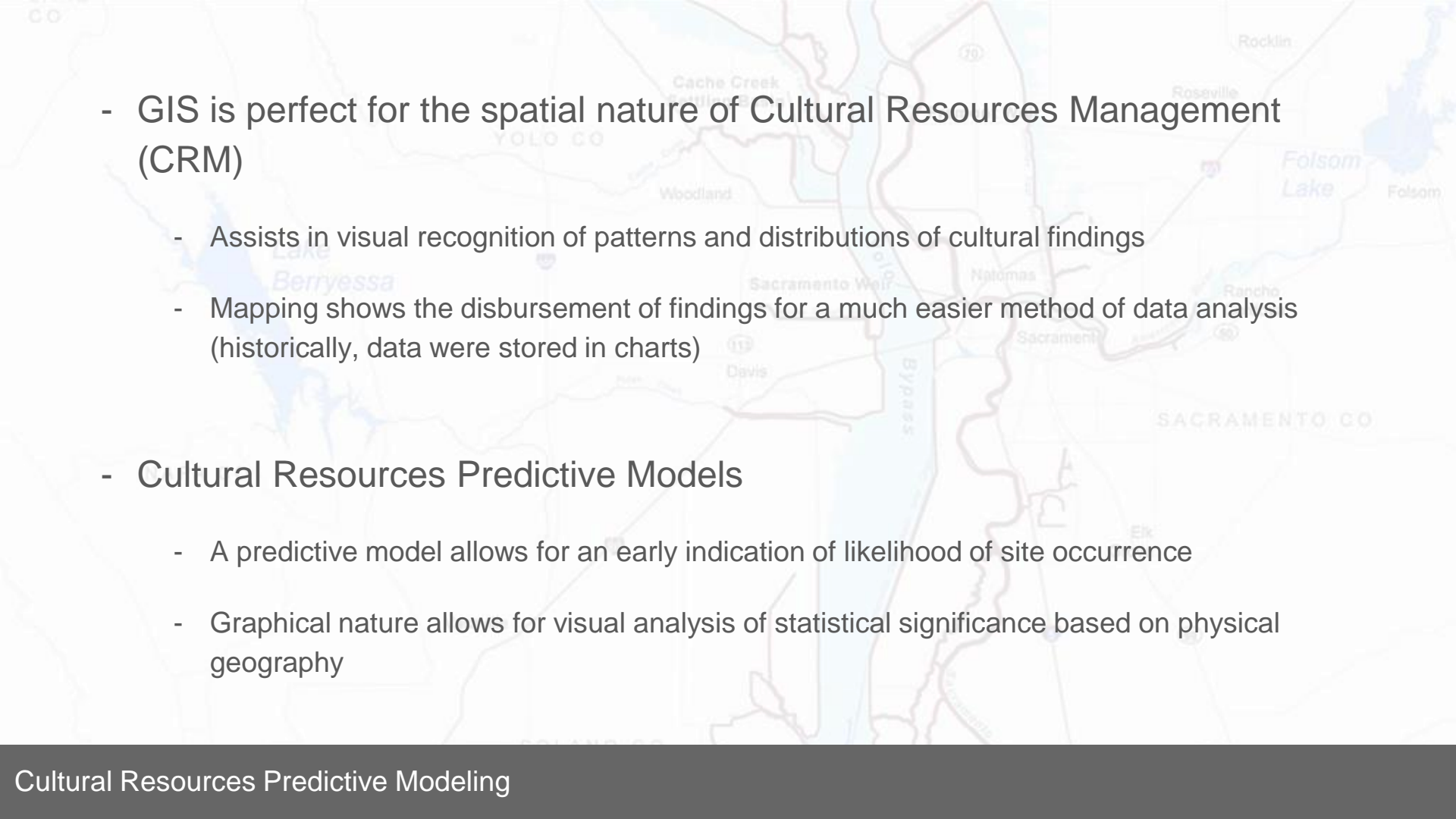
Berkeley Pattern Sites, ~2,800 to 1,000 BP

Augustine Pattern Sites, ~1,000 to 600 BP





Credit: <http://library.csus.edu/services/inst/California%20Native%20Americans.html#top>

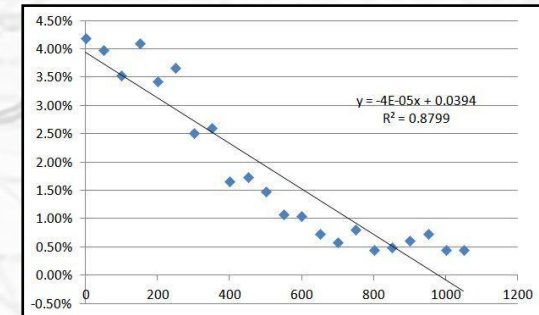
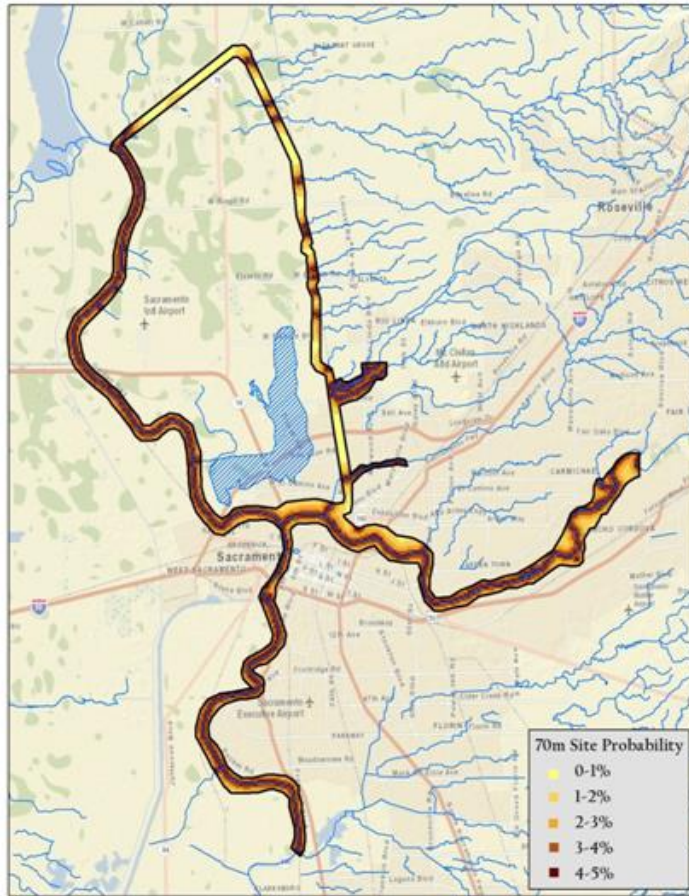
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- GIS is perfect for the spatial nature of Cultural Resources Management (CRM)
 - Assists in visual recognition of patterns and distributions of cultural findings
 - Mapping shows the disbursement of findings for a much easier method of data analysis (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

The Common Features Archaeological Sensitivity Equations and Buried Site Model

Produced 2013

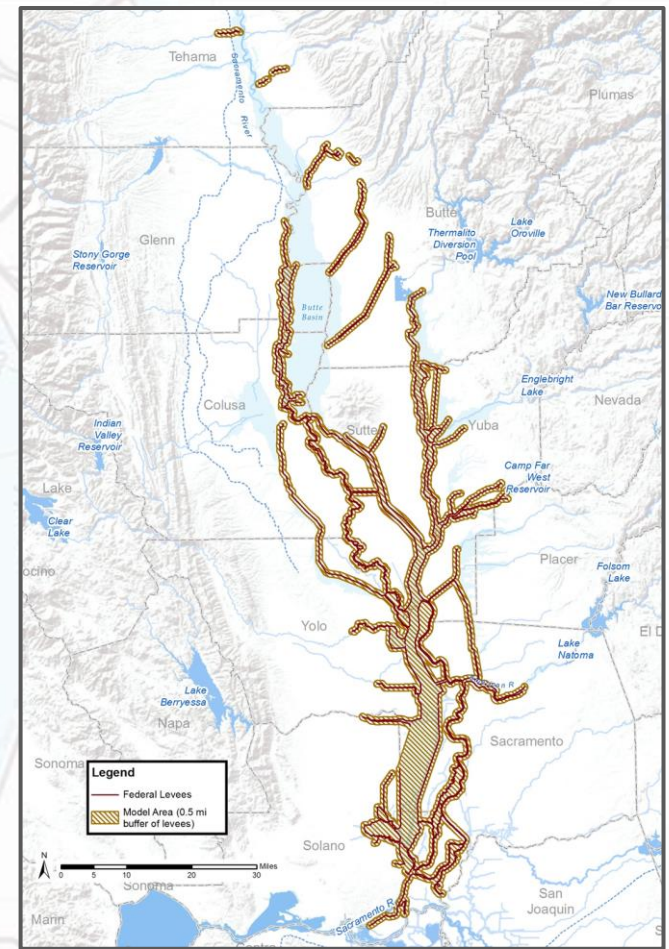
Based on project-defined need and location

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



Credit: Map created by author

Archaeological Predictive Model Workflow

Spatial Database Construction



Data Extraction



Univariate Statistical Testing



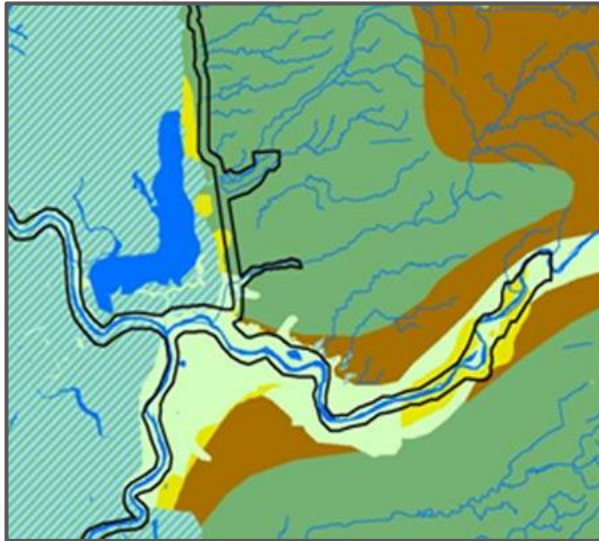
Model Mapping



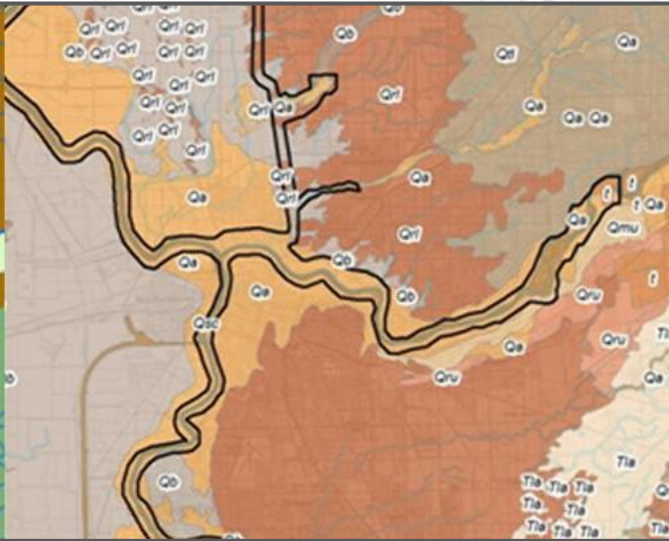
Accuracy Assessment

Independent Variables

Historic Vegetation



Geologic Units



Elevation (LIDAR)



Historic Waterways



Credits: Griffin 2013, Lidar map created by author

Multiple regression equation

$$L = a + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_kx_k$$

L = the dependent archaeological value

a = a constant

$b_1 \dots b_k$ = the regression coefficient

$X_1 \dots X_k$ = independent variable value

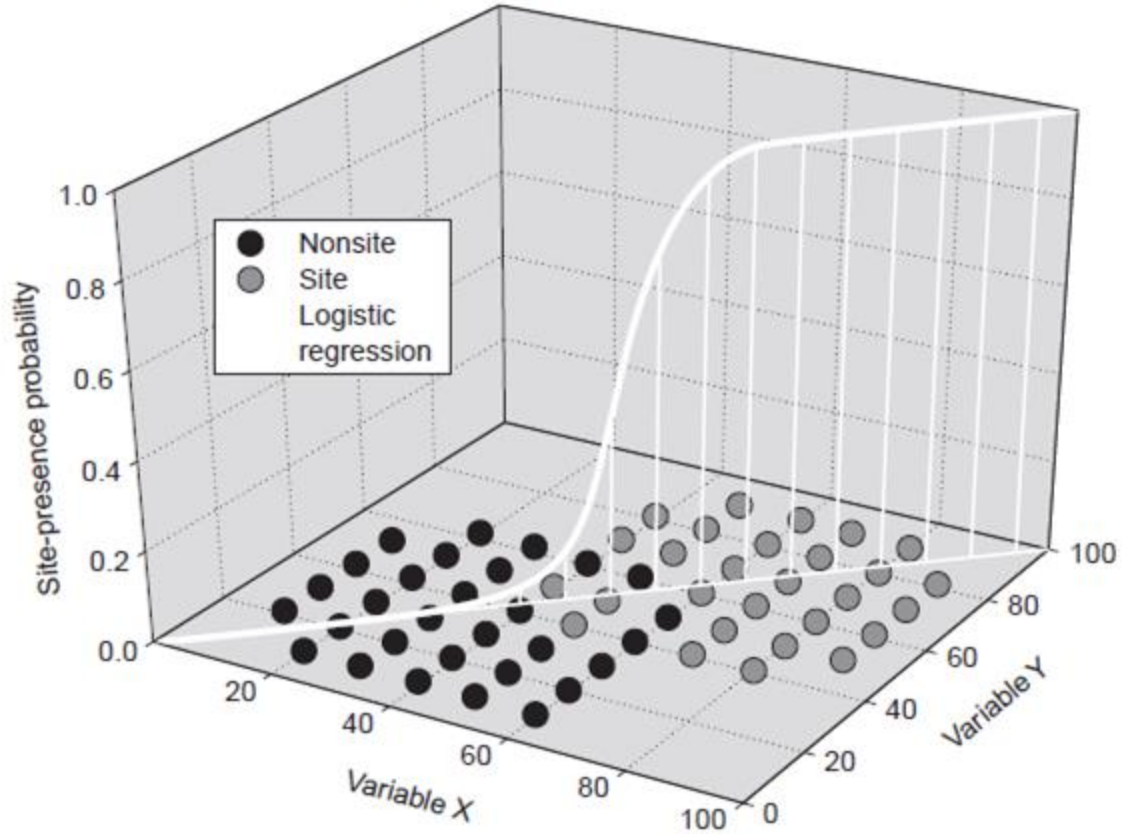
Logistic regression equation

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

p = the calculated probability of the presence of a site

L = calculated value based on the regression equation

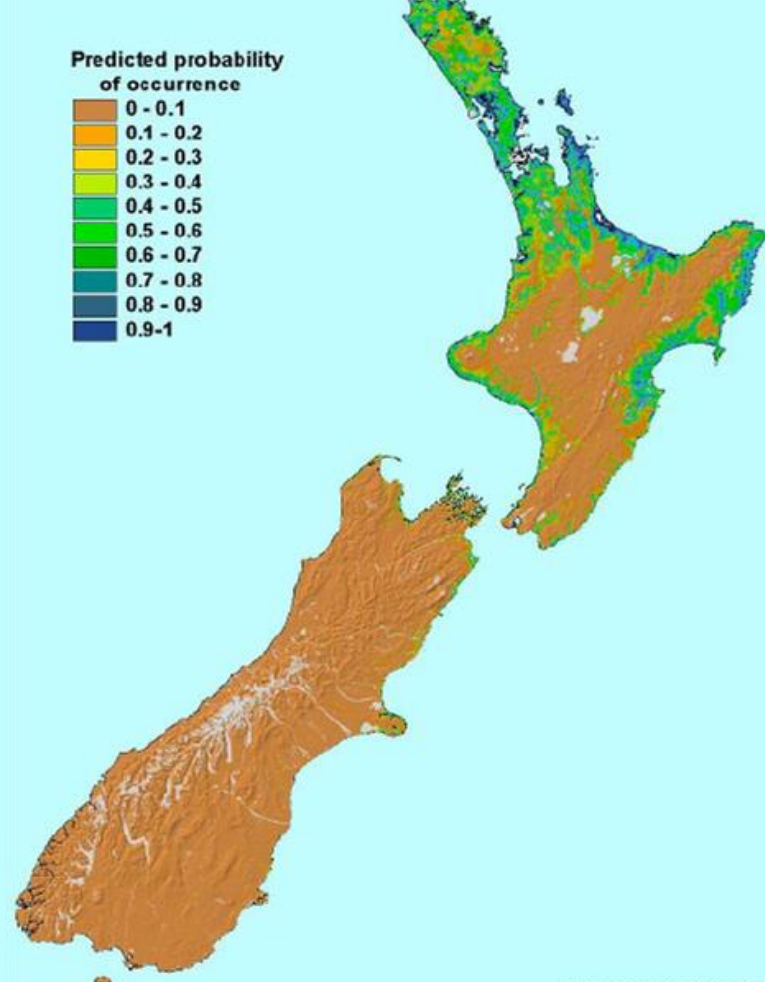
Logistic Regression Model



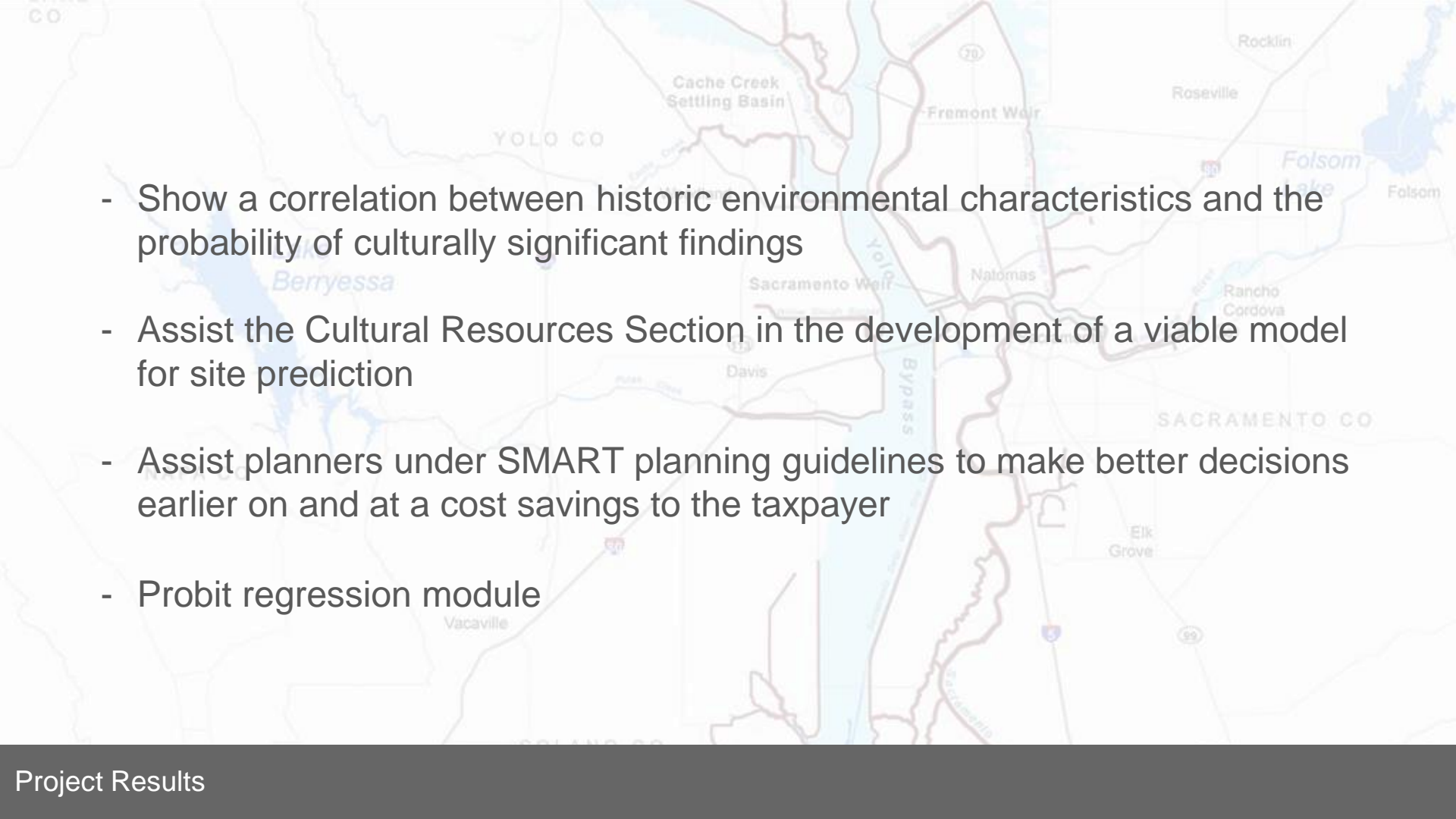
Credit: Warren and Asch, 2000 p9)

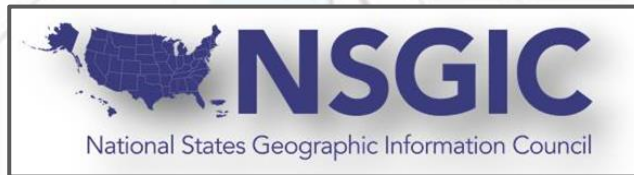
Mapping the results of the predicted probability of occurrences should look something like this...except it will be for the **Sacramento Valley** and not **New Zealand**.

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.



Credit: Leathwick, 2000, p10

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- A map of the Sacramento-San Joaquin River Delta region, showing the Sacramento River, Yolo Bypass, and various weirs and settling basins. The map includes labels for Yolo County and Sacramento County, and cities such as Vacaville, Davis, Natomas, Fremont, Roseville, Rocklin, Folsom, and Elk Grove. Key features include the Cache Creek Settling Basin, Fremont Weir, Sacramento Weir, and Yolo Bypass. Major roads like I-5, I-80, and SR-99 are also shown.
- 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



A topographic map of the Marysville, Oregon area, showing various geographical features like rivers, lakes, and hills. The map is overlaid with text. The text is centered and reads: "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", and "Family and friends".

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

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Questions