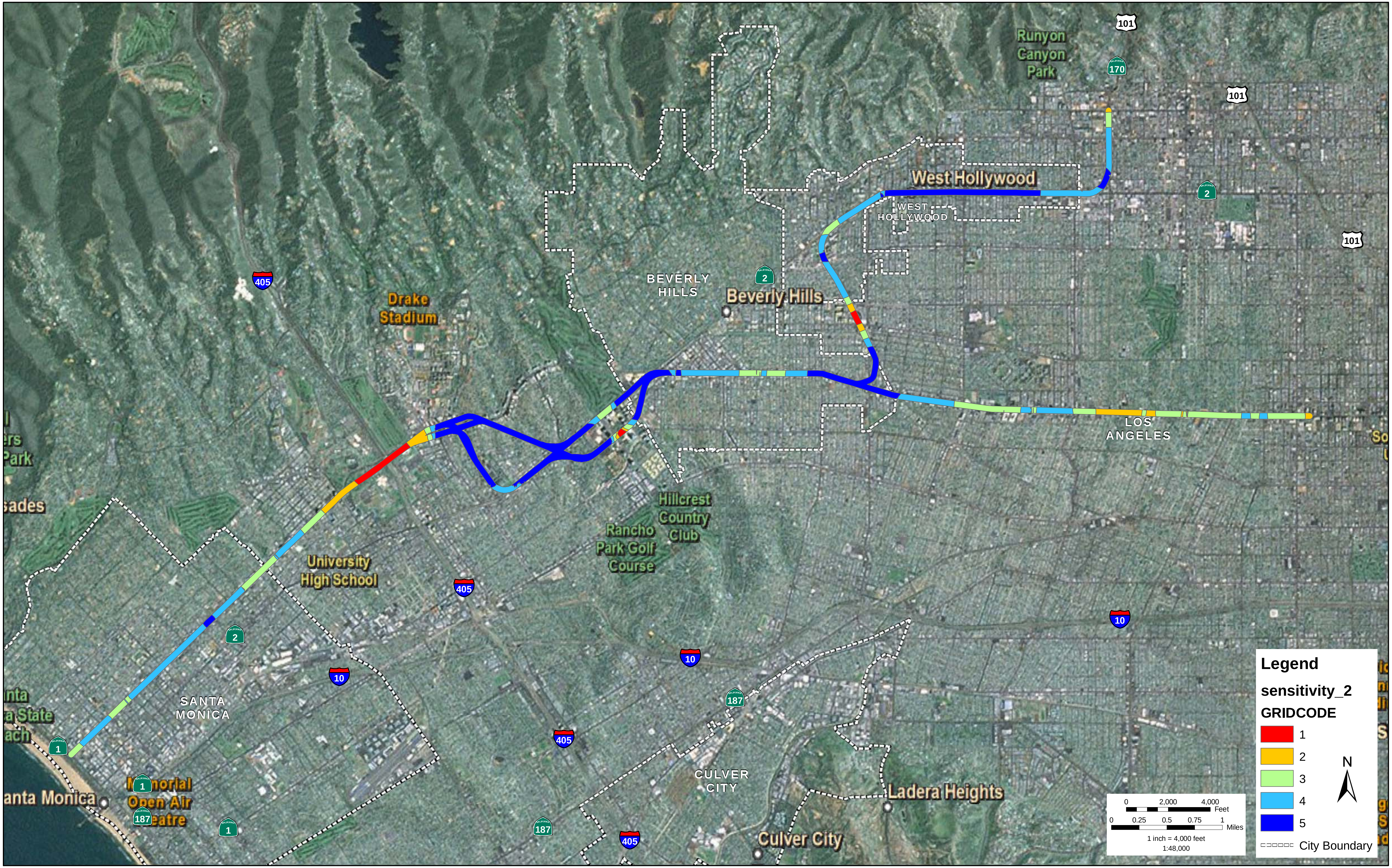
Appendix C
GIS Archaeological Predictive Study



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Drake Stadium
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University High School
SANTA MONICA
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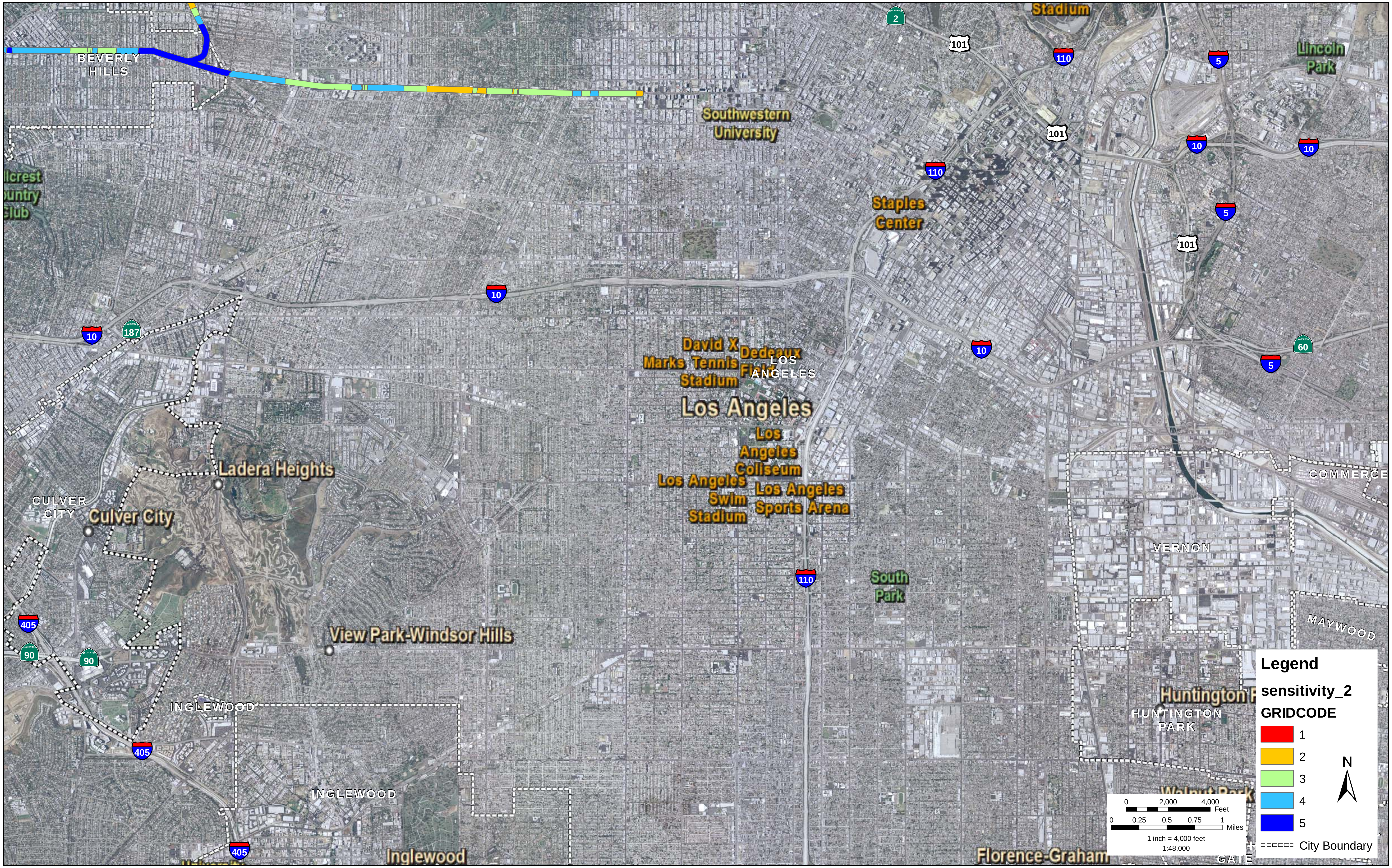
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Lincoln Park
Southwestern University
Staples Center
David X Marks Tennis Stadium
Dedeaux Field
LOS ANGELES
Los Angeles
Los Angeles Coliseum
Los Angeles Swim Stadium
Los Angeles Sports Arena
Ladera Heights
CULVER CITY
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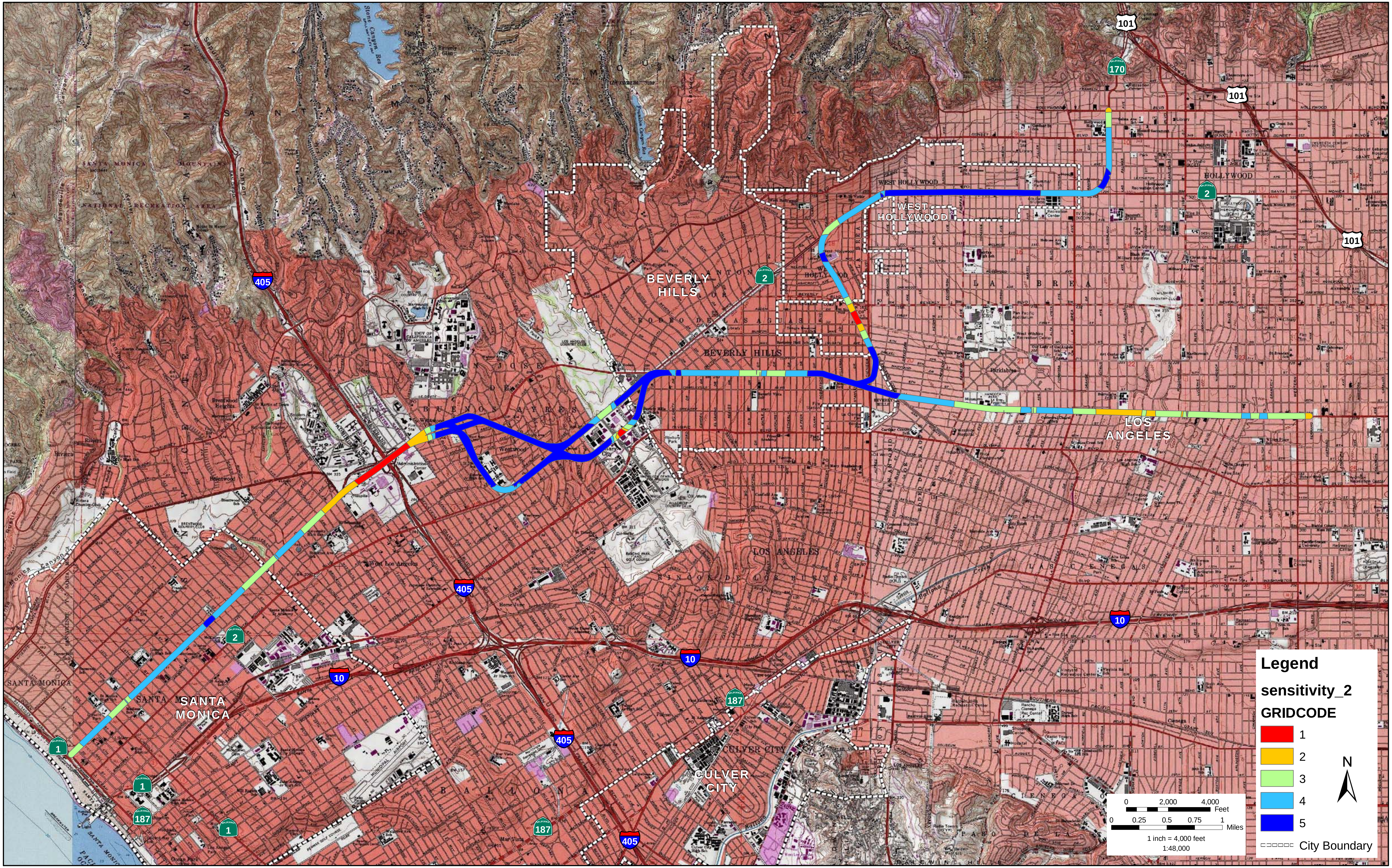

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URS

Memorandum

Date: August 10, 2009

To: Laurie Solis

From: Mark Neal

Subject: **MTA Westside Expansion Predictive Model Feasibility**

Executive Summary

The purpose of this memorandum is to report on the results of a study of the feasibility of creating a geographical information system (GIS)-based model to predict the potential for the presence of previously undiscovered historic and prehistoric resources within the Area of Potential Effect (APE) of the Metro Transit Authority's proposed Westside Expansion of the Metro Rail system.

During this study, a variety of modeling methods and data sources were considered and tested. Most avenues of investigation proved to be unfruitful and, as a result, no method was discovered that had potential to yield a robust, sophisticated, and statistically testable model. As an alternative, a simplified judgmental deductive model based on the density of historic era standing architecture has been created and is presented here.

Background

Though predictive models are generally associated with new technology such as advanced computer systems and spatially-oriented database systems such as GIS, the concept is not new to archaeology. Beginning in the 1950s, archaeologists shifted their methodological focus from the study of single sites to that of regions (Dalla Bona 1994; Trigger 1989). Those studies not only represented an expansion of the geographical dimensions of archaeological investigations, but also expanded the degree to which diverse scientific disciplines were consulted in order to create more comprehensive theories of settlement strategies. The resulting models of settlement systems were most commonly based on environmental data and were created by teams of scientists consisting of archaeologists, zoologists, geologists, botanists, and other specialists (Trigger 1989). The advent of computer-based GIS did foster significant improvements in predictive modeling, primarily in two ways. It greatly increased the ease with which archaeologists could manage large geographic datasets and also initiated a fluorescence of publicly available geographic data, which increased access to especially high-resolution environmental datasets.

Generally speaking, archaeological predictive models are produced by two methods —inductive and deductive. Deductive models are based entirely on theory, previous findings, and ethnological analog (Kvamme 2006). Commonly produced using manual map overlays, these are perhaps the most common models currently employed in urban planning. The strength of these models is that they provide a way of capturing experts' knowledge and experience concerning the relative cultural sensitivity of regions and making that information readily accessible and comprehensible to experts in other disciplines, such as urban planning.

With the advent of sophisticated computers, inductive models have come into wider use. Based on empirical correlations between geographic phenomena and the locations of known cultural resources, inductive models are most powerful when they are created using large geographic datasets, large numbers of known resources, and sophisticated spatial statistics to test the significance of correlations between the two. Models with inductive characteristics have an additional advantage in that they are commonly created using more robust mathematical theory such as Weights of Evidence and Logistic Regression.

However, it is noteworthy that the most advanced and powerful models are created using a combination if inductive and deductive reasoning. In those models, the types of datasets considered for the model are determined deductively by considering their potential to address hypotheses derived from current anthropological and archaeological theory. The hypotheses are tested using spatial datasets and statistical analysis, and the spatial extent of the final layers of evidence are created based on the strength of their statistical correlation to a training set of known resources. An additional advantage of such models lies in the ease with which they can be updated and improved as the datasets employed are refined and new theories are published.

Methods

The following paragraphs describe the layers of evidence that were considered and the reasoning behind their acceptance or rejection for use in the predictive model. In that very different conditions affect the spatial organization of prehistoric vs. historic sites, those two classes of resources will be considered separately.

TRAINING POINTS

In statistically based probabilistic predictive models such as the one proposed here, a dataset of points indicating known locations of the phenomena to be predicted is used to determine the strength of statistical relationships between geographic regions and the phenomena. In this case the phenomena to be predicted are the locations of cultural resources. As with most statistical analysis, larger datasets generally produce more reliable results. Though there are no set limits as to how few training points one can use in a given model and still yield useable results, some general guidelines can be defined. Generally speaking, a dataset of at least 70 training points is required to yield reliable results, though one widely accepted model was created with only 21 training points (Neal 2007). In order to test the final model, it is most advantageous to have an additional dataset of at least that many training points, thereby doubling the number of data points required. In addition, it is the goal of this model to predict the potential for the presence of both historic and prehistoric resources. As those two classes of resources would likely be located according to very different criterion, each would require the minimum number of points necessary to create a complete model. Therefore, the absolute minimum number of training points required to create this model would be 42 points representing historic archaeological resources and 42 representing prehistoric resources.

The current dataset of cultural resources within .25 miles of the archaeological APE for the project consists of four historic archaeological resources and four prehistoric resources. Therefore, there are too few known resources to support the creation of an inductive predictive probabilistic model. However, the possibility of the creation of a deductive, judgmental model is not eliminated by condition.

ENVIRONMENTAL DATASETS INVESTIGATED TO PREDICT PREHISTORIC ARCHAEOLOGICAL SITES

Fortunately, a comprehensive predictive model of prehistoric archaeological sites has recently been produced for an area quite similar to the current project area. The criteria and findings of that model can serve to guide the construction of the currently proposed model. Neal (2007) created an environmentally-based predictive model of village sites within the Santa Ynez Valley, which is the traditional home of one of the groups of Chumash people who inhabited that region from prehistoric to current times. As the environment and social structure of the Tongva people of the current project area are similar to the Chumash, it can be assumed that criteria shaping settlement patterns would also be similar between the two groups. In his study, Neal determined that the most critical criteria for site selection were:

- Proximity to reliable sources of fresh water
- Areas of less than 15° slope.
- Areas within 200 meters of ecotone boundaries.
- Areas with high environmental diversity.

Unfortunately, current efforts were unable to yield adequate datasets to address those criteria in the current project area. Each are discussed briefly below.

Proximity to reliable sources of fresh water – The National Hydrology Dataset as well as early maps were consulted in an effort to create a reliable dataset of reliable water sources. Unfortunately, the local stream network has been disrupted to such a degree and beginning such a long time ago that reconstruction of a defensible depiction of what the local hydrologic environment would have been like in prehistoric times is well beyond the scope of this project. Should such a dataset become available, this aspect of the model could be reconsidered.

Areas of less than 15° slope – The National Elevation dataset was consulted and slope derived for the project area. The project area is depicted as lying primarily in a broad, flat plain and as such there are virtually no areas that do not meet this criterion. Therefore, the slope dataset as it is would add no predictive power to a predictive model.

Areas within 200 meters of ecotone boundaries and areas with high environmental diversity – The source data to address both these criteria is the GAP Landcover dataset. In that dataset, the project area falls entirely within an area designated simply as "Urban." As no other sources were found to accurately depict the boundaries of ecological regions within the project area before the onset of urbanization, it was not possible to incorporate either of these criteria into the model.

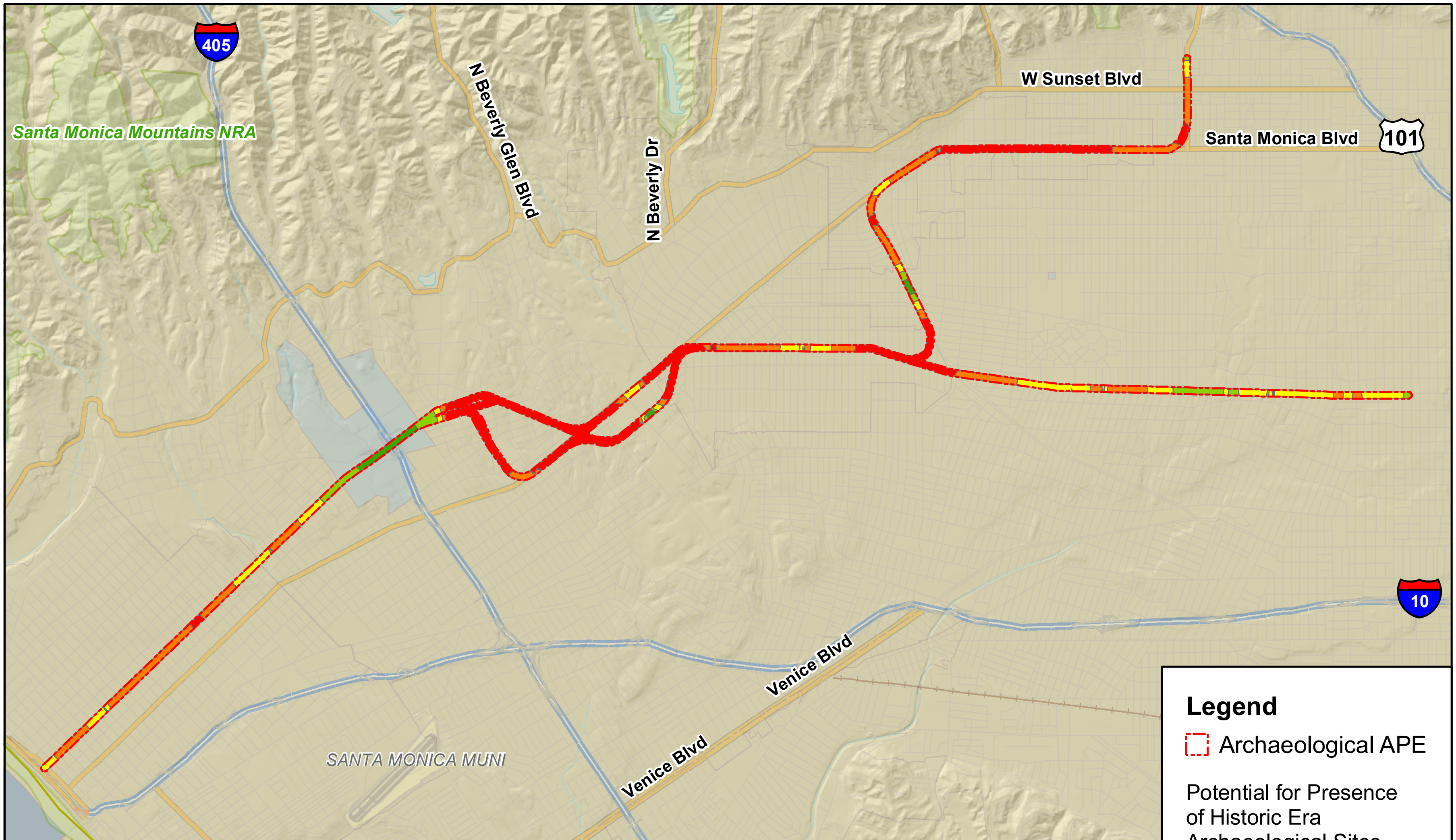
DATASETS CONSIDERED IN ORDER TO PREDICT HISTORIC ARCHAEOLOGICAL SITES.

Virtually any site occupied by humans for habitation or other purposes might yield cultural resources in the form of buried trash pits, privies, wells, remnants of razed architecture, etc. It can be assumed that areas that have remained largely unchanged within the past 50 or more years would be more likely to yield undisturbed archaeological deposits of the historic era.

To address that hypothesis, a cadastral dataset of land parcels within the project area was used. A point dataset of the centroids of each parcel attributed with the built date of the building located on each was created. Based on that layer, a surface reflecting the relative densities of historic-era structures was generated using the ArcGIS Point Density tool. The resulting raster was classified by Quantiles into five classes of relative potential for the presence of undisturbed historic era archaeological resources. That raster was converted into a vector-dataset in order to enhance its portability. A map of the resulting zones is included at the end of this memo (Figure 1).

CONCLUSIONS

The current effort has succeeded in producing a dataset that can be useful in providing a geographic representation of areas expected to have higher and lower potentials for the presence of historic era archaeological resources. Whereas the strength of the resulting model cannot be statistically quantified nor can it predict prehistoric archaeological sites, it is nonetheless a useful tool. Concepts such as density of historic era structures are generally difficult to assess without maps such as the one provided herein. This modeling effort allows that data to be accessed easily and allows it to be overlaid onto other datasets, thereby enhancing the decision making tools available to planners. In addition, when further hypotheses concerning the locations of significant resources are generated and more environmental datasets are made available, they can be incorporated into this model to enhance its overall accuracy and precision. That ability to constantly build on and improve a model is one of the most powerful aspects of predictive models within the modern urban planning environment.



MTA Westside Expansion

URS Corporation

Potential for Presence of Historic Era Archaeological Sites Based on Density of Standing Historic Era Structures

Figure 1

Legend

Archaeological APE

Potential for Presence of Historic Era Archaeological Sites

- Low
- Moderately Low
- Moderate
- Moderately High
- High

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Appendix D
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