A GEOARCHAEOLOGICAL CONTEXT FOR THE GREATER VACAVILLE AREA, SOLANO COUNTY, CALIFORNIA

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Date

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ABSTRACT

PURPOSE OF STUDY: Holocene landscape evolution has created significant biases in the nature and completeness of the archaeological record in much of California. Landscape changes include multiple cycles of deposition which have buried a substantial number of prehistoric archaeological sites. The recent discoveries of several buried archaeological sites in the Vacaville area of Solano County demonstrate their presence and the potential for information important for understanding the influence of landscape changes on the archaeological record.

The purpose of this study was to define the nature and extent of Latest Pleistocene- and Holocene-age depositional landforms within the study area of the Ulatis Creek Watershed and refine the existing knowledge of their evolution and chronology in order to assess the potential for buried prehistoric archaeological sites.

METHODS: The goals of this study were accomplished through a detailed analysis of stratigraphic, radiocarbon, and obsidian hydration evidence to identify and define a soil chronosequence and produce a refined landform surface age map.

FINDINGS: Chronostratigraphic landform units representing six time periods were identified. From oldest to youngest, these units are: pre-Latest Pleistocene, Latest Pleistocene, Early Holocene, Late Holocene, Recent Holocene, and Historic-era to modern.

CONCLUSIONS: The findings of this study indicate that the Ulatis Creek Watershed has a long and complex landscape history with periods of landform stability and soil formation periodically interrupted by cycles of erosion and deposition. The results of this research provide a geoarchaeological landscape context for the Ulatis Creek Watershed through a better understanding of the nature, timing, and extent of Holocene landscape changes. This geoarchaeological context can be used in future cultural resources management planning and archaeological studies of prehistoric culture history.

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CHAPTER 1: INTRODUCTION

Due to the high level of geologic and human activity that has occurred in central California throughout the Holocene, the known archaeological record is not representative of the breadth of human land use in time and space (Meyer 2003:1; Meyer and Rosenthal 2008:15). Few sites in central California have been radiocarbon dated to more than 3,000 to 4,000 years before present (BP) and it is posited that this dearth of early sites is partially due to recent changes in the geomorphic landscape (Meyer and Rosenthal 2008:15; Rosenthal and Meyer 2004a:30). Late Holocene through present-day landscape changes, including those induced by anthropogenic activity, have also buried and altered more recent sites.

The recent discoveries of several buried archaeological sites in the Vacaville area of Solano County demonstrate their presence and the potential for information important for understanding the influence of landscape changes on the archaeological record (Meyer and Morgan 2007; Whitaker 2009; Whitaker and Kaijankoski 2009). Based on a records search conducted at the California Historical Resources Inventory, Northwest Information Center (discussed in Chapter 5), there are currently 156 recorded archaeological resources (including isolates and informal resources) within the study area. Of these, 98 are historic-era, 51 are prehistoric, and seven have both prehistoric and historic-era components. Nine of these sites, one historic-era and eight prehistoric are recorded as buried. This represents close to 14 percent of the known prehistoric sites and just over 5 percent of the total known archaeological record, although fewer than 5 percent of archaeological studies have explicitly looked for buried sites based on this same record search (11 out of 249 studies). Furthermore, all of the recorded buried sites are mapped on two soil series and located within 200 meters of the present location of a perennial stream, implying a correlation between landscape development and the potential for additional buried sites in the study area. The single buried historic-era site is located in downtown Vacaville and was buried by artificial fill rather than natural processes. Although it is possible that additional buried historic-era sites exist in the study area, particularly in the urban areas, this thesis focuses on buried prehistoric sites; historic-era sites are not examined in detail.

PURPOSE OF STUDY

The purpose of this study is to assess the potential for buried prehistoric archaeological sites in the Ulatis Creek Watershed by defining the nature and extent of Latest Pleistocene- and Holocene-age depositional landforms within the study area and refining the existing knowledge of their evolution and chronology. This goal was accomplished by (1) reviewing pertinent background information and compiling and reanalyzing existing chronological evidence, including stratigraphic description, radiocarbon studies and obsidian hydration studies; (2) conducting fieldwork and original dating studies to add to and verify the applicability and accuracy of existing data; and (3) synthesizing existing and original data in order to identify and assign ages to landforms and map the results. The results of this research will provide a geoarchaeological landscape context for the prehistoric archaeology of the study area to be used in future archaeological research and cultural resources management (CRM) planning.

STUDY AREA

The present-day Ulatis Creek Watershed, as defined by the Seamless National Watershed Boundary Dataset (NRCS, USGS, and EPA 2011), encompasses 150 square miles in the eastern portion of Solano County, California, including the City of Vacaville and the surrounding areas to the north and east (see Figures 1.1 and 1.2). A watershed, or drainage basin, is a distinct geomorphic system bounded by a divide and drained by a trunk river fed by multiple branches that become smaller in size with distance from the main trunk. Each branch of the drainage basin can be considered as its own subsystem affected by unique sets of processes and constraints that affect the collection and distribution of both water and sediment (Ritter, Kochel, and Miller 2002:135). Watersheds can also provide boundaries for ecotones and can affect the availability of resources as well as human transportation and communication (Evans 1978:6).

The watershed geomorphic system may provide a useful analytical unit for looking at the effect of landscape changes on the record of human movement and habitation on the landscape. Streams are particularly important features on the landscape because alluvial settings are known to frequently attract human habitation as they sustain many

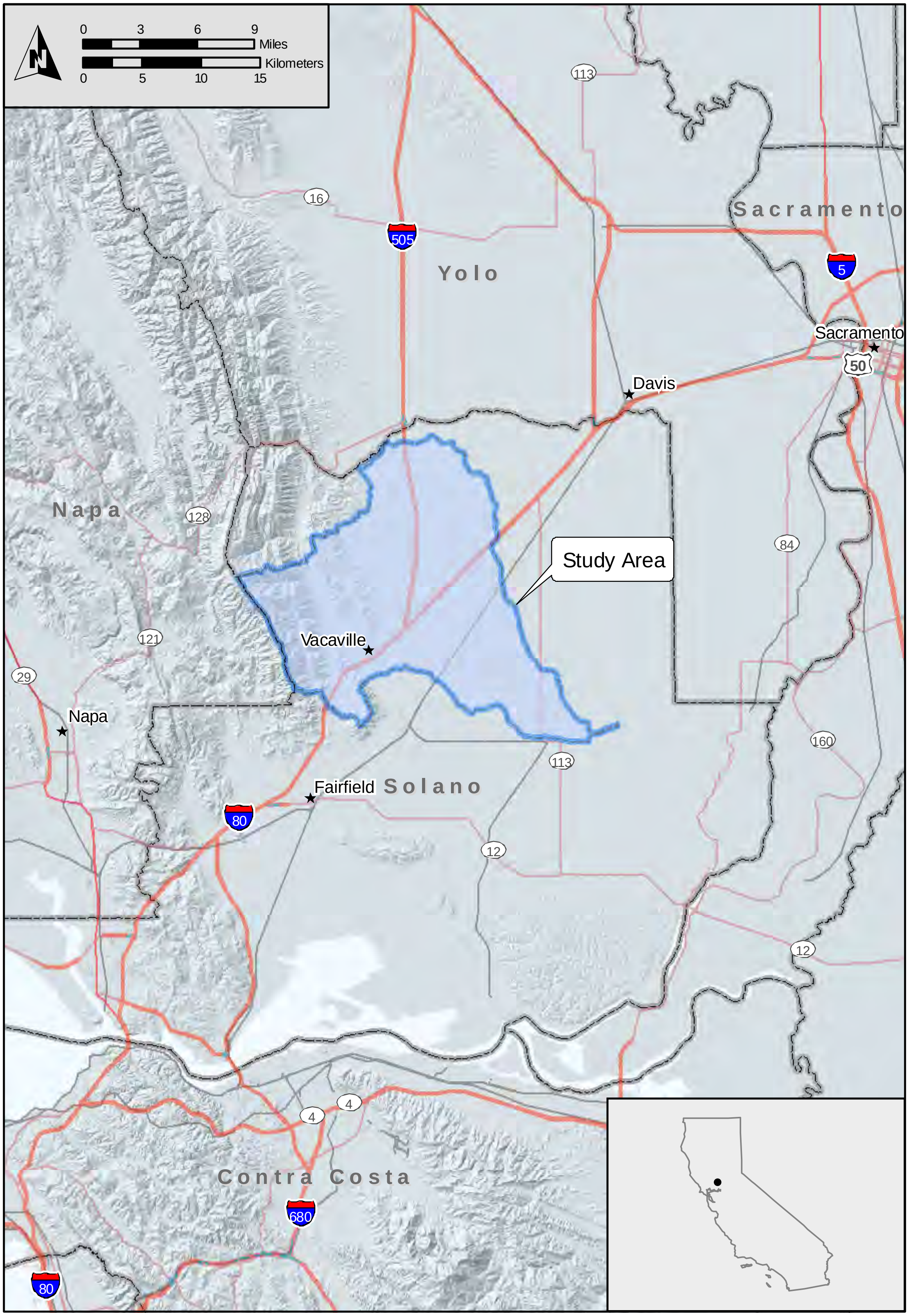


Figure 1.1. Study Area location map (Base imagery: ESRI).

Figure 1.2. Modern creek alignments in the Ulatis Creek Watershed (NRCS, USGS, and EPA 2011).

resources including the key resource of water for "[i]t is no overstatement to say that every major river system in the world contains important archaeological sites" (Rapp and Hill 2006:68). Additionally, many CRM investigations occur in alluvial settings (Ferring 2000:78). However, although alluvial environments would have been attractive to people, the active nature of these environments may also have buried, modified, or destroyed sites (Rapp and Hill 2006:75).

While this study looks at the overall potential of landforms in the Ulatis Creek Watershed to contain buried archaeological deposits, it primarily focuses on the alluvial landforms present in the study area as they are assumed to be archaeologically sensitive. Additionally, alluvial landforms constitute the majority of Latest Pleistocene- and Holocene-age landforms in the study area and many of them are of the right age to contain buried archaeological deposits. Conversely, most upland portions of the study area are excluded from analysis because they are underlain by bedrock or older sedimentary deposits that formed before people arrived in the region and, therefore, cannot contain buried archaeological deposits.

RELEVANCE TO CALIFORNIA ARCHAEOLOGY

Nearly every major valley in the San Francisco Bay Area, northern Diablo Ranges, southern Coast Ranges, and the Central Valley has been found to contain buried archaeological deposits (Hildebrandt et al. 2012:20). In some areas, buried sites represent a high percentage of the known archaeological record, such as in the northern Santa Clara Valley where more than 60 percent of known archaeological sites are buried

(Meyer 1999, 2000). Additionally, buried sites are some of the oldest known in the Bay Area, such as those found at the Los Vaqueros Reservoir in Contra Costa County (Meyer 1996; Meyer and Rosenthal 1997) and the Laguna Creek Site located within the present study area (Hildebrandt et al. 2012). Early buried sites and even younger buried sites may contain valuable data that can fill in gaps in the archaeological record. As such, buried sites in central California have a high research potential to expand knowledge of culture history (Meyer and Rosenthal 2008:19).

The results of this research will be useful for understanding long term economic, technological, and culture-historical changes in the Ulatis Creek Watershed and greater Solano County by evaluating the environmental and geomorphic conditions that have influenced the nature of cultural change through time and the preservation of the archaeological record. Chronological refinement of landscape evolution and the known archaeological record will result in a better understanding of the temporal positions and relationships of sites to each other and to landforms. For example, since the 1980s archaeologists have interpreted the rarity of sites older than 2,500 years in the Central Valley as evidence for a sharp increase in population after that time (Rosenthal, White, and Sutton 2007:159). A landscape history of the study area will help locate underrepresented Early and Middle Holocene archaeological deposits. These older portions of the archaeological record are critical for addressing long term settlement, subsistence, and demographic changes in the study area.

Recent research in the Coso Basin suggests that when survey, geological, and temporal biases are taken into account, the density of Early Holocene sites is just as great as in later time periods. Furthermore, if site density is taken as a proxy for population density Early Holocene populations would also be just as great as later ones (Eerkins et al. 2007:106). The results of the present study can be used to address survey, geological, and temporal biases in the study area and thereby provide a baseline of information necessary for assessing the accuracy of theories of settlement and subsistence patterns and cultural chronology that may be applicable to the surrounding regions.

RELEVANCE TO CULTURAL RESOURCES MANAGEMENT

Buried sites present a unique problem for cultural resources managers. Much of the archaeological work in California is conducted within the framework of CRM which is defined as “the management both of cultural resources and of effects on them that may result from activities of the contemporary world” (King 2008:371). Identification of cultural resources is a major step in compliance with many cultural resource laws at both the state and federal level. These laws include Section 106 of the National Historic Preservation Act of 1966, as amended, which requires that federal agencies take into account the effects of their undertakings on historic properties (36 CFR 800) and the California Environmental Quality Act (CEQA), which has similar requirements for state and local agencies (Title 14 CCR 15000 et seq.). Traditional archaeological techniques are not always sufficient for this identification process and a geoarchaeological approach may be necessary for legal compliance. Additionally, information about sediments and soils at a site can help answer questions regarding site extent, stratigraphic integrity, and age—questions important in legal site evaluation, another important step in the CRM compliance process (King 2008:139-141).

In addition to applicable federal and state level laws, both the Solano County and Vacaville City General Plans address the treatment of cultural resources. One of the goals of the Solano County General Plan is to preserve "the county's valued natural, cultural, and scenic resources" (Solano County 2008:RS-2). The City of Vacaville recognizes that prehistoric sites are dense within the city's Planning Area and additional sites likely exist "most likely to be found in the valleys, at the base of foothills, and on mid-slope terraces along watercourses" (City of Vacaville 2007:8-7). City guiding and implementing policies for the treatment of historic and archaeological resources promote the protection of these resources and review of development projects to determine the presence of known sites and the potential for currently unknown ones (City of Vacaville 2007:8-7).

The use of a geoarchaeological approach can also be valuable from a CRM and planning perspective because it can save time and money by assisting in early identification of sites. Once a project is under way an unanticipated archaeological discovery can be very costly and delay project work. At the same time, early identification of sites provides for better archaeology and resource protection by allowing for avoidance of sites or proper mitigation of effects to them. Determining that the potential for sites in a project area is low can also cut costs by potentially reducing the need for future identification efforts (Stapp and Longenecker 2009).

THESIS ORIGANIZATION

The remainder of this thesis will provide background information on the Ulatis Creek Watershed and discuss the methods and findings of my research illustrating the importance of geoarchaeological methods to California archaeology and CRM. Chapters 2, 3, and 4 provide relevant background information on the geoarchaeological approach being used and the environmental and cultural contexts of the study area. Chapter 5 discusses the methods used in this research followed by the findings and conclusions in Chapters 6 and 7 in which I define the landform units identified in the study area and address the potential for buried archaeological deposits throughout the study area.

CHAPTER 2: GEOARCHAEOLOGICAL APPROACH

DEFINITION AND USE

Geoarchaeology is defined as the use of earth science methods with the purpose of addressing archaeological problems (Butzer 1982:5; Rapp and Hill 2006:xiii, 1). These methods are drawn from various fields including geomorphology, soil science, and geochronology and include stratigraphic description and interpretation, analysis of site formation processes, and absolute dating (Goldberg and Macphail 2006; Rapp and Hill 2006; Waters 1992). Geoarchaeology can be used to address a number of important archaeological problems such as interpreting the spatial and temporal contexts of sites and assessing and improving archaeological visibility (Rapp and Hill 2006:xiii; Waters 1992:7-13).

Archaeological materials can only contribute to the greater body of archaeological knowledge if they are identified. The likelihood of archaeological materials being identified is their discovery probability. Several factors contribute to the discovery probability of archaeological phenomenon including visibility—the extent to which archaeological materials can be detected by an observer (Schiffer 1988; Schiffer, Sullivan, and Klinger 1978). Archaeological visibility is affected by three factors: (1) the distribution of sites at the time of use or occupation; (2) the preservation of those sites; and, (3) site recognition (Guccione 2008:378; Rapp and Hill 2006:60; Waters 1992:100). First, site distribution is affected by environmental conditions at the time of occupation as well as human behavior. Second, differential preservation of sites is caused by postdepositional environmental conditions (Rapp and Hill 2006:63). Third, recognition of sites is a factor of their obtrusiveness—the extent to which they stand out from their surroundings as affected by site characteristics such as size or abundance of artifacts (Schiffer 1988; Schiffer, Sullivan, and Klinger 1978).

Discovery probability can be enhanced by the choice of appropriate archaeological methods. Traditional archaeological methods, such as surface surveys and shallow subsurface testing, are biased towards the detection of sites that are preserved at the surface. Failure to consider factors that contribute to discovery probability and select appropriate techniques to use will introduce biases in the interpretation of the archaeological record. Because of this, a first step of any study should be an assessment of the visibility of the archaeological record in the study area so that appropriate techniques can be chosen (Schiffer, Sullivan, and Klinger 1978:7-8). Geoarchaeological methods can be used to assess the visibility of the archaeological record in a given study area and further used to increase the archaeological visibility, thereby increasing the discovery probability of certain site types, namely buried sites.

HISTORY OF USE IN CULTURAL RESOURCES MANAGEMENT

Geoarchaeology implicitly began as early as the 18th century as both archaeologists and earth scientists began to systematically use stratigraphy to study the history of the Earth’s surface (Beach, Dunning, and Doyle 2008:413; Rapp and Hill 2006:4). However, archaeology and the earth sciences were rarely purposefully integrated prior to 1900 (Beach, Dunning, and Doyle 2008:413; Rapp and Hill 2006:10). In the United States geoarchaeology became a routine component of archaeological investigations after the advent of CRM in the 1970s created a demand for predicting site locations and interdisciplinary evaluation and study of threatened sites (Holliday 2004:29).

Some states have standardized the use of geoarchaeology in CRM investigations. For example, the State Historic Preservation Office (SHPO) Manual for Archaeological Projects in Minnesota recognizes that most archaeological field projects require some level of geomorphic assessment and recommends that archaeologists serving as Principal Investigators have some experience in geomorphology (Anfinson 2005:19-20). The manual also specifies conditions when geoarchaeological or geomorphic studies must be conducted. Specifically, "the archaeological evaluation of river valleys, valley margins, and other settings where deeply buried deposits might occur must incorporate subsurface geomorphic studies extending to depths where deposits are not likely to contain primary archaeological materials or will not be impacted by a project" (Anfinson 2005:21).

Early researchers recognized that many sites in California may have been buried by natural processes (e.g., Heizer 1950; Moratto 1984). However, the effects of landscape changes on the visibility of the archaeological record have only relatively recently been systematically investigated in California. Early geoarchaeological research in California focused on implications for archaeology of sea level and other postglacial changes during the Late Pleistocene and Holocene (e.g., Bickel 1978a, 1978b). Recent work in

California has used predictive models developed by geoarchaeologists to identify areas with the potential for buried archaeological resources (e.g., Meyer 1996; Hildebrandt et al. 2012).

GEOARCHAEOLOGICAL CONCEPTS

The application of stratigraphic and soil formation principles through geomorphic studies is crucial to evaluating how landforms have changed over time and interpreting how these changes relate to past human occupation and land use.

Stratigraphic Principles

The study of stratigraphy is familiar to many archaeologists who often evaluate it in a cultural context. Some of the basic stratigraphic principles that most archaeologists frequently utilize are uniformitarianism and superposition. Uniformitarianism allows us to assume that the processes that operate and are observable in the present are the same processes that have operated in the past, although the extent and duration of these processes may have varied over time (Boggs 1995:5). The Law of Superposition states that if undisturbed, deposits lower in a profile will always be older than those stratigraphically higher in the profile (Boggs 1995:638; Harris 1979:7). Stratigraphy applies these and other concepts to study the evolution of and relationships between stratigraphic units (strata), which are bodies of sediment (or rock) that are distinguishable from neighboring strata based on content, form, boundaries, or time (Boggs 1995:490). Archaeologists have developed principles that supplement those of geologists and that apply to cultural processes that create archaeological sites (e.g., Harris 1979).

The *North American Stratigraphic Code* (NASC) was developed by the North American Commission on Stratigraphic Nomenclature (NACSN 2005). It defines multiple types of stratigraphic units which geologists use as a way to describe and characterize deposits. Three of the most useful geologic stratigraphic unit types for archaeology are: (1) lithostratigraphic units; (2) pedostratigraphic units; and, (3) chronostratigraphic units. In practice geoarchaeologists can use lithostratigraphic units and pedostratigraphic units as a way of describing physical deposits and with the application of stratigraphic principles and chronometric dating techniques correlate these into chronostratigraphic units as a means of organizing and interpreting their observations.

Lithostratigraphic units are defined by the characteristics of their rock content, or lithology, such as composition, texture, structure and stratigraphic position (Holliday 2001:5; NACSN 2005). Lithostratigraphic units represent episodes of deposition and can provide information about the magnitude and duration of these depositional events. These units are time-transgressive, meaning they do not represent specific time intervals, because the amount of time represented by a specific episode of deposition may vary across space (NACSN 2005). Boundaries or contacts between lithostratigraphic units are termed discontinuities. When there is no apparent break in deposition the contacts are said to be conformable. When boundaries are formed by an erosional surface or an episode of non-deposition they are said to be unconformable, in which case the boundary represents the passage of time between overlying and underlying stratigraphic units (Boggs 1995:493; NACSN 2005). The nature of the discontinuities between lithostratigraphic units can indicate changes in depositional modes, long-term stability, or postdepositional alterations to a surface.

One type of unconformable contact is represented by soil formation. The near surface development of sediment into distinct pedologic (soil) horizons in one or more lithostratigraphic units forms pedostratigraphic units. Pedostratigraphic units are always younger than the parent material they were formed in and may obscure the original characteristics of and contacts between lithostratigraphic units (NACSN 2005). Pedostratigraphic units record episodes of landscape stability. Soils are time-transgressive because deposition, soil formation, and subsequent burial and cessation of soil formation do not necessary occur at the same time throughout a region (Birkeland 1999:336).

In contrast to lithostratigraphic and pedostratigraphic units, chronostratigraphic units represent a specific time interval bounded by at least conceptually synchronous horizons and are therefore isochronous. For geoarchaeological purposes, chronostratigraphic studies record the expression of the passage of time in the stratigraphic record as expressed by lithostratigraphic units, pedostratigraphic units, and unconformities and aims to place the events they represent in absolute time using established geologic nomenclature (Waters 1992:77).

Soil Formation

The identification and description of stratigraphic units for geoarchaeological research requires that a distinction be made between soils and sediments. Sediment is solid organic and inorganic material that is transported and deposited by various natural and human processes. The size, or textural properties, of sediment can be indicative of many things including the mode of transportation, the energy of transportation, and the depositional environment (Ritter, Kochel, and Miller 2002:67; Schaetzl and Anderson 2005:32, 773; Waters 1992:15). Soils differ from their parent material in morphological, physical, chemical, mineralogical, and biological properties due to in-place weathering. This weathering process results in the formation of soil horizons (Birkeland 1974:3; Birkeland 1999:2; Ritter, Kochel, and Miller 2002:43). The process of soil formation includes addition, removal, transformation, and transfer of materials throughout the profile and is affected by the factors of climate, organisms, relief, parent material, and time (Birkeland 1999:105-106).

Soil formation is a somewhat predictable process and the extent of soil development can be used to estimate the relative age of the surface represented by the soil (Birkeland, Machette, and Haller 1991). All else being equal, well developed soils with distinct horizons will generally be older, or will have been stable longer, than weakly developed ones with little or no horizon development (Birkeland 1974:163; Birkeland, Machette, and Haller 1991:40; Ritter, Kochel, and Miller 2002:73). As the geomorphic landscape is the physical platform on which people interacted with their environment (Waters 1992:88) a landform that was stable and, therefore, available for human use for a longer period of time is more likely to contain archaeological evidence.

Paleosols are soils that formed in the past but are not actively undergoing soil formation in the present. A paleosol may be buried by more recent deposition, buried at one time and since exhumed, or relict, remaining at the surface. Paleosols can be identified by recognition of soil features such as root traces, horizonation, and pedogenic structures (Birkeland, Machette, and Haller 1991; Rapp and Hill 2006:43; Retallack 1988). Whatever their history, paleosols are stratigraphic markers of formerly stable land surfaces and preserve information about the environmental conditions during active soil formation (Birkeland 1999:339-340; Waters 1992:57, 60). Identification of paleosols can also enable correlation across broad regions and help attain chronologic resolution.

GEOARCHAEOLOGICAL LANDSCAPE APPROACH

A geoarchaeological landscape approach applies concepts of stratigraphy, soil formation, and geomorphic processes as well as knowledge of human ecology to elucidate the environmental context of cultures with the goal of understanding human social and economic change (Rossignol 1992:4). To accomplish this, the type, extent, age, and origin of Late Pleistocene- and Holocene-age sediments and landforms are defined and “evaluated in terms of human land use and occupation” (Meyer 2003:8). This approach has been successfully applied throughout California (e.g., Hildebrandt et al. 2012).

The first step in a geoarchaeological landscape approach is archival research using existing maps and geologic, soils, and geomorphic data. The next step is a detailed study of the Late Pleistocene- and Holocene-age stratigraphy of the study area. Virtually no single exposure will contain a stratigraphic record spanning these time periods. A more complete record can be compiled through correlation of stratigraphic sequences throughout a region, including differing places on the landscape, such as the valley axis and valley margins, which may record different periods of time (Frederick 2000:57). In some cases large-scale episodes of erosion or stability have created regional gaps in the stratigraphic sequence where deposits of a given time interval may be completely absent from a region causing gaps to also exist in the archaeological record (Waters 1992:83).

When the stratigraphic framework is compiled the relative sequence of landforms can be temporally defined and assigned to chronostratigraphic units through chronometric and relative dating (Frederick 2000:57; Waters 2000:542). Chronology is needed in order to correlate archaeological and other paleoenvironmental, or proxy records. Once the foundation of an accurate stratigraphic and temporal sequence is defined a predictive model can be developed that may take into account other factors (environmental or cultural) in predicting where archaeological sites may be located on the landscape (Waters 2000).

Data developed through a geoarchaeological landscape approach can contribute to theoretical frameworks such as human behavioral ecology and environmental archaeology. These approaches are similar in that they focus on the physical context within which human adaptive systems can be understood. Behavioral ecology and environmental archaeology consider the natural environment and the implications this context has for settlement-subsistence systems including the interrelationship between the environment and culture (Aikens 1983:239; Butzer 1982:5, 12). Although focused on environmental context, these theoretical frameworks as utilized today do not subscribe to environmental determinism but recognize that socio-cultural and historical circumstances could have also affected the structure of adaptive systems (Eerkins et al. 2007:88; Rosenthal, Hildebrandt, and Carpenter 2004:16).

CHAPTER 3: ENVIRONMENTAL BACKGROUND

The Ulatis Creek Watershed contains a wide variety of environments from uplands to valley bottomlands, to gently sloping alluvial plains and their respective floral and faunal communities. Through these various environments the watershed is drained by many creeks that form a trellis pattern and eventually all merge with Ulatis Creek before emptying into Cache Slough which leads to the Sacramento River. Many of these creeks retain a more natural state in their upstream portions before entering the urban area of Vacaville. In the downstream portions many creeks have undergone significant improvement projects that have heavily altered their alignments (Solano County 2008).

The diverse habitats in the Ulatis Creek Watershed would have provided an abundance of resources to prehistoric peoples and it is easy to imagine why this area would have been an attractive location for habitation. Various environmental conditions throughout the watershed have affected the preservation of archaeological materials differentially. Many landscape changes occurred here since the Latest Pleistocene. In general, the topographically low areas contain Holocene-age alluvial deposits that may contain buried archaeological resources, while topographically higher (upland) areas are underlain primarily by older deposits and bedrock that have been at the surface since before people inhabited the region and, therefore, do not have the potential to contain buried archaeological resources.

GEOMORPHIC SETTING

The Ulatis Creek Watershed is located in the southwestern portion of the Sacramento Valley where the western edge of the Central Valley, or Great Valley, and the southeastern tip of the North Coast Ranges converge (California Geological Survey 2002; Cosby and Carpenter 1931:1; West et al. 2007). The study area can be broken into geomorphic areas that include, from east to west: the eastern slope of the Vaca Mountains, Vaca Valley and Lagoon Valley, the English Hills, and a portion of the Alluvial Plain to the east of the hills to the point where Ulatis Creek empties into Cache Slough (see Figure 3.1).

Vaca Mountains

The Vaca Mountains form the southeast end of the North Coast Ranges and the peaks of this range mark the western boundary of the study area. Within the study area, the eastern slope of the Vaca Mountains is relatively steep, with Mt. Vaca, the tallest peak, rising to a height of 2,819 feet above mean sea level (Noske and Irwin 2007:ix; Cosby and Carpenter 1931:1). Creeks that begin in the Vaca Mountains include from north to south: Ulatis Creek, Alamo Creek a tributary of Ulatis, and two tributaries of Alamo—Encinosa Creek and Laguna Creek.

Vaca Valley and Lagoon Valley

To the east of the Vaca Mountains lies a structural trough that begins at Putah Creek to the north and extends south through the study area. Remnants of older hills are scattered throughout this trough including a small group located approximately

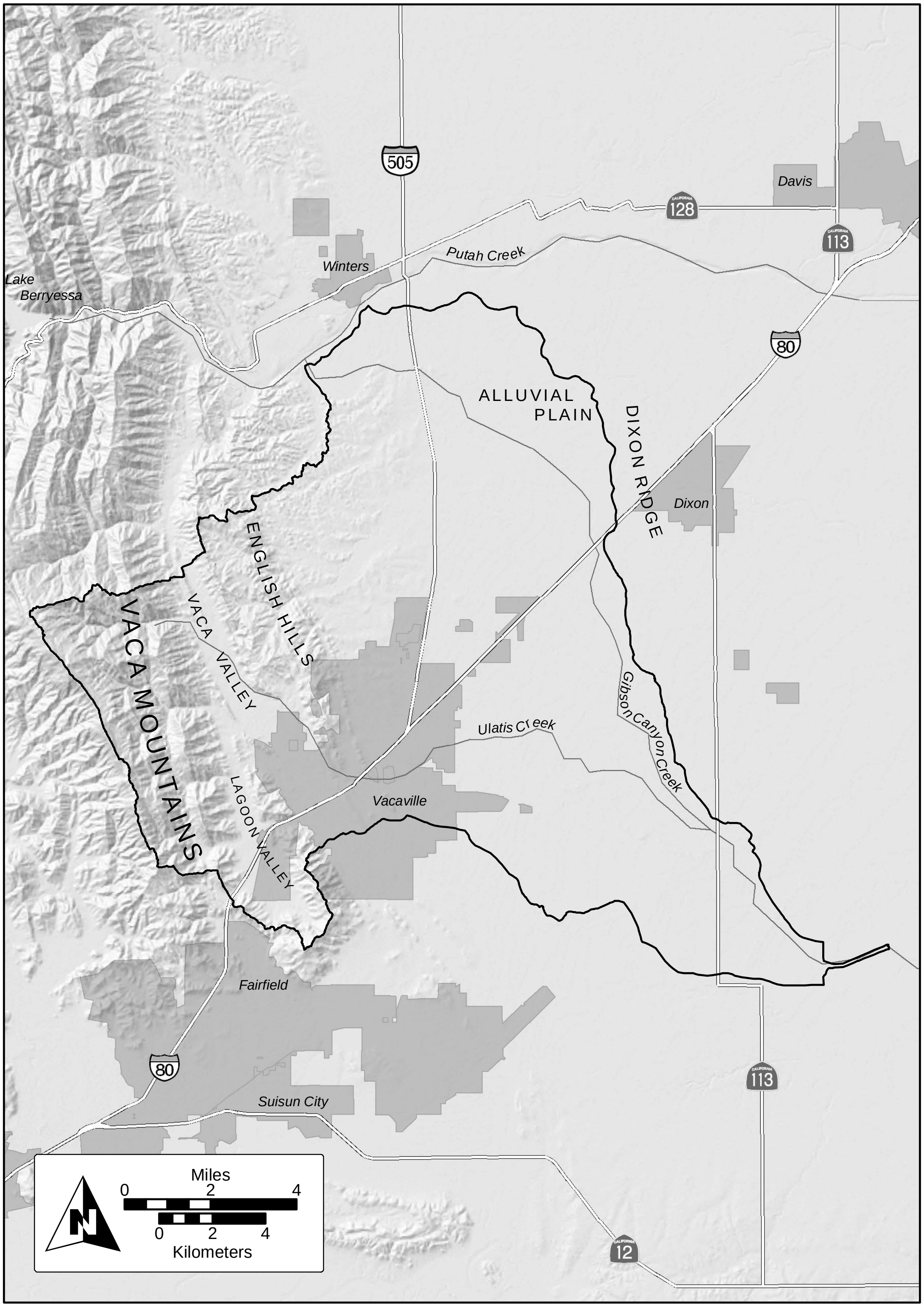


Figure 3.1. Geomorphic areas in the Ulatis Creek Watershed.

midway that forms a drainage divide. The northern drainage forms Pleasant's Valley and drains to Putah Creek. The southern drainage forms Vaca Valley and drains to Ulatis Creek down the east side and Alamo Creek down the west side (Cosby and Carpenter 1931:1-3). Both of these creeks flow through the city of Vacaville, which is located at the south end of Vaca Valley before flowing onto the Alluvial Plain.

Another low group of hills separates Vaca Valley from Lagoon Valley to the southwest which also drains to the Ulatis Creek Watershed via Laguna Creek (Noske and Irwin 2007:ix; Cosby and Carpenter 1931:1-3). Lagoon Valley is relatively small and the southern end contains a topographically low area that is poorly drained and was seasonally flooded under natural conditions, with the largest extent of the former marshland that accompanied this flooding at about the 217 foot contour interval (Meyer, Scher, and Kaijankoski 2012:21). Today this area contains Lagoon Valley Lake, a manmade feature which drains to Laguna Creek and joins Alamo Creek after passing through a narrow break in the hills.

English Hills

Vaca Valley is separated from the Central Valley to the east by the English Hills. These are dissected bedrock hills that begin near Putah Creek and break into a series of low ridges near Vacaville. The western side of the English Hills is relatively steep and reaches an elevation of 1,225 feet above mean sea level. The eastern side slopes gently out towards the Sacramento River. A break in slope around the 100 foot contour interval indicates the beginning of a broad Alluvial Plain that continues to the east. Many small streams begin near the western crest of the English Hills and form erosional valleys with irregular courses that continue out onto the eastern plain to join Ulatis Creek (Cosby and Carpenter 1931:1-3). These include Horse Creek, English Creek, Gibson Canyon Creek, McCune Creek, and Sweeny Creek.

Alluvial Plain

This piedmont represents an ancient alluvial fan with a gradient of about 500 feet to the mile, sloping to the southeast. The upper portion is heavily dissected while lower portions contain more recently active floodplains and fans that grade into basin and wetland deposits as Cache Slough and the valley floor are approached. The eastern boundary of the study area extends to where this plain merges with the Sacramento River Delta at the point where Ulatis Creek empties into Cache Slough at roughly sea level (Cosby and Carpenter 1931:1-3). Historic maps and soils maps indicate the former locations of many creeks and disconnected channels on the Alluvial Plain but they have been so modified during the past 50-100 years that they are mostly unrecognizable today (e.g., Bates 1977; USGS 1908). Just outside of the study area and paralleling the boundary is the location of a former distributary channel of Putah Creek. The eastern boundary of the study area is formed by the topographic high of a levee associated with this former channel known as Dixon Ridge. The Yolo and Brentwood soil series that form the upper part of Dixon Ridge indicate it was active at least within the past 1,000 to 4,000 years as discussed in Chapter 6 (NRCS 2010). Based on the apparent relict channel pattern on the Alluvial Plain it is likely that Ulatis Creek was a tributary of Putah Creek in the past.

GEOLOGIC SETTING

Seismicity

Effects of seismic activity can have a significant influence on landscape evolution and the visibility of the archaeological record. These include landslides and other ground failures that may have buried archaeological sites, particularly those located at the base of hills or along stream channels, and uplift which may preserve older portions of the landscape at the surface (Meyer 1995:3; Rapp 1986:368-370).

The Central Valley and San Francisco Bay Area contain numerous geologically active faults. Some of the largest of these including, the San Andreas, Green Valley, and Hayward faults, have been active during historic times. Several smaller faults are located within the study area—including multiple segments of the Vaca Fault located in Vaca and Lagoon Valleys demonstrated to have been active in the late Quaternary (Jennings 2010). Recent recorded seismic activity in the vicinity includes two magnitude 6.5 earthquakes and a series of aftershocks recorded in April 1892 in the Vacaville area, likely caused by faulting in the English Hills on a southern extension of the Gordon Valley blind thrust fault near Winters, California (Bennett 1987:75; O'Connell, Unruh, and Block 2001:1495).

Geomorphic relationships between alluvial landforms on the eastern side of the English Hills indicate late Quaternary tectonic activity associated with the Gordon Valley fault extension. The English Hills were formed by tectonic uplift, tilting, and folding within the past million years through the present. Alluvial fans along the western edge of the English Hills designated as middle-late Quaternary have been uplifted and significantly dissected, forming a series of broad southeast/northwest trending terraces (O'Connell, Unruh, and Block 2001:1473-1474). Uplift appears to continue today in this area (Bürgmann 2008: Figure 4, Figure 9).

Pre-Quaternary Deposits

The most detailed information available on the bedrock geology of the study area is found in work by Bailey (1930) and generally confirmed by Wiegers, Sowers, and Witter (2006, 2007) who also provide a finer level of detail in some areas. The main significance of these deposits for the purposes of this study is the effect they have on the ability of watercourses to produce and transport sediment throughout the watershed, although they may also provide useful information about the availability of raw materials to prehistoric peoples.

The underlying geology of the Vaca Mountains in the study area, including the hills that surround Lagoon Valley at the southern end, consists of Late Cretaceous sandstone, siltstone, and shale of the Great Valley Sequence in the upper elevations with Eocene and Paleocene shale and sandstone on the lower elevations that emerge as remnants within Vaca Valley including forming the hills that separate the Vaca Valley and Pleasants Valley drainages. These deposits blend with Quaternary alluvium on the valley floor (Bailey 1930; Wiegers, Sowers and Witter 2007).

On the other side of Vaca Valley the steep western slope of the English Hills is underlain by Eocene shale. Higher elevation areas also contain small amounts of

Miocene Putnam Peak Basalt, centered around Putnam Peak at the northern border of the study area with small amounts scattered throughout the English hills, and Pliocene Putah Tuff of the Tehama Formation near Putnam Peak and on broad dissected areas of the lower slope of the English Hills on the eastern side. The eastern slope of the English Hills also contain Eocene and late Miocene sandstones (Bailey 1930; Wiegers, Sowers and Witter 2007). The bedrock strata that underlay the Vaca Mountains and English Hills dip to the east and flatten abruptly to extend in a nearly horizontal section beneath alluvium of the Central Valley (California Geological Survey 2002; O'Connell, Unruh, and Block 2001:1473).

Quaternary Deposits

The most detailed information available on the Quaternary geology of the lowland portions of the study area is available from Knudsen et al. (2000) and Witter et al. (2006) with some additional details on Quaternary deposits in the uplands provided by Wiegers, Sowers, and Witter (2006; 2007). Knudsen et al. (2000) provide the only map that covers the entire study area while only the southwest portion of the study area is mapped by Witter et al. (2006) and only the western side of the study area is mapped by Wiegers, Sowers, and Witter (2006, 2007). In general, these maps vary from each other only slightly which appears to be primarily due to the differences in the mapping scale. Knudsen et al. (2000) primarily mapped at a scale of 1:100,000 while all three of the more recent maps are at a scale of 1:24,000 allowing for more detail to be shown. Details on the Quaternary deposits present in the study area are provided in Figure 3.2 and Appendix A.

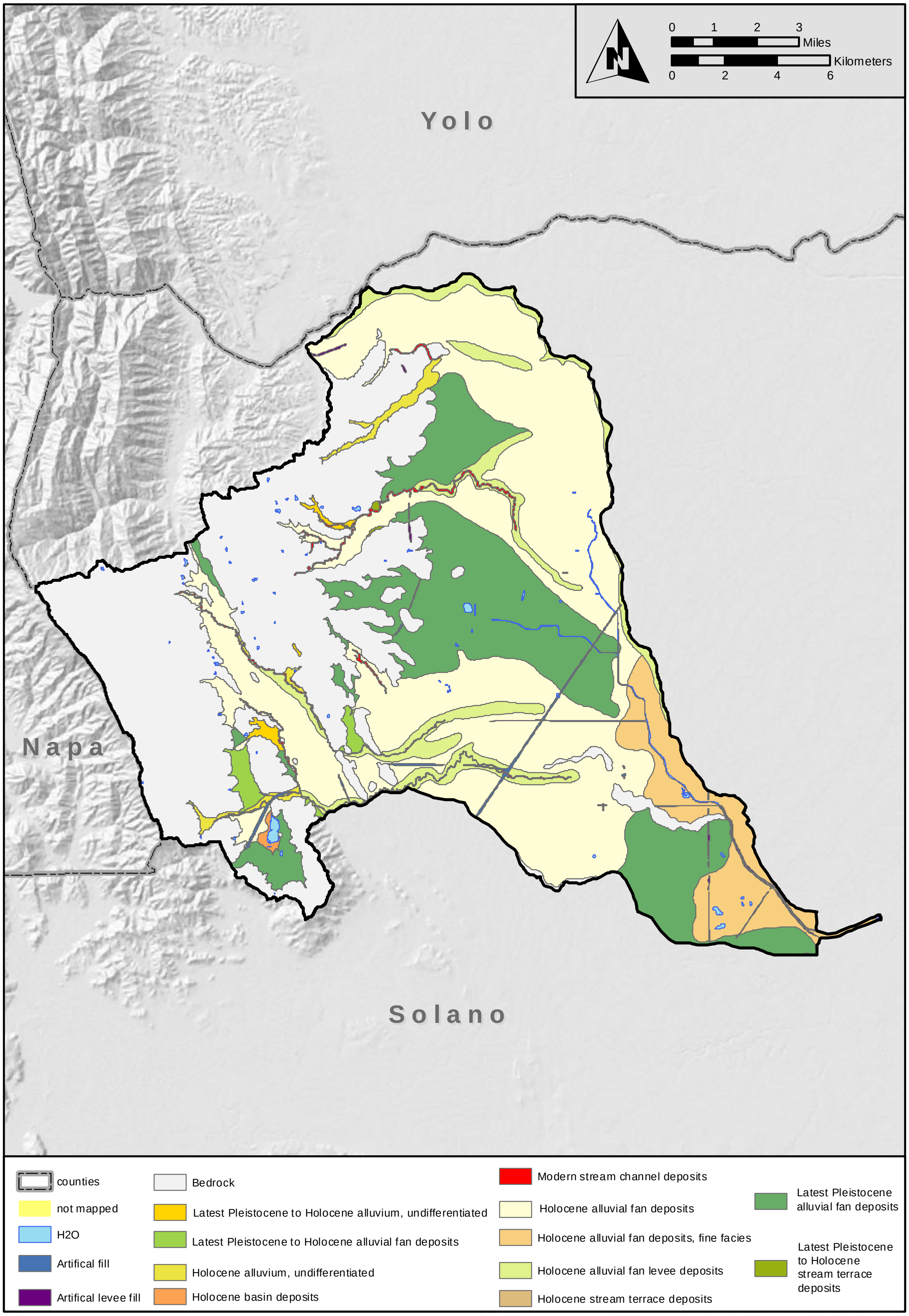


Figure 3.2. Quaternary geology of the Ulatis Creek Watershed (Knudsen et al. 2000).

The study area fits the typical pattern of late Quaternary deposits in the Central Valley with older alluvial plains in topographically higher positions above Pleistocene and Early Holocene fan remnants at the base of foothills and active floodplains and basins in the lowest positions on valley floors (Rosenthal, White, and Sutton 2007:147; Meyer and Rosenthal 2008:22). The geologic maps (Knudsen et al. 2000; Witter et al. 2006; Wiegers, Sowers, and Witter 2006, 2007) generally indicate that within the study area older Pleistocene and Pre-Quaternary deposits are present in the uplands with Latest Pleistocene to Early Holocene alluvial deposits located at the edges of both Vaca and Lagoon Valleys and at the surface on a large portion of the Alluvial Plain due to tectonic uplift. Younger Holocene-age alluvial deposits are located in lower topographic positions, in the bottom of Vaca and Lagoon Valleys and adjacent to presently active creek channels throughout the study area (Knudsen et al. 2000; Wiegers, Sowers and Witter 2006, 2007 Witter et al. 2006).

Soils

Surface soils mapped by the United States Department of Agriculture soil can provide a good basis for assessing relative landform age in many areas (Holliday 2004:62; Rosenthal and Meyer 2004a, 2004b). Soil survey descriptions include details on the physical properties and geomorphic settings of soils, which can provide information about many things, including the depositional environment. Additionally, soil series are typically associated with specific Quaternary deposits of a certain age and depositional environment (Knudsen et al. 2000). Because of this, soil series maps can be used to identify the extent of landforms and define their general chronologic relationships, a method that has successfully been used to predict archaeological sensitivity throughout central California (Knudsen et al. 2000:B-2; Whitaker and Kaijankoski 2009:10). While soil surveys provide a good jumping off point for sensitivity studies, the scale of mapping (1:24,000) generally does not permit accurate representation of the soils at every location which are often too small, or occur in a pattern too complex, to specify at the mapping level. Additionally, boundaries between soil units grade into each other rather than having sharp contacts as illustrated by polygon symbols presented on soil survey maps (Holliday 2004:55-56).

The Solano County Soil Survey (Bates 1977) is the primary source for data on the soil series present in the study area. The survey indicates the study area contains 23 soil series and soil series complexes that include 44 specific soil types (excluding water and borrow pits). The overall patterning of soils in the study area generally corresponds to that of the geology, which is not surprising, given that the geologic maps were developed in part based on soils maps (Knudsen et al. 2000 part; Witter et al. 2006). Soils on bedrock uplands appear to be the oldest followed by later Pleistocene and Early Holocene soils on the valley margins and on portions of the open plain. The youngest soils are present in valley bottomlands and adjacent to present and recent creek courses across the Alluvial Plain. The soil series present in the study area are summarized in Figure 3.3 and Appendix B.

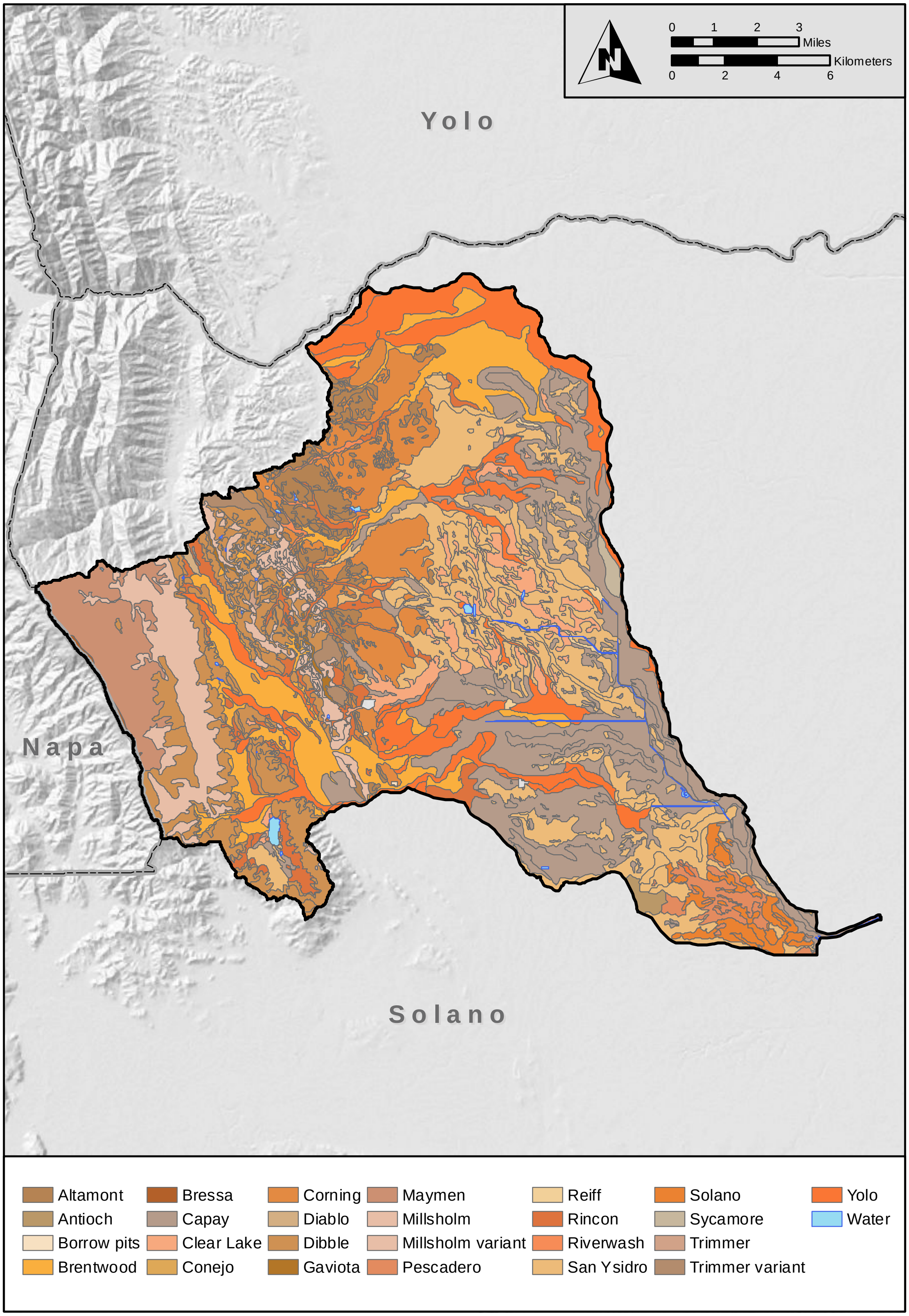


Figure 3.3. Soil series present in the Ulatis Creek Watershed (NRCS 2010).

MODERN DAY ENVIRONMENT

Climate

Climate, through temperature and precipitation and indirect effects to vegetation, is an important factor in soil development, geomorphic processes, and the lives of people. Modern day climate within the study area is considered Mediterranean with hot, dry summers and cool, moist but generally mild winters. For the period from April 1998 to December 2008 recorded temperatures in Vacaville ranged from 38.2-55.5° F in January and 59.7-94.1° F in July. Average rainfall for that same period was 23.18 inches per year with the majority falling between November and March and the driest months being June to September (Western Regional Climate Center 2009). Climate is differentiated across the study area with more rainfall concentrated in the western part of the study area over the Vaca Mountains than over the plains (West Yost & Associates 1999). The lower, more open elevations of the plains are also generally hotter than the higher, more protected elevations in the English Hills and Vaca Mountains.

Flora and Fauna

Geomorphic and climatic differences throughout the study area are also expressed in vegetation patterns. According to Küchler (1977:19-20, 23) the study area is composed of four main vegetation communities. Chaparral, dominated by chemise, manzanita, and California lilac, is present at the far western edge of the study area on the higher elevations of the Vaca Mountains. To the east a swath of Blue Oak-Foothill Pine Forest is present within Vaca and Lagoon Valleys and on the English Hills and the lower elevations of the Vaca Mountains. To the east of the English Hills the forest opens up into a savanna with prairie community plants underneath. The California Prairie community covers the majority of the eastern half of the study area on the Alluvial Plain and consists primarily of bunchgrasses and forbs dominated by needle grass and spear grass and many introduced species. Finally, the northwest corner of the study area is mapped as consisting of Riparian Forest, with broad-leaved deciduous forest dominated by cottonwood with lianas and areas of tule marsh, bordering the south side of Putah Creek, which lies just outside the study area to the north. Riparian vegetation was likely more extensive along the creeks under natural conditions and small patches of it are currently present along perennial stream channels such as Ulatis and Alamo Creeks within the study area. Solomeschch, Barbour, and Holland (2007:397-398) recognize the presence of an additional vegetation community in the study area: vernal pools, which are ephemeral wetlands that seasonally fill and dry each year located on the plains and lowlands that harbor many unique plants and animals.

The Ulatis Creek Watershed also supports a diverse faunal community which under natural conditions included pronghorn, tule elk, deer, coyote and larger predators such as mountain lions and wolves, and small mammals such as mink, weasel, river otter, raccoon, beaver, black-tailed jackrabbit, and ground squirrel. Native birds include western meadowlark and Brewer’s blackbird; migratory birds pass through this part of the Pacific Flyway seasonally (Bartolome et al. 2007:371). Under natural conditions waterways contained freshwater shellfish and many fish species (Moyle 1976).

CENTRAL CALIFORNIA PALEOENVIRONMENT

Proxy records from the past 20,000 years demonstrate that climate change has been more typical than stability during the time since the last glacial maximum in California (West et al. 2007:33-34). Temperatures have fluctuated, sea-level has risen, major vegetation shifts have occurred, large wetlands have emerged, and Pleistocene mega fauna became extinct. Additionally, many climate changes appear to have been very abrupt, taking place over a matter of decades to centuries (Anderson, Goudie, and Parker 2007:95). Early peoples in California would have had to adapt to these evolving conditions (Moratto 1984:78), perhaps within individuals' lifetimes.

Landscape evolution, including the development of alluvial landforms, has been linked to regional scale climatic changes in central California (e.g., Meyer 1996; Meyer, Rosenthal and Young 2010:51-53; Rosenthal and Meyer 2004a:20). Changes in precipitation and vegetation cover are among two of the most important factors affecting depositional and erosional processes (Lowe and Walker 1997:71). In order for deposition to occur, a sufficient amount of sediment and a sufficiently energetic mode of transportation for that sediment are needed at the same time. Both conditions were often met during shifts in environmental regimes that occurred over the past 20,000 years. These climatic changes resulted in geomorphic thresholds being repeatedly crossed and the burial of many former land surfaces as represented by multiple buried soils found throughout central California.

Climate Change

The California climate changed dramatically from the end of the last glacial maximum to the beginning of the Holocene (Masters and Aiello 2007). Climate during the Pleistocene-Holocene transition changed in a stepwise manner separated by abrupt transitions (Knox 1984:27). Evidence from northwest California indicates that at the close of the last glacial maximum the climate was colder and drier, becoming more temperate around 15,000 BP (West et al. 2007:18). The end of the Pleistocene (~15,000-13,000 BP) followed a general warming trend with several rapid reversals to cooler, drier conditions (Kennett and Ingram 1995:510). The most major of these reversals was the Younger Dryas from roughly 13,000 to 11,500 BP (Kennett and Ingram 1995:512). The Younger Dryas was cooler and drier at the beginning with a trend to warmer, wetter climates similar to today's environment as the Pleistocene came to a close (Masters and Aiello 2007:44).

The Holocene has generally been divided into a tripartite structure of Early, Middle, and Late periods (Benson et al. 2002:1-2). Climate changed from dry and warm at the onset of the Holocene (~11,500-10,000 BP) to cool and moist conditions during the Early Holocene (~10,000–6,000 BP). The Middle Holocene (~6,000-3,000 BP) was warm and drier than today and has been characterized as the Altithermal Long Drought (Antevs 1955; Benson et al. 2002; Knox 1984:27, 29). In California evidence of Middle Holocene drying has been documented at Pyramid Lake, Lake Tahoe, and Owens Lake (Benson et al. 2002). Climatic conditions changed back to cool and moist in the Late Holocene (~4,000 BP-present) which has largely persisted to the present day (Benson et al. 2002; Knox 1984:29). However, a series of closely timed periods of drought between about 1,500 and 700 cal BP that are together termed the Medieval Climatic Anomaly have been documented throughout the west (Jones et al. 1999; Stine 1994). In California this is documented by evidence of low stands of Mono Lake (Stine 1994), low water flow levels in the Sacramento River (Meko et al. 2001) and Suisun Bay, and increased salinity in the Sacramento-San Joaquin Delta (Hughes and Brown 1993; Ingram, Ingle, and Conrad 1996).

Vegetation Change

Vegetation changes during the latest Pleistocene and Holocene typically appear to be consistent with climatic forcing. Vegetation was relatively stable during the last full-glacial period. This was followed by rapid vegetation change during the latest Pleistocene and early Holocene (~15,000-8,000 BP), peaking between about 13,000 and 10,000 BP which coincides with the Younger Dryas climatic event. During the Middle and Late Holocene (~7,000-500 BP) vegetation returned to relatively stable conditions (Williams et al. 2004:321). Modern vegetation communities were essentially in place by 6,000 BP although they continued to shift their locations and dominant species (West et al. 2007:21). More recent changes in vegetation have also occurred. For example, pollen cores from Lagoon Valley and nearby along Alamo Creek in the study area indicate that species of oak and pine have recently invaded California grassland areas possibly due to factors such as the end of native burning and historic grazing (Matson 1970:147).

REGIONAL LANDSCAPE EVOLUTION

San Francisco Bay is underlain by a late Pliocene structural trough that has episodically been flooded during the Pleistocene due to eustatic sea level fluctuations, crustal deformation, and tectonic subsidence so that estuaries and stream valleys have alternately occupied the site of the Bay. At least three of these episodes of submergence and emergence occurred before the formation of the present bay (Masters and Aiello 2007:50; Moratto 1984:219).

During the last glacial period the pre-bay valley, termed the Franciscan Valley by Axelrod (1981:848), was drained by multiple tributaries that fed into a large river, termed the California River by Howard (1979:74), which flowed through the Golden Gate and across what is now the submerged continental shelf before emptying into the Pacific Ocean (Masters and Aiello 2007:50). The California River flowed from eastern California carrying the combined water from the Sacramento and San Joaquin rivers with 40 percent of the runoff in California. The San Francisco Bay was then a forested valley covered in Pleistocene alluvial and aeolian deposits that were stable for some time during this period of lower sea level (Helley et al. 1979; Masters and Aiello 2007:50-51). The open continental shelf was likewise covered in an extensive dune field (Masters and Aiello 2007:51). Pleistocene fauna including mammoths, horses, bison, camels, and many smaller vertebrates roamed the Franciscan Valley during the Late Pleistocene (Dundas and Cunningham 1993; Edwards 1992; Masters and Aiello 2007:50-51)

The most recent flooding that formed the current San Francisco Bay began about 18,000 to 15,000 BP (Masters and Aiello 2007:51). The history of recent sea-level rise is complex and includes periods of more rapid and slower rise, stillstands punctuated by meltwater pulses, and possibly higher sea levels than today. Around 15,000 BP global sea level was over 120 meters lower than it is today and the central California coastline was located over 25 kilometers farther west near the Farallon Islands which were then hills rising above a broad alluvial plain (Masters and Aiello 2007:50-51; Muhs et al. 2003:153). Sea level initially rose quickly to a level of 56 meters lower than present by 10,000 BP, and 18 meters lower than present by 7,000 BP. By about 9,000 or 8,000 BP the ocean had begun to submerge San Francisco Bay (Masters and Aiello 2007: 51). After 8,000 BP the rate of sea-level rise slowed and by 5,000 BP sea-level reached nearly its present position (Masters and Aiello 2007:47, 51; Shlemon and Begg 1975:264).

The current delta began to form around 6,000 BP and continued expanding towards the Sacramento-San Joaquin confluence until about 3,500 BP (Rosenthal, White, and Sutton 2007:152-153; Shlemon and Begg 1975:264; West et al. 2007:24). During the Late and Recent Holocene (i.e., the last 4,000 years) the delta continued to expand in response to gradual sea-level rise and decomposition, compaction, and subsidence of wetland deposits (Brown and Pasternack 2004). Up to about 1850, the Sacramento-San Joaquin Delta supported a lush wetland with extensive riparian forests. Mining activity in the Sierra Nevada between 1856 and 1887 caused massive erosion that deposited large amounts of sediment that infilled the San Francisco Bay system (Gilbert 1917; Jaffe, Smith, and Torresan 1998). Since then Bay filling has continued, although at a slower rate, due to deforestation, poor farming practices, and other modern activities such as urban development and reclamation of wetlands around the Delta (Atwater and Belknap 1980; Ingebritsen et al. 2000; Jaffe, Smith, and Torresan 1998).

Stratigraphic Record

Stratigraphic evidence from throughout central California indicates that paleoenvironmental fluctuations produced widespread landscape responses throughout the region, characterized by prolonged periods of stability briefly interrupted by periods of erosion and deposition. This is recorded in well-developed buried soils found throughout lowland areas in central California (Rosenthal and Meyer 2004a:19).

Many alluvial fans and floodplains in the lowlands of central California underwent a significant period of deposition in response to climate change during the Pleistocene-Holocene transition that resulted in extensive buried Late Pleistocene alluvial landforms and a clear stratigraphic boundary between the Late Pleistocene and Holocene in many places. Another episode of widespread alluvial deposition was initiated by a shift to a warmer and drier environment at the beginning of the Middle Holocene (Rosenthal, White, and Sutton 2007:151).

After this, a period of landscape stability occurred as evidenced by buried soils from this time period in alluvial landforms throughout the region that contain some of the best documented Middle Archaic deposits. A third episode of deposition and subsequent landscape stability and soil formation occurred during the Late Holocene as climate changed again to generally cooler and wetter conditions. These soils remain at the surface in many areas and often cap the more heavily weathered Middle Holocene landscape (Rosenthal, White, and Sutton 2007:155-156). Climate since the Late Holocene has fluctuated between periods of decreased and increased precipitation. Response to these fluctuations was variable throughout the region with stratigraphic evidence of multiple episodes of deposition in some areas while an absence of deposition is evident in others (Meyer and Rosenthal 1997; Rosenthal and Meyer 2004a, 2004b; Rosenthal, White, and Sutton 2007:157).

Evidence from a recent geoarchaeological study along the Interstate 80 (I-80) freeway corridor through Solano County confirms several periods of landscape stability with soil formation during the last 15,000 years, punctuated by five periods of deposition at approximately 12,000, 7,000, 4,000, 3,300, and 2,700 years ago. This landscape evolution history is considered to be roughly synchronous with stratigraphic sequences elsewhere in the region (Hildebrandt et al. 2012). These landscape changes generally correspond with significant climatic changes during the Younger Dryas (12,000 BP), the onset of the Middle Holocene (7,000 BP), the onset of the Late Holocene (4,000 BP), and during the Late Holocene (3,300 and 2,700 BP). At these times climatic changes from cool and wet to warm and dry and from warm and dry to cool and wet (described above) with changes in precipitation and vegetation coverage "had a destabilizing effect on the regional landscape, resulting in widespread erosion and deposition" (Hildebrandt et al. 2012:88-91; Rosenthal and Meyer 2004a).

CHAPTER 4: CULTURAL BACKGROUND

This chapter provides an overview of the cultural history of the Ulatis Creek Watershed study area as it is understood to date. It begins with a broad discussion of the prehistory and ethnography of the greater surrounding region and then moves to a localized discussion of history of Vacaville. This discussion focuses mainly on the types and locations of sites and how people may have interacted with and affected the landscape.

PREHISTORIC OVERVIEW

The prehistory of Solano County is poorly understood although the surrounding regions of the San Francisco Bay and the Sacramento-San Joaquin Delta are two of the most studied districts in central California (Milliken et al. 2007:102; Rosenthal 1996:1; Whitaker and Kaijankoski 2009:4). Solano County is at times considered part of the Bay Area but is also included in archaeological discussions of the Central Valley (e.g., Milliken et al. 2007; Rosenthal, White, and Sutton 2007). This is due to the fact that Solano County straddles the geographic boundary between these two regions. Prehistoric peoples living in Solano County likely interacted frequently with neighbors in both directions, making it difficult to place the county in a cultural discussion solely of either area. Additionally, few studies have focused on developing specific local cultural sequences for Solano County (an exception being Rosenthal 1996). Because the prehistory of Solano County is poorly understood this overview relies heavily on the prehistory of the greater Bay Area and the Central Valley.

The most useful chronological sequence developed for Solano County comes from the works of Fredrickson (1973, 1974, and 1994), as modified by Milliken et al. (2007), Rosenthal, White, and Sutton (2007), and Whitaker and Kaijankoski (2009) who recognize the following five chronological periods:

- Paleo-Indian	(>11,000 cal BP)
- Lower Archaic	(11,000-7,500 cal BP)
- Middle Archaic	(7,500-2,500 cal BP)
- Upper Archaic	(2,500-850 cal BP)
- Emergent	(850-200 cal BP)

Paleo-Indian Period (>11,000 cal BP)

There is currently no clear evidence of human occupation in Solano County during this time period. Fredrickson originally described the Paleo-Indian period as a time when people were organized into highly mobile, small groups with sites primarily located by lakesides. Archaeological evidence from this time period is scarce in part because people who traveled over large geographic areas probably left little evidence in comparison to more permanent settlements during later periods (Fredrickson 1994:100). No Paleo-Indian sites have been identified in the Bay Area but isolated projectile points from this time period have been found at a few locations in the Central Valley such as the Woolfsen Mound (CA-MER-215), Tracy Lake, and at CA-SOL-347 in Solano County (Heizer 1938; Jackson and Simons 1991; Milliken et al. 2007:114; Rosenthal and Meyer 2004b; Rosenthal, White, and Sutton 2007:151).

Lower Archaic (11,000 – 7,500 cal BP)

Two sites from this period are located in the study area, the Laguna Creek Site and CA-SOL-334 (Hildebrandt et al. 2012; Ruby 2010). The Laguna Creek Site is buried along Laguna Creek in Lagoon Valley and produced a radiocarbon date of 8,864 cal BP. This site is the oldest well documented evidence of occupation in the northern Bay Area (Hildebrandt et al. 2012). CA-SOL-334 is a surface site located along Gibson Canyon Creek with a chronologically mixed assemblage including a Lower Archaic, ca. 7,500 BP, component dated through obsidian hydration (Ruby 2010:i). CA-SOL-468 is a buried site along Alamo Creek in Vaca Valley that may also date to the Lower Archaic (Whitaker and Kaijankoski 2009). Sites from this period are also found nearby in Contra Costa County as well as farther south and farther north in Lake County and elsewhere in the North Coast Ranges (Whitaker and Kaijankoski 2009:7; White et al. 2002).

During this period Bay Area peoples continued to live in small groups, likely based on the extended family, seasonally visiting semi-permanent camps (Fredrickson 1994:100). A distinct difference is evident during this period between valley floor and foothill assemblages which may represent seasonal movement of the same people (Rosenthal, White, and Sutton 2007:152). The introduction of millingslabs and handstones technologically marks this period and indicates an increasing emphasis on plant foods (Fredrickson 1994:100).

Middle Archaic (7,500 – 2,500 cal BP)

Although Early Middle Archaic sites are rare in Central California (Rosenthal, White, and Sutton 2007:153), several sites from the Terminal Middle Archaic (4,500-2,500 BP) have been identified in Solano County, all of which have included human burials (Whitaker and Kaijankoski 2009:8). CA-SOL-468 and CA-SOL-334 along Gibson Canyon Creek are two well-documented sites from this time period in the Ulatis Creek Watershed (Whitaker and Kaijankoski 2009; Wohlgemuth, Ruby, and Kaijankoski 2010).

It is during the Middle Archaic, beginning around 3,500 BP, that evidence of sedentism or at least semisedentism is found in the Bay Area, accompanied by population growth. Other groups continued to forage but may have done so on a more local scale than earlier in time (Fredrickson 1994:100; Milliken et al. 2007:115). Separate adaptations between people at foothill and valley sites become more distinct, with valley sites evidencing a comparatively longer pattern of residential settlement (Rosenthal, White, and Sutton 2007:153-155).

Technologically, this period is marked by the introduction of the mortar and pestle in the Bay Area, which implies the introduction of an acorn economy (Fredrickson 1994:100). By about 3,500 BP mortars and pestles were commonly used with millingslabs and handstones becoming less common at most sites. Evidence from this period in Solano County indicates passive acorn leaching and use of small seeds as well as a peak use of bulbs (Milliken et al. 2007:109). In Solano County, by the Terminal Middle

Archaic, obsidian from the Napa Valley source was used almost exclusively of other obsidian sources (Rosenthal, Hildebrandt, and Carpenter 2004:15).

Upper Archaic (2,500 – 850 cal BP)

Sites from this period are well documented compared to earlier time periods (Rosenthal, White, and Sutton 2007:156). In Solano County, sites in Green Valley, Vaca Valley, and near Dixon in the western Sacramento Valley have been excavated from this period (Whitaker and Kaijankoski 2009:8). Examples in the study area include CA-SOL-471 in Lagoon Valley and CA-SOL-425/H in downtown Vacaville (Barrow and Origer 2010; Rosenthal, Carpenter, and Whitaker 2009).

By the Upper Archaic a more sedentary adaptation based on intensive acorn usage is evident. Sites typically consist of midden deposits including large numbers of human burials and habitation features indicating long-term residence (Whitaker and Kaijankoski 2009:8). By the end of this period increased complexity of both culture and economy is evident (Fredrickson 1994:100). A variety of burial postures and artifact styles, including well-developed bone tool and ornament industries, indicates increased cultural diversity throughout Central California (Bennyhoff and Fredrickson 1994; Rosenthal 1996). In the study area, a social boundary lying between Ulatis and Alamo Creeks in Vaca Valley is demonstrated by differences in mortuary practices (Rosenthal 1996; Whitaker, Berg, and Carpenter 2009).

Emergent (850 - 200 cal BP)

The Emergent period can be divided into the Lower (1,300-500 BP) and Upper Emergent (500-200 BP) based on technological and economic distinctions. In the Sacramento Valley this is the best represented period and shows the most diversity of all prehistoric periods (Rosenthal, White, and Sutton 2007:157). Sites from this period are plentiful throughout Solano County (Whitaker and Kaijankoski 2009:9) including CA-SOL-30/H in Lagoon Valley and CA-SOL-320/H in downtown Vacaville (Hildebrandt et al. 2012; Rosenthal, Carpenter, and Whitaker 2009).

Emergent period peoples created central villages where political leaders resided, as well as associated hamlets and specialized activity sites (Fredrickson 1994). Large midden sites are common (Whitaker and Kaijankoski 2009:9). During this period cultures continued to increase in complexity and people continued to shift toward a collection subsistence strategy over a foraging one while investing more time in the creation of wealth objects (Milliken et al. 2007:116). Bedrock milling stations first appear during this period along with the bow and arrow (Fredrickson 1994:100; Rosenthal, White, and Sutton 2007:157).

ETHNOGRAPHIC OVERVIEW

At the time of Spanish contact most of the study area was located in Patwin territory (Johnson 1978:350). A small portion in the southeast of the study area may have belonged to the Plains Miwok or may have been unclaimed or shared territory (Johnson 1978:350; Levy 1978:398). Both the Patwin and Miwok groups were thus named by ethnographers based on linguistic similarities (Johnson 1978:350; Powers 1877:218; Levy 1978:398). In reality, these terms were used by each group in reference to themselves, meaning something along the lines of "the people" (Johnson 1978:350; Powers 1877:218; Kroeber 1925:443).

The Patwin and other Bay Area peoples were organized politically into tribelets that operated independently of one another and held fixed territories of 10 to 12 miles in diameter. These groups were from 200 to 400 members in size and occupied three to five semi-permanent villages (Milliken et al. 2007:99). Major settlements were located near reliable water sources, often on low knolls and above marshy floodplains (Johnson 1978:355; Moratto 1984:172). In the hills, most settlements were located in intermountain valleys. Plains occupation was seasonal, as much of this land was flooded in the winter and hot and dry in the summer (Johnson 1978:350). Two ethnographic Patwin villages are recorded within the study area. *Ululato* is thought to have been located along Ulatis Creek in modern, urban Vacaville (Johnson 1978:350; Powers 1877:218). *Malaka* was located in Lagoon Valley (Powers 1877:218).

Spanish contact impacted native culture significantly and affected the people both spiritually and physically though missionization, disease, and displacement (Johnson 1978:351; Moratto 1984:172). The Spanish took converts from Patwin territory to Mission Dolores in San Francisco and Mission San Francisco Solano in Sonoma (Johnson 1978:351). After mission secularization, the people who survived likely returned to the area to work for Mexican ranch owners. Although the native populations were significantly reduced post contact, modern Patwin still exist today, mainly as part of the Cortina Band of Wintun Indians and the Rumsey Indian Rancheria of Wintun, both federally recognized political entities.

HISTORIC OVERVIEW

The first non-native settlers recorded in the Vacaville area were Manuel Vaca and Juan Felipe Pena who came to California from New Mexico in 1842 (Noske and Irwin 2007:ix). Together they applied for and received a Mexican land grant, *Lihuaytos,* or the Rancho Los Putos after Putah Creek which was also called Lihuaytos Creek at the time (Limbaugh and Payne 1978:20). Vaca and Pena built adobe houses on adjoining parcels in Lagoon Valley (Noske and Irwin 2007:ix). In 1850, Solano became one of the original 27 California counties (Limbaugh and Payne 1978:14). In that same year William McDaniel purchased a portion of the Rancho Los Putos from Manuel Vaca and designated one square mile of the land as the town of Vacaville. (Bowen 2004:7-8). By this time other settlers were coming to the area including the Wilsons and the Pleasants who settled Pleasants Valley to the north of the study area (Limbaugh and Payne 1978:26, 31)

From 1850 to 1880 the major products of Solano County were livestock and wheat (Limbaugh and Payne 1978:44). The area began to turn to fruit as a major crop in the 1870s and by the 1890s much of the Vacaville area was planted as orchards (Limbaugh and Payne 1978:55, 109). In 1895 the fruit district centered in the Vacaville area produced over 25 percent of fruit on the market in California (Limbaugh and Payne 1978:127). This fruit district was very profitable until the 1920s when the industry began to decline due to competition from southern California (Limbaugh and Payne 1978:233).

Intensive agriculture in the Vacaville area precipitated landscape changes, including hillside erosion and a massive loss of topsoil. Early orchardists had denuded the hills of vegetation believing that they had to remove ground cover in order to save water for fruit trees. As early as the late 1880s Vacaville farmers in the English Hills made attempts to slow down erosion by terracing the most fertile hillsides. It is reported that at this time topsoil was eroding from the slopes at a rate of one to two inches per year (Limbaugh and Payne 1978:234). Denuded hillsides also contributed to an increase in water runoff which caused both Ulatis and Alamo creeks to deepen or entrench. The creek beds are reported as being 10 feet deep by the 1890s. Today Ulatis Creek is about 30 feet deep in Vacaville. This is a stark contrast to reports of early Vacaville ranchers crossing the stream with wagons of wheat for sale in Suisun (Limbaugh and Payne 1978:235).

Major floods in 1883, 1907, 1931, and 1940 deposited massive amounts of sediment likely bolstered by increased yields due to this denudation and erosion (Limbaugh and Payne 1978:235). Soil conservation programs through the Civilian Conservation Corps were started in the 1930s in an attempt to remedy some of the effects to the landscape cause by poor land management (Limbaugh and Payne 1978:246). In the 1960s the Soil Conservation Service performed channel modifications in the downstream portion of the watershed from approximately the eastern city limit of Vacaville to Cache Slough to provide flood protection. These modifications included realigning and widening along Ulatis, Alamo, Horse, Gibson Canyon, Sweeney, and McCune Creeks. Lagoon Valley Lake in Lagoon Valley was developed in the 1980s on former wetlands that were likely seasonally flooded (EIP Associates 2004:4.11-4-4.11-5)

Flooding continues to be a problem in the Vacaville area and projects continue to be implemented to control erosion and the flow of water in the study area. These projects include the development of several detention basins along multiple creeks and have resulted in the discovery of several buried sites in the study area, including CA-SOL-324, -451, and P-48-000867. Urbanization in the Vacaville area has increased the amount of impervious ground surface which has in turn affected water flow patterns. Consequently, most localized flooding events occur in the rural areas downstream of the city. Intensification of agricultural practices in recent years in these same rural areas has also reduced the availability of overland runoff storage (AES 2010:4.7-3).

LANDSCAPE CHANGES AND THE ARCHAEOLOGICAL RECORD

The lack of sites from the Paleo-Indian period may be due in part to the fact that over time early sites located on Late Pleistocene landscapes have been eroded away or buried by alluvium (Milliken et al. 2007:114). Additionally, many of the Pleistocene landforms that have remained at the surface are located in environments that would have only attracted limited human occupation (Rosenthal, White, and Sutton 2007:151). The same landforms that have remained at the surface have also continually accumulated archaeological materials and older evidence of human land use may not always be recognized as such, particularly if mixed with occupations from later periods. Early Holocene climate change caused widespread deposition that likely buried many early archaeological deposits in central California (Milliken et al. 2007:114). For example, the earliest date of 9,870 BP for a millingstone component in the greater Bay Area is from a site buried near a creek in the Los Vaqueros Reservoir of eastern Contra Costa County (Meyer 1996; Meyer and Rosenthal 1997; Milliken et al. 2007:114).

The early Middle Holocene was a time of continued climate change and concomitant landscape changes. These changes included the expansion of new wetland habitats in the Central Valley as rising sea-level progressed inland forming the Sacramento-San Joaquin Delta (Goman and Wells 2000). Deposition during the Early and early Middle Holocene was followed by landscape stabilization, demonstrated by Middle Holocene buried soils identified throughout central California (e.g., Meyer and Rosenthal 1997; Rosenthal and Meyer 2004a). The dearth of sites from this time period from the valley floor compared to the foothills may be due to geomorphic changes (Rosenthal, White, and Sutton 2007:153). Sites from both the foothills and the valley floor are often associated with buried landforms (Rosenthal, White, and Sutton 2007:153).

Renewed deposition and soil formation during the Late Holocene buried many earlier Holocene landforms and archaeological deposits; the deposits from this period currently remain at the surface in many areas (Rosenthal and Meyer 2004a). Sites from this period are typically found near freshwater streams, particularly in lowland valleys, many in buried contexts (Whitaker and Kaijankoski 2009:8). Climate since the Late

Holocene fluctuated with localized floods and droughts causing periodic pulses of floodplain deposition in some areas (Rosenthal, White, and Sutton 2007:157). Most of the known sites from this period are located at the surface, but buried sites have been found in most interior valleys of the region (e.g., Meyer and Rosenthal 1997).

Historic-era and present day anthropogenically induced landscape changes have altered sediment yield and sediment storage patterns and may be linked to both recent channel entrenchment and deposition. Based on observations during fieldwork in the study area, a large amount of deposition has occurred from the historic-era to the present. This extremely recent deposition caps former landscapes from all periods, particularly in close proximity to the present day courses of creeks in the study area.

CHAPTER 5: METHODS AND RESULTS

As previously discussed, the goal of this thesis is to provide temporal resolution of the Latest Pleistocene and Holocene landscape evolution in the Ulatis Creek Watershed in order to better assess the potential for buried prehistoric archaeological deposits. This was achieved by identifying and defining chronostratigraphic landform units (landform units), resulting in a local soil chronosequence. The development of this chronosequence relies on stratigraphic, radiocarbon, and obsidian hydration (hydration) data obtained from previously reported sources and during survey in the study area. Relative landform units were first identified through stratigraphic analysis. These units were then temporally defined within the study area through the application of radiocarbon and hydration data. Additionally, a landform surface age map was produced that indicates the distribution and extent of the landform units within the study area. This landform surface age map and the definitions for individual landform units are presented in Chapter 6 (see Figure 6.1).

DATA SOURCES

Records Search

A records search that included all previously reported archaeological sites, excavation reports, and geoarchaeological studies within the study area was conducted at the California Historical Resources Inventory, Northwest Information Center (Information Center) in Rohnert Park, California. All archaeological sites and geoarchaeological testing locations reported in the study area as of September 2011 were mapped and associated with a soil series and all stratigraphic, radiocarbon, and hydration data from these sites and testing locations were collected.

Fifty-eight prehistoric sites and/or sites with prehistoric components had been previously recorded in the study area (see Figure 5.1 and Appendix C). Most of these are clustered around present-day creeks including Ulatis Creek, Alamo Creek, Encinosa Creek, Laguna Creek, and English Creek. Fifty-three (91.4%) of these sites are located in Vaca and Lagoon Valleys and in the English Hills and lower elevations of the Vaca Mountains. Only five (8.6%) prehistoric sites are recorded to the east of the English Hills in the study area, indicating low site density, low survey coverage, and/or low site visibility on the Alluvial Plain.

At the time of the records search, 6.4 percent (5,859 acres) of the Ulatis Creek Watershed (92,512 total acres) had been mapped at the Information Center as previously studied by archaeologists. One survey (S-5156; Treganza et al. 1965) was excluded from this analysis because the entire area mapped at the Information Center likely over-represents the degree of survey coverage for the study. This study was described as surveying more than 250 miles of irrigation ditch on the west side of the Sacramento Valley and mapped as covering 18,782 acres or 20.3 percent of the total study area, which may be inaccurate. Excluding the Treganza survey (S-5156), the coverage of the western portion of the study area (5,425 out of 28,094 acres), including the western slope of the English Hills, Vaca and Lagoon valleys, and the Vaca Mountains, accounts for 5.9

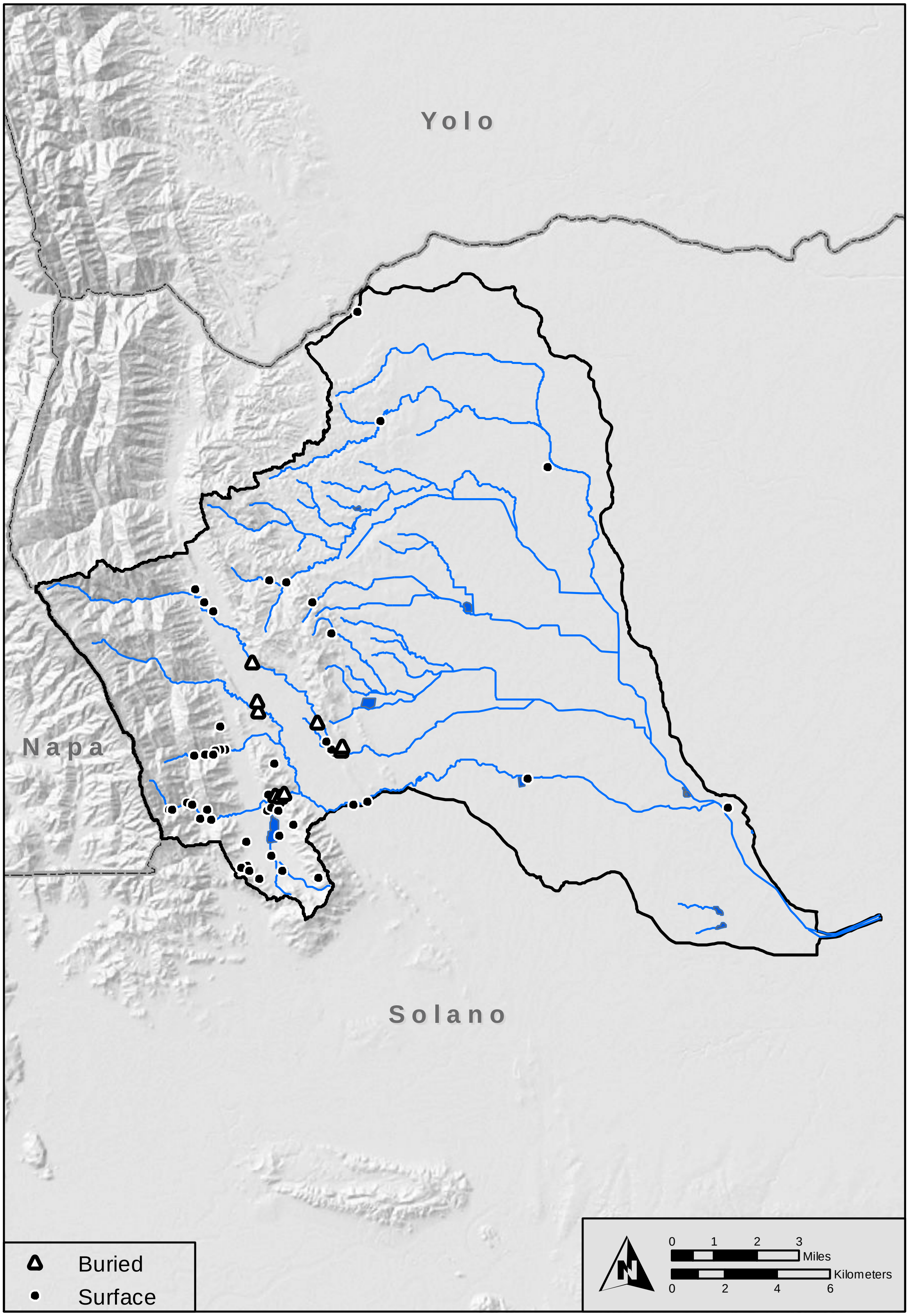


Figure 5.1. Prehistoric sites recorded in the Ulatis Creek Watershed.

percent of the total study area. In contrast, the previous study coverage of the eastern portion (434 out of 64,418 acres), including the eastern slope of the English Hills and the Alluvial Plain, only accounts for 0.5 percent of the total study area. This analysis indicates a general lack of data for the eastern portion of the study area which suggests that the known archaeological record may not be representative of the actual distribution of sites in the Ulatis Creek Watershed.

Field Reconnaissance

Reconnaissance survey in the study area was undertaken periodically between fall of 2010 and summer of 2011. Survey was initially guided by the results of the literature search and refined based on conditions in the field. Areas mapped as pre-Latest Pleistocene on geologic and soils maps were excluded from survey at the outset because they were formed prior to human occupation of the region and are dominated by erosional processes. This survey occurred primarily in modern creek channels as they provide access to naturally exposed stratigraphic sections and are active depositional environments which may contain buried soils and archaeological deposits.

This effort proved to be only moderately successful, as many portions of the creeks were difficult to access and/or on private property, particularly on the Alluvial Plain, and many others have been altered by human activity or are heavily vegetated. Several locations, however, did provide accessible exposures, six of which were selected for detailed stratigraphic identification and description (Table 5.1). These descriptions were included with the previously reported stratigraphic data for analysis purposes and are available in Appendix D.

Table 5.1. Stratigraphic Exposures Described During This Study

NO.	LOCATION	GEOMORPHIC POSITION	MAPPED SOIL SERIES	LANDFORM UNIT IDENTIFIED AT THE SURFACE
1	Vaca Valley, Ulatis Creek, location of CA-SOL-357	Inset terrace	Brentwood	Recent Holocene
2	Lagoon Valley, Laguna Creek, location of CA-SOL-324	Floodplain	Yolo	Recent Holocene
3	Lagoon Valley, Laguna Creek, downfan from location of Laguna Creek Site	Distal fan	Yolo	Recent Holocene
4	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	Floodplain	Yolo	Recent Holocene
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	Floodplain	San Ysidro	Recent Holocene
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	Floodplain	San Ysidro	Recent Holocene

Stratigraphic Identification and Soil Description

Stratigraphic units (strata) were identified in the field primarily on the basis of their physical characteristics (e.g.., texture color, and structure), boundaries (i.e., unconformities), stratigraphic relationships, textural transitions, and relative soil development (Birkeland 1999; Birkeland, Machette, and Haller 1991; Waters 1992). Stratigraphic descriptions use nomenclature described by Schoeneberger et al. (2002) and the USDA Soil Survey Staff (1993, 2010). Following these methods, stratigraphic units are designated with Roman numerals starting with the oldest (lowest) unit up through the youngest unit present. Master soil horizons, defined by in-place weathering characteristics, are designated by upper-case letters. Arabic numerals precede master horizon designations to distinguish between stratigraphic units, with number 1 assumed but not indicated (e.g., Cu and 2Cu are from different stratigraphic units). Lower-case letters describe specific characteristics of master horizons and are used as suffixes after the upper-case letters. Finally, Arabic numerals that follow all other horizon designations indicate subdivisions within the horizon based on minor internal differences in morphological characteristics such as in color or structure. Combinations of these designators are used to describe soils and sedimentary deposits. See Appendix E for further details on soil profile and description nomenclature.

Sampling and Dating

Thanks to grant funding obtained from the Anthropological Studies Center and the Sacramento Archaeological Society, and volunteer effort from Tom Origer and Associates Obsidian Hydration Lab (Tom Origer), some new radiocarbon dates and hydration readings were generated as part of this study. In order to provide better temporal control for areas where the stratigraphic relationships were unclear when compared to previously recorded descriptions, samples were selected for dating from three of the six stratigraphic profile locations described in the field. A total of two radiocarbon samples were submitted to Beta Analytic and seven hydration samples were submitted to Tom Origer as summarized below. The results of these were included with the radiocarbon and hydration datasets obtained from the literature search for analysis purposes and are available in Appendix F and G.

Both of the radiocarbon samples and two of the hydration samples were obtained from a single stratigraphic exposure in the bank of Ulatis Creek that contained archaeological materials that likely belong to previously recorded site CA-SOL-357. The remaining five hydration samples were collected from exposures in Laguna Creek, three from an exposure that is likely associated with previously recorded site CA-SOL-324 and two from an exposure approximately 130 meters (435 feet) downstream that demonstrates the truncated toe of an older alluvial fan that may be associated with the Laguna Creek Site, recorded directly to the north along Interstate 80.

IDENTIFYING CHRONOSTRATIGRAPHIC LANDFORM UNITS

The potential of a landform to contain buried archaeological deposits is directly related to its age. Therefore, to be able to assess this potential a detailed understanding of the chronology of the landscape evolution in the study area was necessary. A first step in this process was the identification of the major landform units present in the study area. In order to accomplish this, analysis of the stratigraphic evidence was conducted that focused on archaeological sites and other locations in the study area that provided both stratigraphic and radiocarbon and/or hydration evidence that could be used to identify and temporally define landform units. As defined here, stratigraphic evidence or data refers to information about stratigraphic relationships and the degree of soil development associated with a landform.

Stratigraphic evidence was analyzed from 20 separate locations within the study area. These included 13 archaeological sites and eight additional areas that were

Figure 5.2. Stratigraphic Descriptions from the Ulatis Creek Watershed.

geoarchaeologically tested, or described during the fieldwork for this study (see Figure 5.2 and Appendix D). While the size, number of stratigraphic descriptions and degree of detail varied greatly between the locations, together they provided a fairly comprehensive picture of the landscape evolution within the Ulatis Creek Watershed. The landscape contexts for the locations with available radiocarbon and/or hydration data were re-evaluated so that this data could be used to temporally define the landform units identified.

The stratigraphic and soil formation principles discussed in Chapter 2 were used to infer the most probable landform associations for both the surface and buried soils at the selected locations and identify the relative chronosequence of the stratigraphic units identified. The three main criteria used for these purposes are (1) geomorphic position—based on depictions on geologic and soils maps and observations in the field; (2) degree of soil development—which increases with age in a fairly predictable way as indicated in Table 5.2; and, because soils are time-transgressive and soil formation may not be uniform within landform units, (3) stratigraphic position—based on the Law of Superposition. Additionally, it is assumed that the relationships between landform units are relatively consistent throughout the study area, even where not directly observed based on the information available from the soil survey and geologic maps.

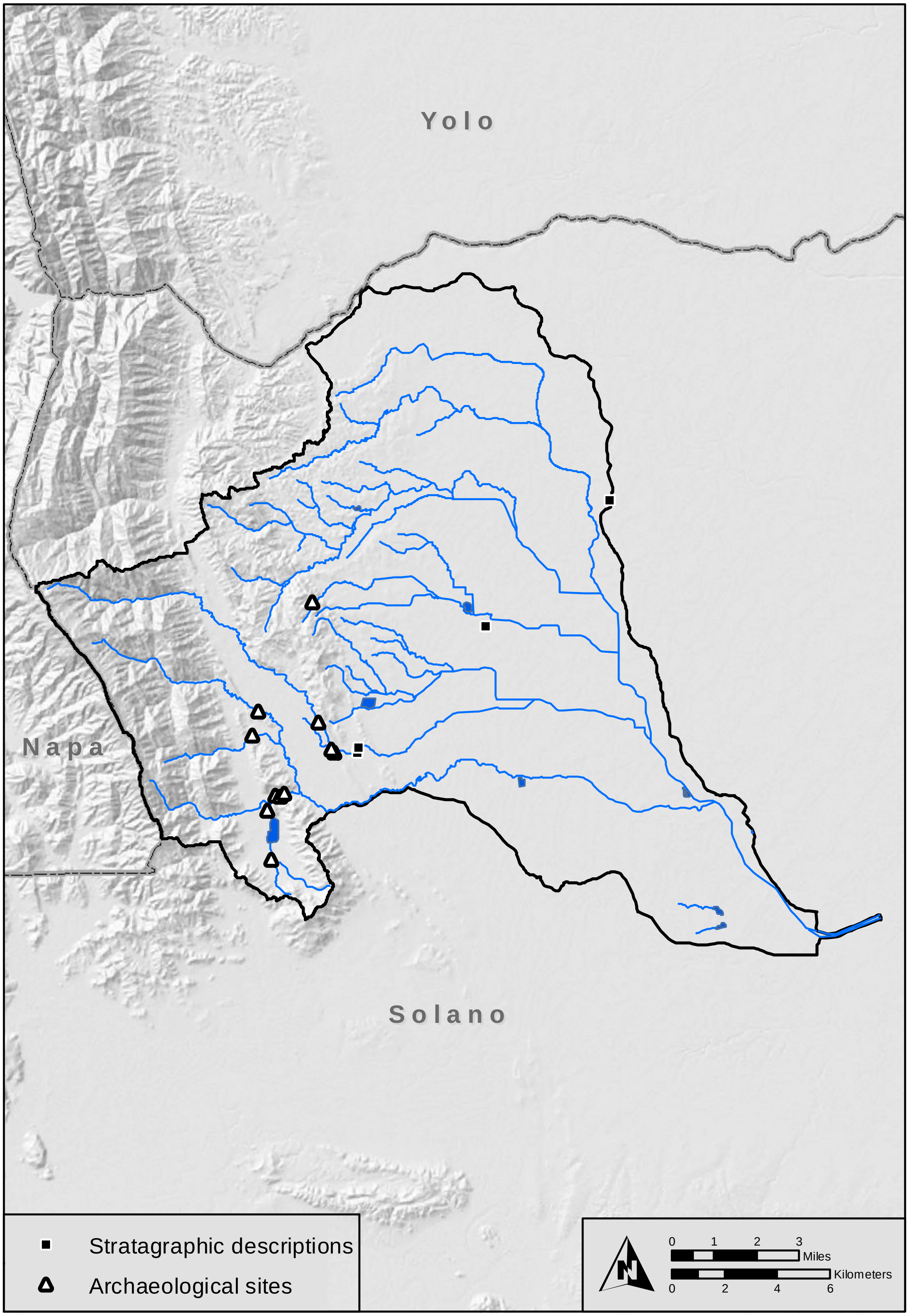
This analysis indicates that at least six major landform units are present in the study area. These units are designated from oldest to youngest: pre-Latest Pleistocene, Latest Pleistocene, Early Holocene, Late Holocene, Recent Holocene, and Historic-era to modern. Each unit identified was assigned a sensitivity level for buried archaeological deposits based on the age of the landform. Five categories of buried site sensitivity were assigned: None, Very Low, Low, High, and Very High. Sensitivity generally increases as landforms become progressively younger for two main reasons. First, the younger a landform there is a respectively longer span of time for possible human occupation or use that may be represented beneath it. Second, human populations are thought to have been lower and more mobile earlier in time so it is assumed that archaeological deposits from earlier time periods are less common overall. The chronostratigraphic landform units identified in the study area are summarized in Table 5.2.

DEFINING CHRONOSTRATIGRAPHIC LANDFORM UNIT AGES

Radiocarbon and hydration datasets obtained from this study and previous studies were analyzed to evaluate and refine the temporal resolution of specific landform units (see Figure 5.3). Although both radiocarbon and obsidian hydration methods are commonly used in central California to date archaeological deposits the radiocarbon method provides an absolute form of dating, while the hydration method is only a relative means of dating (Beck and Jones 2000:124; Taylor 2000:84; Tremaine 1989). Because of this, the natural and cultural deposits of different ages can sometimes be placed in proper temporal order using hydration, but it does not provide the same level of temporal resolution as radiocarbon dating.

Table 5.2. Chronostratigraphic Landform Units Identified

LANDFORM UNIT	ASSOCIATED SOIL SERIES IN STUDY AREA	DEGREE OF SOIL DEVELOPMENT	DESCRIPTION OF SOIL DEVELOPMENT	SENSITIVITY LEVEL BASED ON LANDFORM SURFACE AGE
Historic-era to modern	Borrow Pits, Riverwash	Very weakly developed soil	weak AC and/or undeveloped C horizon, often contains historic-era to modern debris (e.g. glass)	Varies – e.g., artificial fill or borrow pits are Very Low but natural alluvial deposits of this age are Very High
Recent Holocene	Clear Lake, Reiff, Sycamore, Yolo	Weakly developed soil	AC to thin A horizon with slightly stronger structural development and perhaps some oxidation in the C horizon	Very High Sensitivity
Late Holocene	Brentwood, Capay, Conejo	Moderately developed soil	Increased soil structure and pedogenic accumulations. Relatively clear A horizon with some B horizon development (Bw and/or Bk) and oxidation of the C horizon. (May be more weakly expressed where buried)	High Sensitivity
Early Holocene	Rincon	Well-developed soil	Distinct structure and accumulation of pedogenic constituents. Relatively thick and distinct A and B (Bt or Bt/Bk) horizons and oxidized C horizon.	Low Sensitivity
Latest Pleistocene	Antioch-San Ysidro, Pescadero, San Ysidro, Solano, Solano-Pescadero	Very well-developed soil	Similar to well-developed soils except the B horizon is generally more distinctly developed and may be thicker and redder, contain more clay, and have a more strongly developed structure. These soils are frequently truncated/ dissected in both surface and buried contexts.	Very Low Sensitivity
Pre-Latest Pleistocene	Altamont, Bressa-Dibble, Corning, Diablo-Ayar, Dibble-Los Osos, Gaviota, Maymen-Los Gatos, Millsholm, Trimmer	Very well-developed soils	Red to reddish brown in color. Often shallow to bedrock and/or on steep slopes. May contain a high percentage of gravel/cobbles. Strong pedogenic accumulations.	Not sensitive



5.3. Dated sites and stratigraphic descriptions in the Ulatis Creek Watershed.

For purposes of analysis, the following basic assumptions were made about the radiocarbon and hydration datasets. First, it is assumed that landforms were stable prior to human occupation or use and that carbon from both natural and cultural contexts could have been accumulated throughout the time the surface was stable. Similarly, obsidian artifacts are also assumed to have been deposited on a surface after it was stabilized. Therefore, radiocarbon and hydration dates from both natural and cultural contexts provide at least a minimum age for the surface that they are on/from.

Additionally, when radiocarbon and hydration dates are obtained from buried soils, both provide a limiting maximum age for the time of burial and the deposition of the overlying unit. This is because the introduction of new or recent carbon and other archaeological materials to soils essentially ceases at the time of burial in both natural and cultural contexts. Because carbon and artifacts only accumulate on landforms while they are at the surface, those that remain at the surface are expected to have younger mean age values for both radiocarbon and hydration than landforms where they have been buried for a prolonged period. Finally, if the radiocarbon and hydration evidence is valid for assigning ages to landform units, then both datasets should be in the same relative chronological order between units, and should be consistent with the age assignments based on stratigraphic observations, whether or not the two sets record time in the same way.

Radiocarbon Dataset

Twenty-three radiocarbon dates from within the study area were compiled in an Excel database, presented in Appendix G. To facilitate consistent age comparisons and accurate temporal assignments, all radiocarbon dates were recalibrated using the program CALIB v6.1.1 (Stuiver and Reimer 1993) which uses the 2009 International Calibration dataset to calibrate corrected radiocarbon dates to calendar years before present (BP). Four dates from a single archaeological site CA-SOL-270 were excluded from analysis for lack of verifiable stratigraphic context. Additionally, one of the dates obtained during fieldwork from the Ulatis Creek exposure of CA-SOL-357 was excluded from analysis because, based on stratigraphic evidence and the other dates from the site, it appears to be an erroneous date likely caused by the presence of older carbon that was introduced into the soil at the time of deposition. This exclusion process resulted in 18 radiocarbon dates that were used in analysis; these include 11 from cultural contexts and eight from natural contexts from seven archaeological sites and three additional locations that have been geoarchaeologically tested with negative results for archaeology.

Obsidian Hydration Dataset

Data associated with 362 obsidian hydration samples obtained from 11 archaeological sites in the study area were compiled into a separate Excel database that is provided in Appendix F. Thirty-two of these samples were unreadable for hydration and are considered null. Five of the samples were reported with two mean hydration values and in these cases the higher of the two values was excluded for purposes of analysis. An additional 67 values were rejected for analysis because they: (1) either resulted in dates too old to be representative of human occupation, or (2) lacked verifiable provenience and stratigraphic context. Finally, five of the remaining hydration values were excluded from further analysis using Chauvenet's criteria, which rejects values based on their magnitude of deviation from the mean of all measurements (Barnett and Lewis 1995:4). With these samples excluded, the analysis focused on the remaining sample of 253 mean hydration values from nine archaeological sites.

Most of the obsidian samples from the study area had been sourced either by X-ray fluorescence (n=58) or visually (n=176) as Napa Valley obsidian with only two samples from a single site explicitly identified as coming from other sources based on visual sourcing (CA-SOL-471; Barrow and Origer 2010). The remainder (n=17) of the samples lacked source data. Additionally, previous studies have determined that Napa Valley obsidian accounts for over 90 percent of all obsidian found at archaeological sites in Solano County (Rosenthal 1996). For these reasons, for the purposes of analysis for this study all obsidian samples were treated as if they are from the Napa Valley source.

The most commonly used rate (k=153.4) for converting hydration values for Napa Valley obsidian into calendar years was developed by Origer (1982), which is considered to be fairly accurate throughout central California (Rosenthal 2005). More recently, a conversion rate for Napa Valley obsidian has been proposed by Rosenthal (2005) that refines Origer's rate through the use of more than six times the original number of radiocarbon-hydration pairs. Conversions based on Rosenthal's rate (k=148.99) consistently produce ages that are about three percent younger than those based on Origer's conversion rate.

The results from both rates were initially compared to the stratigraphic and radiocarbon evidence to see if there was any indication of one rate being more accurate than the other. This comparison indicated that the dates that result from both rates appear equally valid in most cases. However, both appear problematic in the cases of several of the buried archaeological sites, where the suggested hydration ages are significantly younger than those indicated by the radiocarbon and/or stratigraphic evidence (e.g., the Laguna Creek Site). As neither rate appears to be more accurate, the rate proposed by Rosenthal was used for purposes of analysis.

Obsidian Hydration, Effective Hydration Temperature, and Buried Sites

It is generally acknowledged that several physical and environmental factors affect the rate of obsidian hydration. The most recognized factors include available moisture and effective hydration temperature (EHT), the latter of which is used to adjust for the acceleration of hydration at high temperatures compared with cooler temperatures (Origer 1982:306). Researchers in California have frequently adjusted for differences in EHT between locations based on measurements of ambient air temperature. The Santa Rosa, California area is the reference point for Napa Valley samples because the conversion rate was originally based on hydration-radiocarbon pairs from that area (Origer 1982; Rosenthal 2005). As the ambient air temperature in the Vacaville area is generally hotter than the Santa Rosa reference area (WRCC 2012), adjusting for EHT following commonly used methods (e.g., Lee 1969; Rogers 2007) results in younger ages. Thus, hydration values from buried sites, which already appear too young, are even younger once these corrections are applied.

However, Rosenthal's (personal communication with Rosenthal 2/21/12) recent research in central California indicates that hydration values do not correspond consistently to differences in temperature, leading him to believe that slight differences in EHT as currently assessed do not significantly affect hydration results. With this in mind, the evidence from the study area suggests that factors other than ambient air temperature may be affecting the EHT of buried obsidian samples.

This observation is not unique to the study area, as other researchers have previously observed that hydration is often problematic for dating buried archaeological sites, including at several locations in the Bay Area. These researchers have recognized that differences in hydration results from buried and surface sites may be due to the differences in temperature and moisture availability between buried and surface contexts, with buried contexts experiencing generally cooler and less variable temperatures and, therefore, a lower EHT (Martin and Meyer 2005; Meyer and Rosenthal 1997; Rogers 2007). It has also been observed that the disparity between radiocarbon and hydration-derived dates may increase with age (Rosenthal 2005). However, the exact mechanism behind these differences in hydration rates is not well understood.

Although the influence of ambient surface temperature on the EHT and rate of hydration can be dismissed, it remains possible that the hydration of obsidian artifacts in buried contexts is impeded due to depth and/or length of time of burial, which results in an overall lowering of the EHT (Hildebrandt et al. 2012; Martin and Meyer 2005; Rapp and Hill 2006:162; Rogers 2007; Rosenthal 2005). Therefore, obsidian hydration as currently understood and utilized may not provide accurate temporal assignments for landform units. With this understanding it is not surprising that the hydration samples from some of the buried sites in the study area appear too young on the basis of hydration in comparison to radiocarbon and/or stratigraphic evidence.

Data Analysis

The radiocarbon and hydration datasets were analyzed in three ways: (1) by mapped soil unit at the location of the sample; (2) by inferred landform unit at the surface of the location of the sample; and, (3) by inferred landform unit that the sample is from whether buried or at the surface. In each of these analyses dates were grouped internally based on whether samples were collected from buried or surface contexts.

For radiocarbon data subsets that contain only one radiocarbon date the 2 sigma range derived for that date during calibration serves as the total range for that set. For data subsets that contain multiple radiocarbon dates, the mean and one standard deviation (1-sigma range) of the dataset were calculated using the Data Analysis Tool Pack in the Excel database. One standard deviation was used to establish the minimum and maximum age ranges for each subset except when this resulted in a minimum and/or maximum age beyond the 2-sigma range provided by the dates within a given subset. All hydration data subsets have more than one value and are reported as a mean of those values with a one standard deviation range in order to account for a normal measurement error of +/- 0.2 microns for hydration readings (Beck and Jones 2000:140) and to be comparable with the radiocarbon dataset.

Initial analysis of the radiocarbon and hydration datasets was conducted on the basis of the mapped soil series at the sample locations. Analysis by this method only appears to provide chronological information for the surface landform unit at a given location without allowing for all landform units to be analyzed comparatively or internally. For both the radiocarbon and hydration datasets this analysis indicates that dates from soils at the surface are younger than dates obtained from below those surfaces, but it does not allow the variation in buried landform units to be addressed. It also appears that the use of mapped surface soil for analysis purposes inevitably includes errors inherent in the soil survey data. In this case the Recent Holocene and Late Holocene landform units as identified on the basis of stratigraphic evidence and represented by the Yolo and Brentwood soil series, respectively, are indicated as reversed in age. These landform units are both located on relatively recent floodplains, and share many of the same characteristics. Therefore, the soil survey mapping may not be accurate enough to accommodate the close spatial and temporal relationships between these soils. For the hydration dataset, Yolo surface dates are actually indicated as being older than dates from beneath Yolo surfaces. This is likely also due to Brentwood age landforms being ascribed to Yolo age soils on the basis of current mapping (see Tables 5.3 and 5.4).

Analysis of the radiocarbon and hydration datasets by inferred landform unit at the surface of the sample locations again indicates that dates from a particular surface are younger than dates from beneath that surface. This method seems to correct for minor problems caused by the scale and accuracy of the existing soils map, specifically the Recent Holocene and Late Holocene age reversal. However, this analysis still does not adequately clarify or provide temporal resolution for individual landform units or the chronological relationships between them because not all dates can be associated with a specific landform unit (see Tables 5.5 and 5.6).

Finally, an analysis by the inferred landform unit from which the sample derives—whether in a surface or buried context—allows for separation of, and age assignments for, the individual landform units identified and for comparison between surface and buried contexts of each unit. For the radiocarbon dataset, the landform units compared this way order chronologically as expected and generally seem to agree with the ages inferred on the basis of stratigraphic evidence. Only the Late Holocene data subset has radiocarbon dates associated with both surface and buried contexts. In this case, a comparison between the mean radiocarbon ages of each indicates that the mean age of the buried context is indeed slightly older than the surface context mean age.

Table 5.3. Results of Radiocarbon Analysis by Mapped Surface Soil

	BENEATH YOLO **N=6**	**BENEATH BRENTWOOD** **N=6**	**BRENTWOOD SURFACE** **N=6**
Min. cal BP 1-StDev (if > 1 date)	3,257	794	158
Mean cal BP (med. prob.)	10,195	2,480	939
Max. cal BP 1-StDev (if > 1 date)	17,133	5,109	1,720

Radiocarbon dates calibrated using the program CALIB v6.1.1 (Stuiver and Reimer 1993)

Table 5.4. Results of Obsidian Hydration Analysis by Mapped Surface Soil

	RINCON SURFACE **N=28**	**YOLO SURFACE** **N=10**	**YOLO BURIED** **N=26**	**BENEATH BRENTWOOD** **N=21**	**BRENTWOOD SURFACE** **N=168**
Min. cal BP 1-StDev (if > 1 date)	1,575	1,352	279	532	64
Mean cal BP (med. prob.)	4,747	2,522	1,968	1,375	1,038
Max. cal BP 1-StDev (if > 1 date)	7,919	3,692	3,657	2,218	2,012

Hydration values converted to calendar years using Rosenthal's 2005 rate, k=148.99

Table 5.5. Results of Radiocarbon Analysis by Inferred Surface Landform Unit

	BENEATH LATE HOLOCENE N=4	LATE HOLOCENE SURFACE N=3	BENEATH RECENT HOLOCENE N=2	RECENT HOLOCENE SURFACE N=9
Min. cal BP 1-StDev (if > 1 date)	6,791	441	794	147
Mean cal BP (med. prob.)	9,707	1,239	5,214	338
Max. cal BP 1-StDev (if > 1 date)	12,623	2,037	12,209	523

Radiocarbon dates calibrated using the program CALIB v6.1.1 (Stuiver and Reimer 1993)

Table 5.6. Results of Obsidian Hydration Analysis by Inferred Surface Landform Unit

	EARLY HOLOCENE SURFACE N=28	BENEATH LATE HOLOCENE N=14	LATE HOLOCENE SURFACE N=141	BENEATH RECENT HOLOCENE N=33	RECENT HOLOCENE SURFACE N=37
Min. cal BP 1-StDev (if > 1 date)	1,575	1,177	251	429	146
Mean cal BP (med. prob.)	4,747	2,989	1,318	1,166	350
Max. cal BP 1-StDev (if > 1 date)	7,919	4,801	3,657	1,903	554

Hydration values converted to calendar years using Rosenthal’s 2005 rate, k=148.99

When applied to the hydration dataset this same analysis indicates that landform units order as expected on the basis of stratigraphic and radiocarbon evidence, both across the entire dataset and within the buried and surface subsets of the Early Holocene and Late Holocene landform units. However, when the samples obtained from buried contexts are compared to those from surface contexts for these same landform units they do not trend as expected. Instead, the mean and range of hydration values from the buried contexts are younger than those from the surface contexts for both the Early Holocene and Late Holocene landform units (see Tables 5.7 and 5.8, and Chart 5.1).

Table 5.7. Results of Radiocarbon Analysis by Inferred Landform Unit Being Dated

	LATEST PLEISTOCENE (BURIED) **N=1**	**EARLY HOLOCENE (BURIED)** **N=4**	**LATE HOLOCENE (BURIED)** **N=6**	**LATE HOLOCENE (SURFACE)** **N=4**	**RECENT HOLOCENE (SURFACE)** **N=2**
Min. cal BP 1-StDev (if > 1 date)	12,727	5,981	794	441	195
Mean cal BP (med. prob.)	12,952	7,314	1,706	1,239	338
Max. cal BP 1-StDev (if > 1 date)	13,112	8,647	2,751	2,037	523

Radiocarbon dates calibrated using the program CALIB v6.1.1 (Stuiver and Reimer 1993)

Table 5.8. Results of Obsidian Hydration Analysis by Inferred Landform Unit Being Dated

	EARLY HOLOCENE (SURFACE) N=28	EARLY HOLOCENE (BURIED) N=15	LATE HOLOCENE (SURFACE) N=141	LATE HOLOCENE (BURIED) N=32	RECENT HOLOCENE (SURFACE) N=37
Min. cal BP 1-StDev (if > 1 date)	1,575	1,151	251	459	146
Mean cal BP (med. prob.)	4,747	2,914	1,318	1,193	350
Max. cal BP 1-StDev (if > 1 date)	7,919	4,677	2,385	1,927	554

Hydration values converted to calendar years using Rosenthal's 2005 rate, k=148.99

Results

Based on the results described above the radiocarbon data is considered to be the most valid and reliable line of evidence for chronostratigraphic control of landform units. The general validity of hydration as a relative dating technique is at least partially confirmed by both analysis of the entire dataset and by the internal consistency of the buried and surface sample subsets. However, as initially suspected, at least some of the hydration samples from buried contexts appear to return dates younger than would be expected based on stratigraphic and/or radiocarbon evidence. At the same time, those samples from surface contexts appear to return dates that are comparable to those indicated by the other lines of evidence. Therefore, I conclude that only the obsidian from surface contexts yields hydration results that are useful for providing relative chronostratigraphic control for landform units in the study area, while those from buried contexts are not.

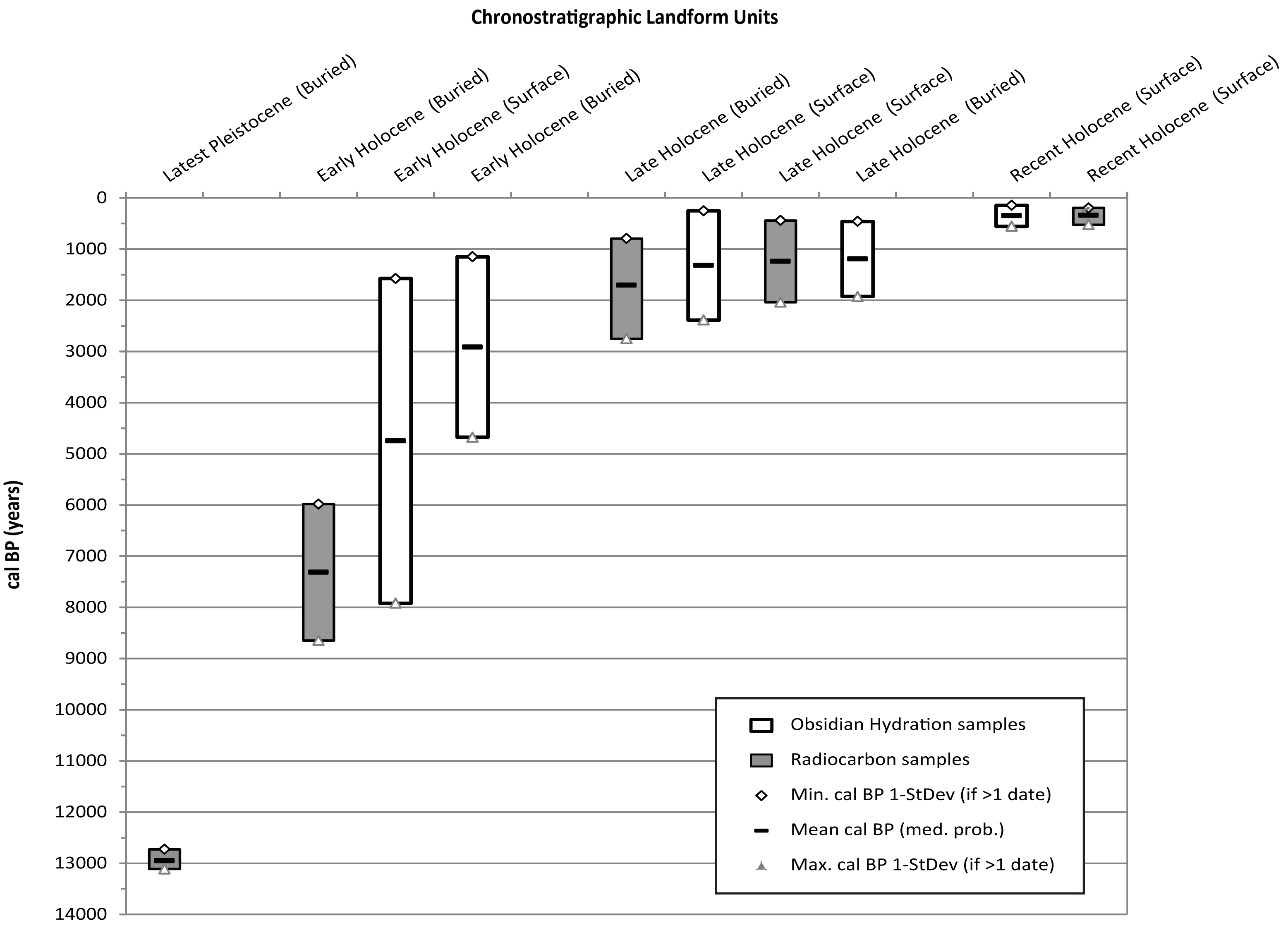


Chart 5.1. Results of Radiocarbon and Obsidian Hydration Analysis by Inferred Landform Unit Being Dated.

An analysis based on the inferred landform unit being dated confirms the chronological ordering of the six major landform units in the study area as compared with the stratigraphic evidence, and therefore, seems to provide the best temporal resolution for assigning ages to individual landforms. It was using this approach that the landform units within the study area were placed in relative order, assigned to particular age groups, and mapped as described below.

MAPPING

An additional result of this study is a map that indicates the surface distribution and extent of the major landform units identified in the study area (see Figure 6.1). Degree of soil development and geomorphic position indicated by the soil survey data was used to correlate the soil series present in the study area that have not been directly observed with those that have been well-documented already and have dates associated with them. This correlation was used to assign all soil series present in the study area to a specific landform unit. Soil series included in each landform unit are indicated in Table 5.2 and the soil series used as the basis for age assignments to landform units are discussed in Chapter 6. Soil series were then grouped in a Geographic Information System using the existing Soil Survey Geographic Database (SSURGO) shape files to create boundaries between landform units. SSURGO data, available online, was used as the basis for mapping because soils data provides the most detailed mapping currently available without requiring complete re-mapping or significant modification. The resulting map serves as a basis for assessing the potential for buried archaeological deposits throughout the study area.

CHAPTER 6: FINDINGS AND INTERPRETATIONS

The findings of this study indicate the Ulatis Creek Watershed has a long and complex landscape history with periods of landform stability and soil formation periodically interrupted by cycles of erosion and deposition. Chronostratigraphic landform units representing six time periods were identified. From oldest to youngest, these units are: pre-Latest Pleistocene, Latest Pleistocene, Early Holocene, Late Holocene, Recent Holocene, and Historic-era to modern. These landform units are discussed in detail below. See Figure 6.1 for the distribution of these landform units at the surface (discussed further below).

CHRONOSTRATIGRAPHIC LANDFORM UNITS

Pre-Latest Pleistocene (>15,000 cal BP)

Because landforms older than about 15,000 years most likely pre-date the arrival of people to California, they are assumed to be too old to contain buried archaeological materials and are grouped into a single unit for mapping purposes. Pre-Latest Pleistocene landforms vary widely in age, including at least one episode of landform stability during the last glacial maximum (~22,000 BP) as represented by radiocarbon dates obtained from buried deposits. Typically, where mapped at the surface, these landforms have steep slopes and are frequently dominated by erosion indicating that if archaeological deposits are present they should either be at the present ground surface (e.g., bedrock mortars) or deposited in secondary contexts.

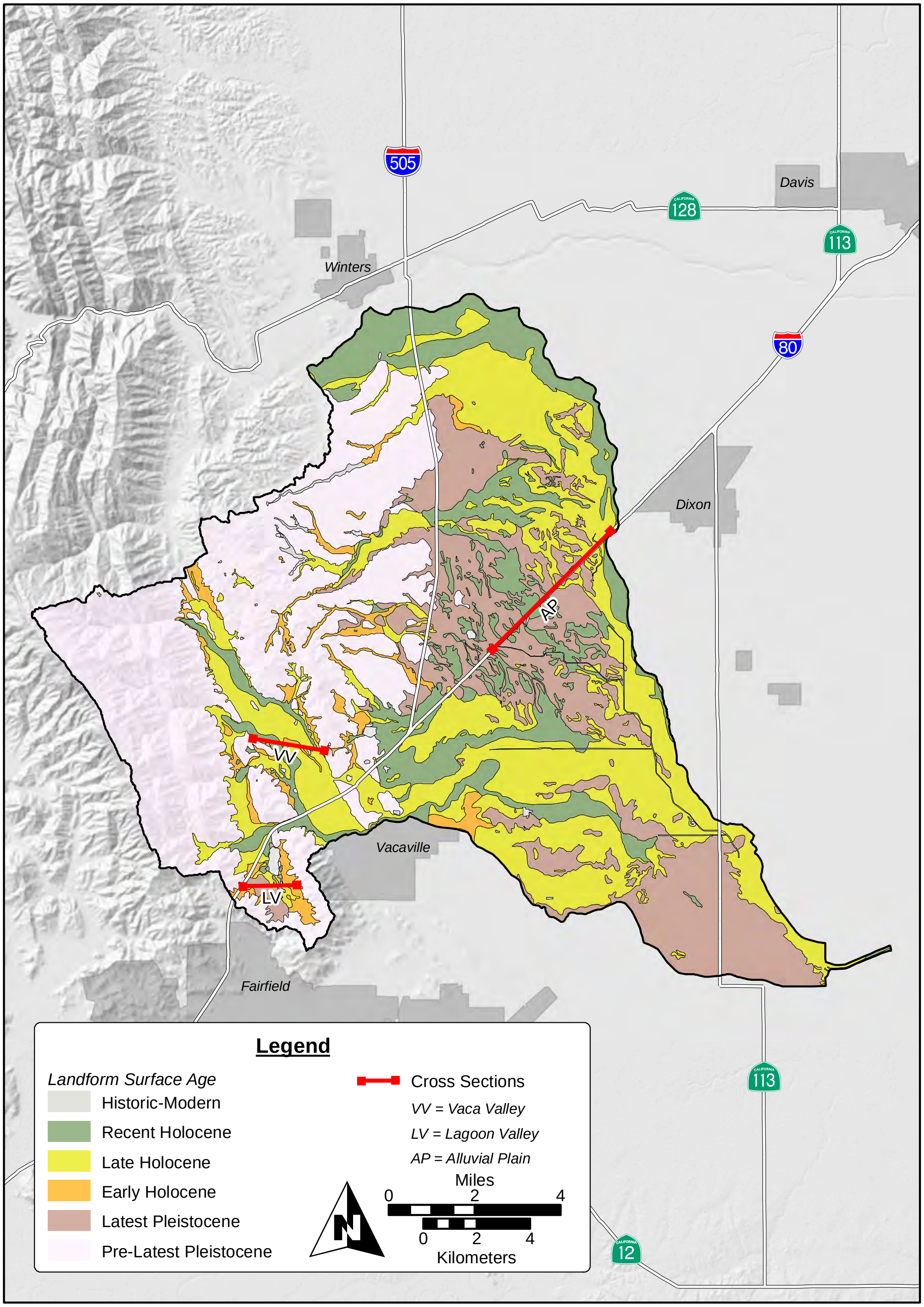


Figure 6.1. Present-day surface distribution of Chronostratigraphic Landform Units in the Ulatis Creek Watershed.

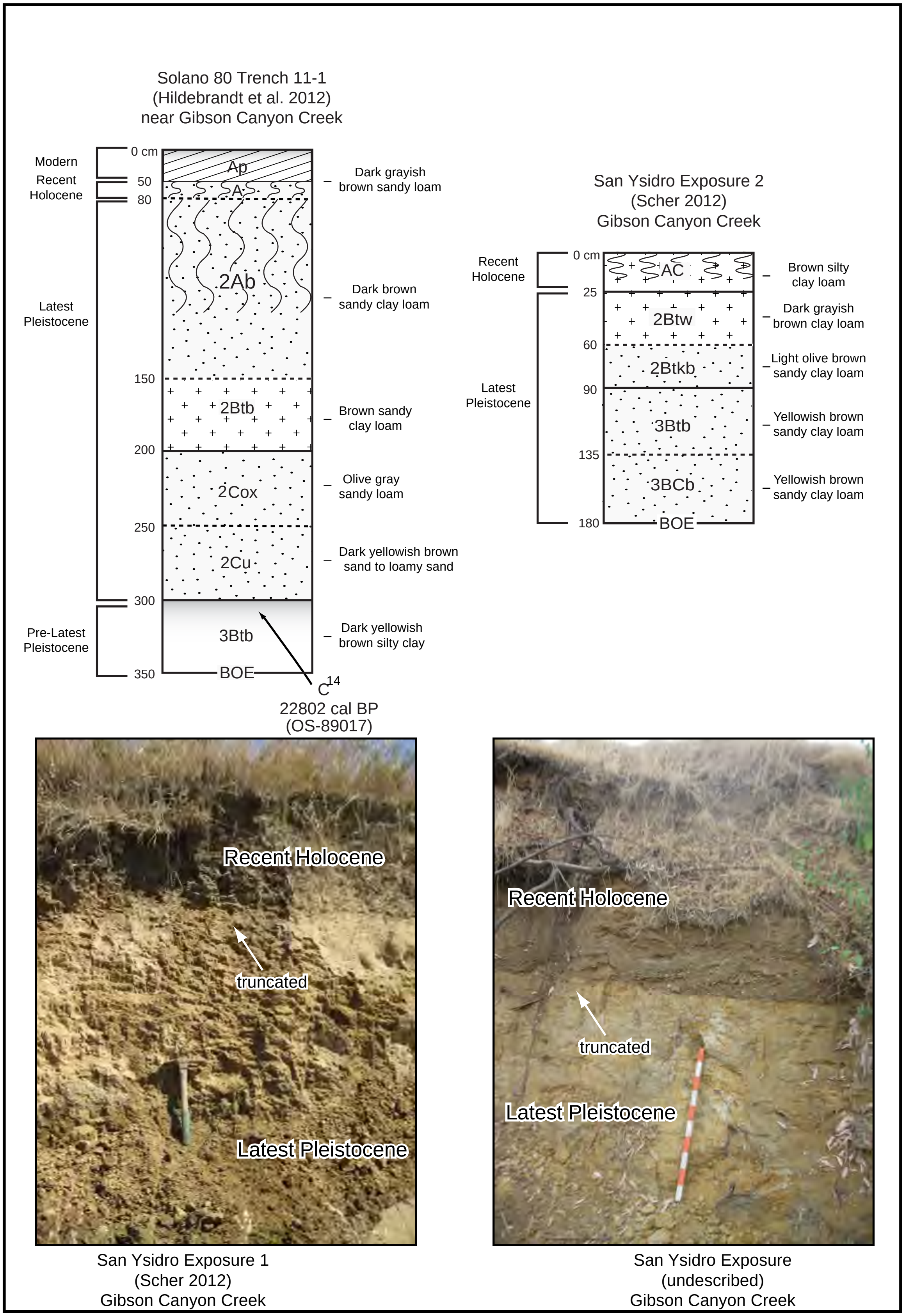
Pre-Latest Pleistocene landforms occur in 32.98 percent (30,511 acres) of the study area as represented by soil types from 10 different soil series. Generally, based on soil survey descriptions and observations, soils of this age have very well-developed profiles and many have a shallow depth to bedrock (see Table 5.2). These older deposits are primarily mapped and observed at the higher elevations in the study area on the Vaca Mountains and English Hills, with small remnants scattered through the lowlands. One radiocarbon date of 22,802 cal BP (OS-89017) has been obtained in the study area from a pre-Latest Pleistocene buried soil at a depth of 340-350 centimeters below surface (cmbs) on the Alluvial Plain near Gibson Canyon Creek. A second radiocarbon date of 24,029 cal BP (OS-88979) was obtained from a buried soil at a depth of 370-390cmbs identified farther to the east on the Alluvial Plain outside of the study area (Hildebrandt et al. 2012:53). These dates indicate that buried pre-Latest Pleistocene deposits sometimes occur at relatively shallow depths in the study area and surrounding region. This may be due partially to the effect of continual uplift to the east of the English Hills throughout the Pleistocene or to pre-existing variation in the topography at the time of burial. On the other hand, these deposits may be much deeper in other places as indicated by the lack of observation of such deposits elsewhere in the study area.

Most recorded archaeological sites on soils mapped as pre-Latest Pleistocene are bedrock mortar sites associated with the Emergent period (1,300-200 BP). All of these sites have been identified at the surface with none known to be present on buried deposits of this age.

Latest Pleistocene (15,000 to 11,500 cal BP)

Climatic fluctuations during the Pleistocene-Holocene transition caused significant amounts of deposition throughout central California. The resulting landforms rarely occur at the present ground surface but are often identified in buried contexts throughout the Central Valley and the North Coast Ranges, as well as other parts of California. Radiocarbon dates from soils of this age and overlying deposits from the surrounding region suggest a period of widespread landscape stability between about 13,900 and 12,900 cal BP. Dates from five Latest Pleistocene buried soils identified nearby in Solano and Yolo counties have a mean age of 13,071 cal BP for this period of stability (Hildebrandt et al. 2012:88). These surfaces are of the right age to contain evidence of early Paleo-Indian occupation but, where present at the surface, have a very low potential for buried archaeology because of their age.

In the study area, surface soils associated with landforms of this age typically belong to five soil series (see Table 5.2). The San Ysidro series, common in Solano County, is the most widely distributed of these and is considered to be representative of landforms related to this time period (see Figure 6.2). Both in the study area and elsewhere, San Ysidro soils have very well-developed profiles that appear to be partly truncated by erosion in many cases (i.e., portion of upper A horizon removed). Based on its strong soil development and its relative geomorphic position, the San Ysidro soil has previously been estimated to be Late Pleistocene in age (Meyer and Rosenthal 2008) and its maximum age is constrained by the radiocarbon date of 22,802 cal BP (OS-89017) from the study area, discussed above (Hildebrandt et al. 2012:76).



San Ysidro Exposure 1
(Scher 2012)
Gibson Canyon Creek

San Ysidro Exposure
(undescribed)
Gibson Canyon Creek

Figure 6.2. Latest Pleistocene representative soil profiles.

Latest Pleistocene landforms occur in 20.57 percent (19,027 acres) of the study area. In the study area soils of this age are mapped at the surface primarily on the Alluvial Plain and in southern Lagoon Valley, where they are preserved on proximal fans and remnant high terraces. On the Alluvial Plain this is likely due to the effect of uplift as previously discussed. Fault structure and/or activity associated with a segment of the Vaca Fault system may have also been a contributing factor in Lagoon Valley, but this area is also positioned near the head of the drainage system where sediment deposition is more limited.

Stratigraphic evidence from the study area indicates that these deposits are indeed present at the surface in large areas of the Alluvial Plain and southern Lagoon Valley, although in the latter location several places where these soils are mapped at the surface they have been observed to be buried at relatively shallow depths of between 50 and 170cmbs (Meyer, Scher, and Kaijankoski 2012:14). Additionally, buried deposits of this age have also been identified at depths ranging from 50 to 400cmbs on the Alluvial Plain and the western margin of Vaca Valley (Hildebrandt et al. 2012:53; Whitaker and Kaijankoski 2009:19). One radiocarbon date of 12,952 cal BP (Beta-261742) has been previously obtained from within Vaca Valley from a buried soil that underlies the Early Holocene and Late Holocene deposits that contain CA-SOL-468.

No known archaeological sites in the study are associated with these landforms either in buried or surface contexts. This may be due to several factors including the amount of dissection that these landforms have undergone which may have eroded archaeological materials along with the surface of the landform. Additionally, where these landforms have remained intact at the surface they are located in environments that would have only attracted limited human occupation (Rosenthal, White, and Sutton 2007:151).

Early Holocene (11,500 to 7,000 cal BP)

At the close of the Pleistocene a regional episode of deposition occurred between 12,900 and 11,500 cal BP, corresponding with the Younger Dryas cool interval. Relative climatic stability at the onset of the Holocene resulted in renewed landform stability and the formation of an Early Holocene landform unit. Early Holocene landforms are even more rarely represented at the surface in the surrounding region than are Latest Pleistocene landforms. Generally, Early Holocene landforms are only represented at the present day surface around the margins of valleys, where they typically form less than 10 to 15 percent of the Holocene-age surface landforms (Hildebrandt et al. 2012:90; Meyer and Rosenthal 2008). The surface distribution of this landform unit suggests that Early Holocene deposition was much less extensive than at the close of the last glacial maximum and was primarily restricted to distal fans and valley floodplains, many of which were subsequently buried by sediments (Rosenthal and Meyer 2004a:67).

Buried Early Holocene deposits have been identified at multiple locations throughout the Central Valley and North Coast Ranges, and were once probably more extensive than their limited distribution at the present surface suggests (Hildebrandt et al. 2012; Meyer and Rosenthal 2008; Meyer, Kaijankoski, and Rosenthal 2011; Meyer, Rosenthal, and Young 2010). Dates from these landforms place the main period of stability between about 10,000 and 7,500 cal BP, indicating relative stability through most of the Early Holocene. However, the timing of stability may have been regional in scale occurring earlier or lasting longer in some places than others (Meyer, Rosenthal, and Young 2010; Hildebrandt et al. 2012:88). For example, eight Early Holocene radiocarbon dates ranging between 10,200 and 7,200 cal BP (8,366 cal BP mean) have been obtained from buried soils in Solano County alone (Hildebrandt et al. 2012). Because these landforms date to an early phase of prehistory they are considered to have a low sensitivity to contain buried prehistoric sites. At the same time, however, it is likely that a substantial part of the Early Holocene archaeological record is associated with these landforms in both surface and buried contexts (Hildebrandt et al. 2012:90).

In Solano County and neighboring areas, surface landforms of this period are primarily represented by soils of the Rincon series, estimated as Early Holocene in previous studies based on radiocarbon and stratigraphic evidence (see Table 5.2 and Figure 6.3; Meyer and Rosenthal 2008; Kaijankoski and Meyer 2009). Rincon soils generally have well-developed profiles but are not as well-developed or dissected as Latest Pleistocene (San Ysidro) soils by comparison. The maximum age for the Rincon series is constrained by a radiocarbon date of 12,480 cal BP (Beta-261296) from a buried soil along Bird Creek in Yolo County (Kaijankoski and Meyer 2009) which is close to the Latest Pleistocene date from the study area discussed above.

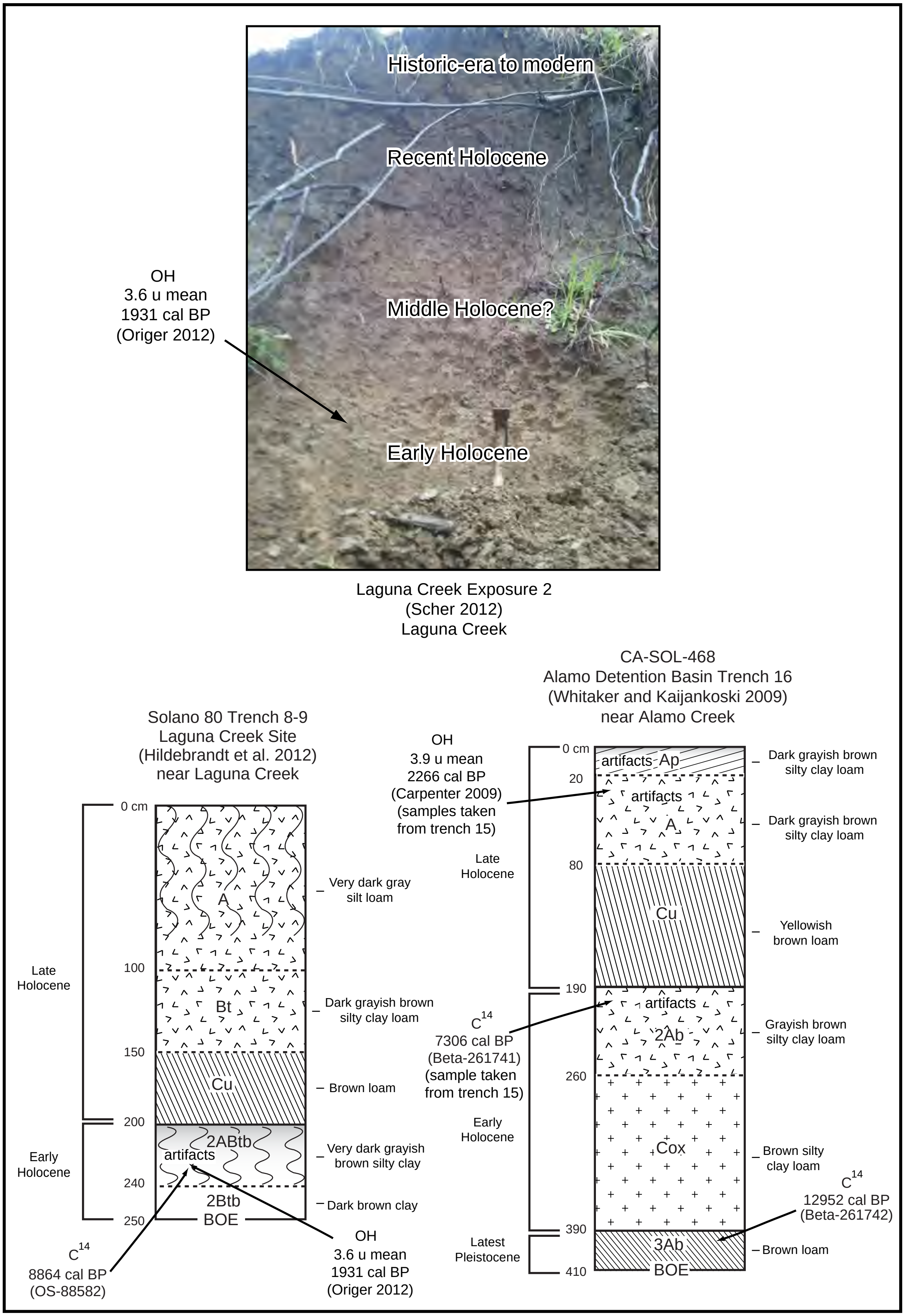


Figure 6.3. Early Holocene representative soil profiles.

Rincon soils are mapped at the surface in only 3.2 percent (2,948 acres) of the study area. These soils occur on alluvial fans emanating from the hill slopes surrounding Vaca and Lagoon Valleys, with small remnant areas mapped on the valley floors as well as in the headwaters of small drainages on the eastern slopes of the English Hills. Previous studies have identified these deposits at the surface in southern Lagoon Valley and the English Hills and buried at depths of 90 to 350cmbs in both Vaca and Lagoon Valleys.

Early Holocene radiocarbon dates have been obtained from buried deposits in the study area at three locations, which have a combined mean age of 7,314 cal BP and a range of 5,981 to 8,647 cal BP at a 1-sigma standard deviation. Only one archaeological site (CA-SOL-334), located in the English Hills, can be confidently assigned to this period based on the hydration results from obsidian artifacts (Wohlgemuth, Ruby, and Kaijankoski 2010). However, the Laguna Creek Site, which dates to the Late to Recent Holocene based on hydration, actually appears to date to the Early Holocene based on the radiocarbon and stratigraphic evidence (Hildebrandt et al. 2012). This may also be the case for a buried site component at CA-SOL-468, dated to the Middle Holocene on the basis of hydration (Whitaker and Kaijankoski 2009).

Several previously recorded surface sites in the study area may also be associated with these landforms (as mapped) although the stratigraphic context of most of these sites is unclear (i.e., lacking stratigraphic and/or dating evidence) and the sites may be associated with younger, adjoining landform units. Of the two known sites from this period, CA-SOL-334 occurs at the surface and the Laguna Creek Site occurs in a buried context. However, since most of the deposits of this age occur in buried contexts it is more likely that additional archaeological sites from this period are also buried.

Middle Holocene (7000 to 4000 cal BP)

The generally warm and dry climatic conditions that dominated the Middle Holocene were not conducive to widespread deposition due to a lack of energy for sediment production and transportation. Archaeological and geologic studies throughout central California indicate that the Middle Holocene is often the least represented and most spatially restricted of all geologic units that make up the surface landscape. In many parts of California, evidence of human occupation during the Middle Holocene also seems to be missing or rare (Hildebrandt et al. 2012:90). Evidence from geoarchaeological studies indicates that Middle Holocene landscape changes varied greatly from one area to another and that, at least in some places, multiple intervals of landscape instability and deposition occurred that were likely caused by brief periods of greatly increased and/or sustained precipitation (Meyer and Rosenthal 2010:300; Hildebrandt et al. 2012:90; Meyer 2008; Rosenthal and Meyer 2004a, 2004b).

A few relatively small bodies of Middle Holocene landforms occur at the present-day surface in isolated parts of the Central Valley, generally located on the medial portions of alluvial fans in intermediate positions between older and younger landforms (Meyer and Rosenthal 2010:300; Hildebrandt et al. 2012:90; Meyer and Rosenthal 2008; Meyer, Rosenthal, and Young 2010). Middle Holocene landforms are most frequently identified in central California in relatively low landscape positions (e.g. inset terraces, basin rims, distal fans, or incised channels) that have since been buried by deposition of younger sediment (Meyer and Rosenthal 2010:299-300; Hildebrandt et al. 2012:90; Meyer and Rosenthal 2008:94, 121; 2010:99-300). Radiocarbon and stratigraphic evidence from central California indicate two primary depositional pulses, the first between about 7,000 and 6,800 cal BP and the second between about 4,300 and 3,700 cal BP with landscape stability and soil development occurring in the intervening period (~6,800 to 4,300 cal BP; Hildebrandt et al. 2012:90).

One possible Middle Holocene radiocarbon date of 5610 cal BP (OS-89044) was obtained from a buried soil at a depth of about 145cmbs within Dixon Ridge on the Alluvial Plain at the eastern edge of the study area. However, based on the advanced degree of soil development this landform is believed to be Early Holocene in age. The lack of evidence in the study area from the Middle Holocene indicates that deposition was not widespread during this time. In southern Lagoon Valley, the presence of former channels incised into the Latest Pleistocene (San Ysidro) and Early Holocene (Rincon) soils suggest that the Middle Holocene may have been characterized by localized erosion and channel entrenchment, at least in headwater areas, while other Latest Pleistocene and Early Holocene landforms remained stable at the surface. If this was the case throughout the study area, then Middle Holocene-age strata may be preserved in only a few discrete buried contexts: in the topographically low areas of the southeast Alluvial Plain or as channel deposits or inset terraces within larger entrenched channels or arroyos, which are now overlain by Late Holocene to Historic-era to Modern alluvial deposits.

At least ten Middle Holocene radiocarbon dates have been derived from low topographic positions of less than 75 feet above mean sea level in Solano and Yolo Counties. Eight of these were obtained from the Alluvial Plain of the Central Valley north and east of the study area, with the others located in Green Valley to the southwest (see Figure 6.4). All ten are from buried contexts that range in depth from about 90 to 410cmbs, and together they have a combined mean age of 5,084 cal BP and with a range of 6,210 to 4,300 cal BP at 1-sigma standard deviation. All occur within the lower reaches of their respective drainage systems where there may have been enough sediment supplied from the upper reaches collected to form a laterally extensive Middle Holocene landform unit. Thus, it appears that Middle Holocene landforms tend to be stored in low topographic positions that are no longer represented at the present ground surface.

Although a distinct Middle Holocene landform unit is missing from the study area, previously recorded archaeological sites from this period are just as common as those from the Early Holocene. Two previously recorded sites may date to this period based on hydration: CA-SOL-334 located at the surface and CA-SOL-468 located in a buried context. Both of these sites were discussed above as they also contain, or may contain, an Early Holocene component and are located on Early Holocene landform surfaces. Additional Middle Holocene sites in the study area are also likely to be found in buried contexts on Early Holocene landforms which are more extensive, or on Middle Holocene landforms which have a more limited distribution.

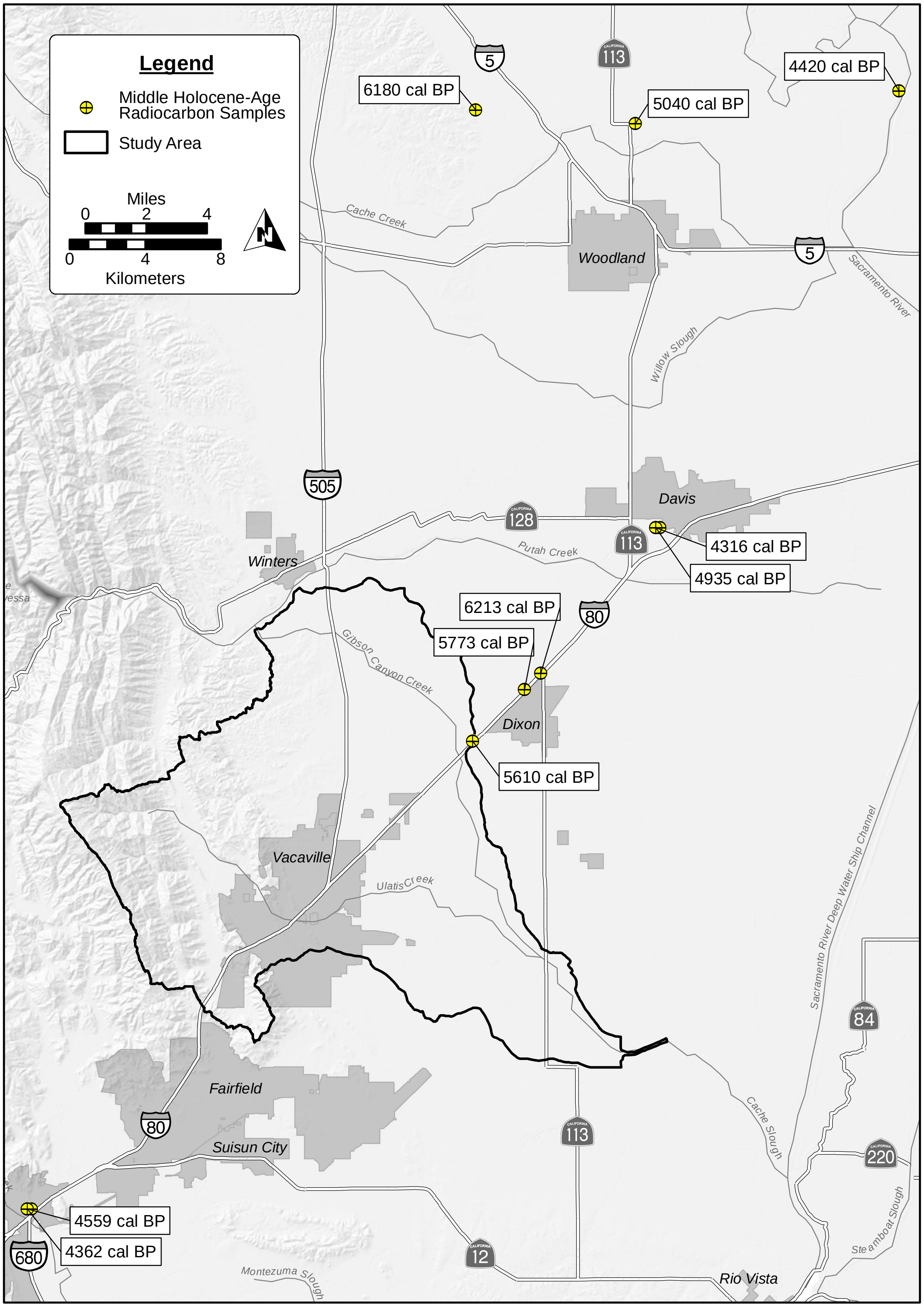


Figure 6.4. Distribution of Middle Holocene radiocarbon dates from Solano and Yolo Counties.

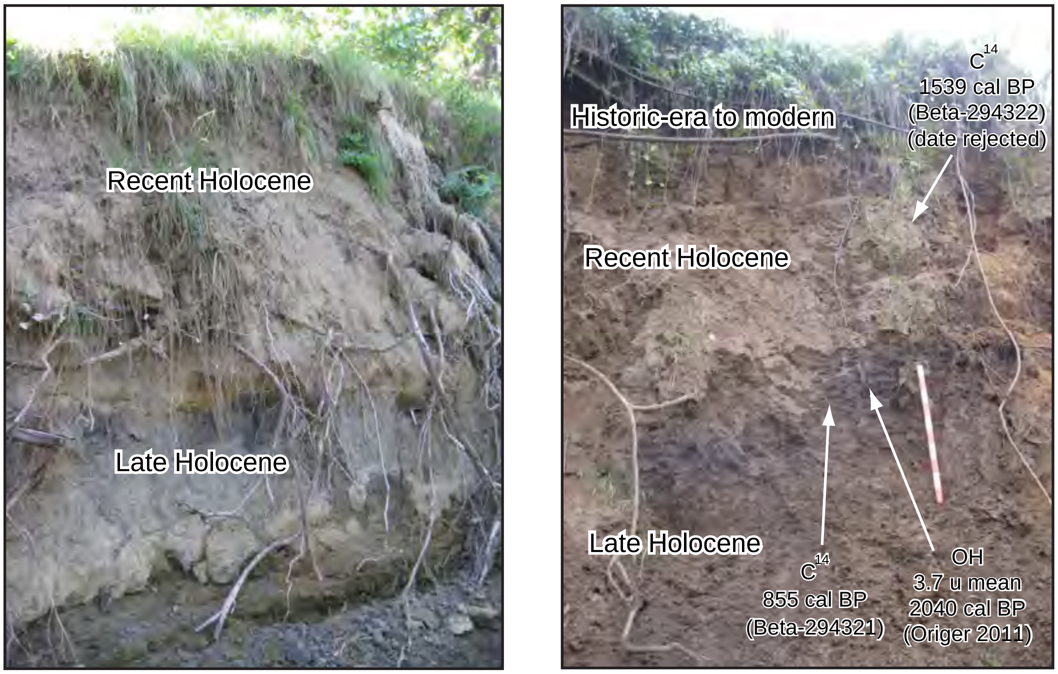
Late Holocene (4,000 to 1,000 cal BP)

As the arid conditions of the Middle Holocene shifted toward wetter conditions in the Late Holocene, there was another major pulse of deposition around 4,000 cal BP that is consistently recognized in valleys throughout the region (Meyer and Rosenthal 1997, 2008; Rosenthal and Meyer 2004a, 2004b). Deposits of this age occur as alluvial fans and floodplains that often remain at the surface of valleys as well as in buried contexts. Numerous buried soils in central California date to between about 3,600 and 2,200 cal BP indicating widespread landscape stability and soil formation during the Late Holocene. Nineteen radiocarbon dates obtained from buried Late Holocene-age contexts in Solano and Yolo counties range in age from 3,990 to 2,040 cal BP, and have a mean age of 3,040 cal BP overall (Hildebrandt et al. 2012:90).

A second regional pulse of deposition has been recognized occurring at or around 2,000 cal BP during the Latest Holocene as sometimes designated by previous studies (Meyer and Rosenthal 1997, 2008; Meyer, Rosenthal, and Young 2010; Meyer, Kaijankoski, and Rosenthal 2011; Rosenthal and Meyer 2004a, 2004b). At least nine Latest Holocene dates, ranging from about 1,985 to 1,370 cal BP (1,665 cal BP mean), have been obtained from buried contexts in nearby parts of Solano and Yolo counties (Hildebrandt et al. 2012). Because deposits of this age date to the latter portion of the prehistoric-era they are considered to have a higher potential to contain buried archaeological deposits than those from earlier periods. It follows that Late Holocene archaeological sites are more likely to occur at the surface than in buried contexts as compared to sites from previous time periods (Hildebrandt et al. 2012:90-91).

In Solano County, surface landforms of this age are mainly represented by soils of the Capay and Brentwood series (see Table 5.2 and Figure 6.5; Hildebrandt et al. 2012; Meyer and Rosenthal 2008). Brentwood soils are mapped on fans and floodplains and Capay soils are mapped in topographically lower, basin positions. These soils are most typically moderately developed. However, soils from the Late Holocene vary in the degree of soil development with some that have remained at the surface appearing to be better developed than some of their counterparts in buried contexts. These differences likely reflect variations in the timing of deposition and burial of at least 2,000 years or more based on the depositional history outlined above.

Available evidence indicates that Brentwood and Capay soils are generally associated with Late Holocene-age landforms (4,000 to 2,000 cal BP; Meyer and Rosenthal 2008), as demonstrated by a radiocarbon date of 4,200 cal BP from a buried soil and channel deposits underlying Capay soils in Sacramento County (Meyer, Scher, and Kaijankoski 2012.). Further, analysis of ten radiocarbon dates associated with Brentwood soils in Solano County places its maximum age at about 3,000 cal BP, and its minimum age at about 2,000 cal BP (Meyer, Scher, and Kaijankoski 2012:17).



Alamo Creek Exposure
(undescribed)
Alamo Creek

CA-SOL-357
(Scher 2012)
Ulatis Creek

Solano 80 Trench 10-1
(Hildebrandt et al. 2012)
near Ulatis Creek

Solano 80 Trench 10-6
(Hildebrandt et al. 2012)
near Ulatis Creek

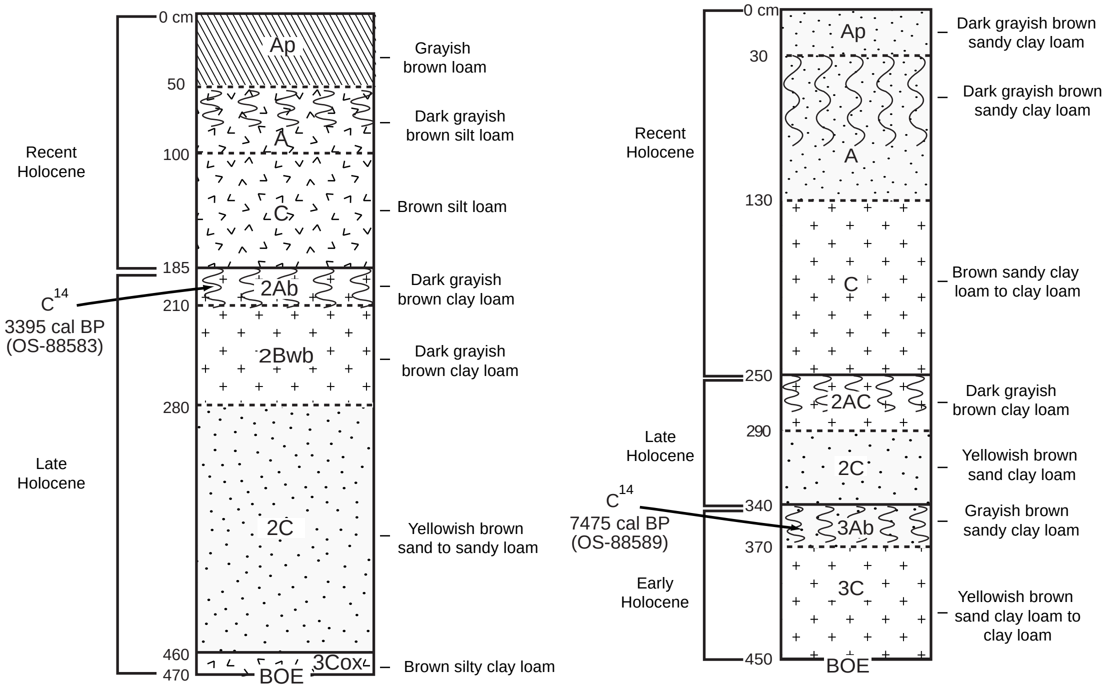


Figure 6.5. Late Holocene and Recent Holocene representative soil profiles.

Late Holocene soils are mapped at the surface in 27.42 percent (25,365 acres) of the study area, and in all geomorphic areas except for the Vaca Mountains. These units overlie most of Vaca Valley and northern Lagoon Valley, headwater areas in the English Hills, and a large portion of the Alluvial Plain. Small amounts of these deposits may also extend into the headwaters of some of the drainages that originate in the Vaca Mountains. Stratigraphic evidence and observations in the field confirm that Late Holocene soils are widely distributed in the study area. Soils of this age are frequently described in surface contexts but have also been observed as buried below younger deposits, within and near modern creek channels.

Thirteen radiocarbon dates from the Late Holocene have been obtained from the study area; five of these were excluded from analysis as discussed in Chapter 5. Eight radiocarbon dates are confidently associated with landforms of this age. Of these, those from buried contexts have a mean age of 1,710 cal BP and a range of 794 to 2,751 cal BP at 1-sigma standard deviation, while those from surface contexts have a mean age of 1,239 cal BP and range of 441 to 2,037 cal BP at 1-sigma standard deviation. The dates included in this analysis suggest that deposition may have occurred earlier in places as represented by two radiocarbon dates of 3,636 cal BP from CA-SOL-324 in Lagoon Valley (No lab number reported) and 3,395 cal BP from a buried soil near Ulatis Creek in downtown Vacaville (OS-88583). Analysis of the obsidian hydration values associated with these landforms shows that they are only slightly younger than the associated radiocarbon dates. The hydration values from surface contexts have a mean age of 1,318 cal BP and a range of 251 to 2,385 cal BP at 1-sigma standard deviation, and values from buried contexts yield a mean age of 1,193 cal BP and range of 459 to 1,927 cal BP at 1-sigma standard deviation. Once again, the hydration results from individual sites indicates that human occupation extends to about 4,000 cal BP at some locations (e.g., CA-SOL-435), which suggests that some of these landforms may have stabilized significantly earlier than others.

Sites from this period are found in both surface (e.g., CA-SOL-320/H and CA-SOL-425/H) and buried contexts (e.g., CA-SOL-324 and CA-SOL-357) in the study area. Several additional, undated sites are located at the surface where these soils are mapped indicating that these sites must be younger than 4,000 years old. Buried sites have been identified both on these surfaces and beneath Late Holocene deposits, with one-half of the known buried prehistoric sites (n=4) occurring beneath them. Given the relatively young age and widespread extent of these landforms, it is highly likely that many additional sites will be found both on and beneath these deposits.

Recent Holocene (1,000 to 150 cal BP)

Geoarchaeological studies have identified a Recent Holocene pulse of widespread sediment deposition in the region just after about 1,000 cal BP (Meyer and Rosenthal 1997, 2008; Meyer, Rosenthal, and Young 2010; Meyer, Kaijankoski, and Rosenthal 2011; Rosenthal and Meyer 2004a, 2004b) that may be due to changing climatic conditions following the Medieval Climatic Anomaly. Deposits of this age frequently remain at the present-day surface as levees and floodplains adjacent to modern stream channels. At least 55 radiocarbon dates have been obtained from surface contexts in Solano and Yolo counties that range between about 1,185 and 159 cal BP (460 cal BP mean; Hildebrandt et al. 2012). Because of the young age and location of these landforms they are considered to have a very high potential to contain buried archaeological deposits. At the same time archaeological sites dating to this period will most likely be found in surface contexts although some may be buried beneath Historic-era to modern deposition.

Deposits from this period are represented by four soil series in the study area. Most are mapped as Yolo series soils, which are widespread in Solano County, and considered to be the most representative of deposits of this age (see Table 5.2 and Figure 6.5). These soils are weakly developed but may superficially resemble older deposits as many are formed from parent material derived from older alluvial deposits. The maximum age of the Yolo soil is about 1,000 cal BP, and its minimum age is about 500 cal BP (Meyer, Scher, and Kaijankoski).

Yolo soils are mapped at the surface in 15.1 percent (12,969 acres) of the study area where they typically occur adjacent to stream channels and as levee and floodplain deposits. These soils are mapped throughout Vaca and Lagoon Valleys and the topographically lower areas of the Alluvial Plain. Though not mapped, these soils have been observed in southern Lagoon Valley, Vaca Valley, and on the Alluvial Plain where they cap older deposits and occur as inset terraces. As expected, these deposits occur primarily in surface contexts but are sometimes buried by even younger (Historic-era to modern) alluvial deposits.

Four Recent Holocene radiocarbon dates have been previously obtained from the study area. One of these (855 cal BP; Beta-294321) is associated with a Late Holocene age surface buried by Recent Holocene deposits, which limits the maximum age of deposition for the Recent Holocene unit to about 800 cal BP. The remaining three dates were obtained from surface contexts and have a mean age of 338 cal BP and range of 195 to 523 cal BP at 1-sigma standard deviation. Obsidian hydration values dating to this period are found at only one site (CA-SOL-30/H) in the study area, which is associated with a surface context. The hydration values from this site produce a mean age of 350 cal BP (146 to 554 cal BP 1-sigma range) which is nearly identical with the radiocarbon dates associated with this unit.

Recent Holocene sites have only been identified in surface contexts within the study area, although it is possible that some may be buried by Historic-era to modern deposits based on stratigraphic evidence. Since one-half of the known buried prehistoric sites (n=4) occur beneath these deposits, it is likely that additional sites are buried below this unit elsewhere in the study area.

Historic-era to Modern (< 150 cal BP)

Widespread deposition during the Historic era has been noted in many places in the United States. Historic-era land-use patterns have altered some river systems more dramatically than during earlier Quaternary climate changes (Montgomery and Wohl 2004:229). Since Historic-era to modern deposits can bury archaeological materials from all previous time periods, some areas overlain by these deposits have a considerable potential to contain buried archaeological deposits. However, areas such as borrow pits have low sensitivity due to the level of ground disturbance that has occurred there, as do areas where active stream channels either prevented human occupation, or removed the evidence of occupation due to erosion.

Deposits from this period in the study area include very recently deposited alluvium and riverwash as well as artificial fill and borrow pits. Only the riverwash and borrow pits are mapped at the surface in 0.3 percent (277 acres) of the study area. There is, however, abundant evidence of Historic-era to modern deposition in the study area. During fieldwork for this study, alluvium of this age was observed to be laterally extensive in areas adjacent to present-day stream channels in many parts of the study area. Similar deposits have also been reported from previous stratigraphic descriptions (e.g., Meyer, Scher, and Kaijankoski 2012). Additionally, archaeological reports have documented several inches of deposition occurring between consecutive field seasons, as well as evidence of recent channel incision of up to 10 feet (Brown 1964; McGonagle 1966; Slaymaker n.d.). A radiocarbon date of 180 cal BP (Beta-216163) obtained from a buried soil (4Ab horizon) in southern Lagoon Valley that was subsequently buried by three additional stratigraphic units demonstrates multiple cycles of deposition beginning just prior to the Historic era (date not included in data analysis; Meyer, Scher, and Kaijankoski 2012).

SUMMARY OF LANDSCAPE EVOLUTION IN THE ULATIS CREEK WATERSHED

During the Latest Pleistocene (15,000 to 11,500 years ago), the lowlands of the Ulatis Creek Watershed were covered by gently sloping alluvial fans and floodplains. It appears that this period was characterized by relative landscape stability and soil formation that began by about 13,000 years ago, as well as possibly localized head-ward erosion of gullies and stream channels that drained the adjoining uplands. For example, in southern Lagoon Valley the formation of arroyos or incised channels within the Latest Pleistocene landscape is evident (Meyer, Scher, and Kaijankoski 2012). In many places these landforms were dissected by erosion, before being buried by sediments. While no evidence of early occupation has yet been found in association with landforms of this age, they are of the right age to have been occupied by some of the region's earliest inhabitants.

Renewed deposition between about 12,000 and 10,000 years ago resulted in alluvial fans and floodplains that stabilized in the study area about 9,000 years ago. In many places, Early Holocene alluvium was deposited on the existing landscape, as observed in the eastern part of southern Lagoon Valley and at CA-SOL-468 on the west side of Vaca Valley. While the upper part of many Early Holocene fans were relatively stable and subject to ongoing soil formation and localized channel incision, many of the lower fan positions were buried by younger alluvial deposits.

Little evidence of Middle Holocene landscape changes were identified in the study area. Instead, it appears that many Early Holocene and Latest Pleistocene landforms remained stable and continued to form much of the land surface through this period. Localized channel incision and erosion is evidenced in southern Lagoon Valley and may have been occurring elsewhere around the same time.

If Middle Holocene surfaces exist in the study area they are likely only in low-lying positions on the landscape such as inset terraces or within incised channels. Larger bodies of Middle Holocene deposits may exist on the Alluvial Plain as this portion of the study area forms the west edge of the Sacramento River basin and the topography becomes progressively lower to the east. However, the stratigraphic and radiocarbon evidence as well as evidence for uplift to the east of the English Hills suggest that larger Middle Holocene landforms are more likely to be located even farther to the east and lower in the basin or in other low-lying places in the region. Because Middle Holocene landforms are rare in the study area, archaeological materials from this time are likely to be associated with landforms that are Early Holocene and older.

The transition to cooler and wetter conditions during the Late Holocene brought about the most dramatic landscape changes to occur in the Ulatis Creek Watershed in several thousand years. Deposition resumed during the end of the Middle Holocene or beginning of the Late Holocene before the landscape stabilized again by 1,700 years ago. Deposition occurred primarily in lower floodplain positions as represented by Brentwood and Capay soils. This deposition may have occurred in two pulses around 4,000 and 2,000 years ago as described for the surrounding region (Hildebrandt et al. 2012). Dixon Ridge, formed by a former distributary of Putah Creek and located at the eastern edge of the study area, appears to have formed by at least by this time based on the soil series mapped at the surface (Yolo and Brentwood soils). This is also supported by evidence from an archaeological site, CA-SOL-363, located on the surface of Dixon Ridge that has been radiocarbon dated to 1,340 cal BP (Beta-61554; Rosenthal and White 1994). Evidence from southern Lagoon Valley also demonstrates the wetter conditions during this time based on stratigraphic evidence and two radiocarbon dates. These indicate the presence of a wetland for about the last 1,000 years prior to the Historic era (Meyer, Scher, and Kaijankoski 2012). Archaeological sites from this time period occur in both surface and buried contexts.

Alluvial deposition occurred in the study area around 800 years ago with subsequent stability and soil formation by 500 years ago during the Recent Holocene. Deposition was primarily restricted to areas adjacent to stream channels including levees and floodplains. Overall, wetter conditions that began during the Late Holocene continued; Dixon Ridge continued to build up and wetland conditions continued in southern Lagoon Valley (Meyer, Scher, and Kaijankoski 2012:19). Multiple pulses of deposition that occurred through the Historic era to the present have likely been caused by Historic-era land use including agriculture and the effects of modern development. These deposits form a capping unit in many parts of the study area that can overlie all previous landform units. While Recent Holocene-age archaeological sites are primarily found in surface contexts, some may also be buried by deposits dating to the Historic-modern eras. Consequently, only sites dating to the ethnographic or Historic era may be found at the surface where these deposits are present.

BURIED SITE SENSITIVITY

This section addresses the general potential for buried archaeological deposits in the geomorphic areas within the Ulatis Creek Watershed. In general, the lowland areas in the valleys and along present-day and recent stream channels are sensitive for buried archaeological sites because Late Holocene and Recent Holocene soils are present at the surface. Higher topographic areas (uplands) generally consist of older landform units and have low sensitivity for buried archaeological deposits because they formed prior to people being in the region.

The landscape history described above indicates that large portions of formerly stable landform units once available for human use and occupation are now buried throughout the study area, along with any associated archaeological deposits. Therefore, landscape changes have created a significant bias in the archaeological record as older landforms and archaeological sites associated with them are under-represented at the present day surface. For example, Latest Pleistocene and Early Holocene landforms that remain at the surface have the potential for sites that span the entire period of human occupation (e.g., CA-SOL-334). However, archaeological sites older than the Late Holocene are more likely to occur in buried contexts than at the surface. Conversely, it is likely that archaeological sites found at the surface of Recent Holocene landforms will not be older than about 800 to 1,000 years and only ethnographic or Historic-era sites will be found on Historic-era to modern deposits.

Vaca Mountains

Overall, the Vaca Mountains have a very low sensitivity level for buried archaeological deposits because they consist of primarily pre-Latest Pleistocene landforms. Additionally, many of these landforms are steep and dominated by erosion so that archaeological deposits that are present may be in secondary contexts. Small pockets of unmapped, more recent landform units that would have a higher level of sensitivity may be present in some of the headwater areas of drainages as low-lying floodplains and inset terraces or preserved on low-angle slopes and footslopes.

Vaca Valley

Most of Vaca Valley is underlain by Late Holocene to Historic-era to modern landform units at the surface that have been identified burying Late Holocene and Early Holocene as well as Latest Pleistocene deposits. Therefore, Vaca Valley has an overall high to very high sensitivity for buried archaeological deposits of almost any age. Small amounts of Early Holocene landform units, which have a low sensitivity based on age, are mapped at the surface at the fringes and in the middle of the valley. It is unclear how accurately these units are mapped, and, particularly where near stream channels, they may be capped by younger deposits. The presence of five buried sites (CA-SOL-357, -466, -468, -469, P-48-000406) in Vaca Valley that range in age from Early Holocene through Late Holocene confirms their presence. It is likely that additional buried archaeological deposits exist in Vaca Valley. As all of the previously identified buried sites are located within less than 200 meters (656 feet) of a present-day creek, additional buried sites are most likely to be located near Ulatis and Alamo Creeks and other sources of fresh water. The stratigraphic relationships between landform units in Vaca Valley are presented in Figures 6.6 and 6.7.

Lagoon Valley

Most of Lagoon Valley has a high to very high potential for buried archaeological deposits. The northern portion of Lagoon Valley is underlain primarily by Late Holocene and Recent Holocene deposits. Some areas of older deposits (Latest Pleistocene and Early Holocene) with low to very low sensitivity for buried deposits are located at the surface, primarily in small amounts at the fringes of the northern valley and in greater quantities in the southern valley at the top of the drainage system. However, a recent geoarchaeological study in southern Lagoon Valley indicates that Latest Pleistocene and Early Holocene deposits are not as extensive at the surface as indicated by the soils map but rather, they are shallowly buried by Late Holocene and Recent Holocene deposits on the valley floor (Meyer, Scher, and Kaijankoski 2012:14-16). This study also suggests the presence of a wetland in southern Lagoon Valley for about the last 1,000 years leading up to the Historic era which likely provided attractive resources, such as tule and waterfowl, to prehistoric peoples, as indicated by the presence of site CA-SOL-471 at the south end of this marsh and multiple bedrock mortar sites in the hills surrounding the southern valley. Older deposits may also exist in shallowly buried contexts near the edges of the valley as demonstrated in southern Lagoon Valley and at the Laguna Creek Site and perhaps at greater depths at the valley axis. Additionally, three buried sites (CA-SOL-270, -324, Laguna Creek Site) have been

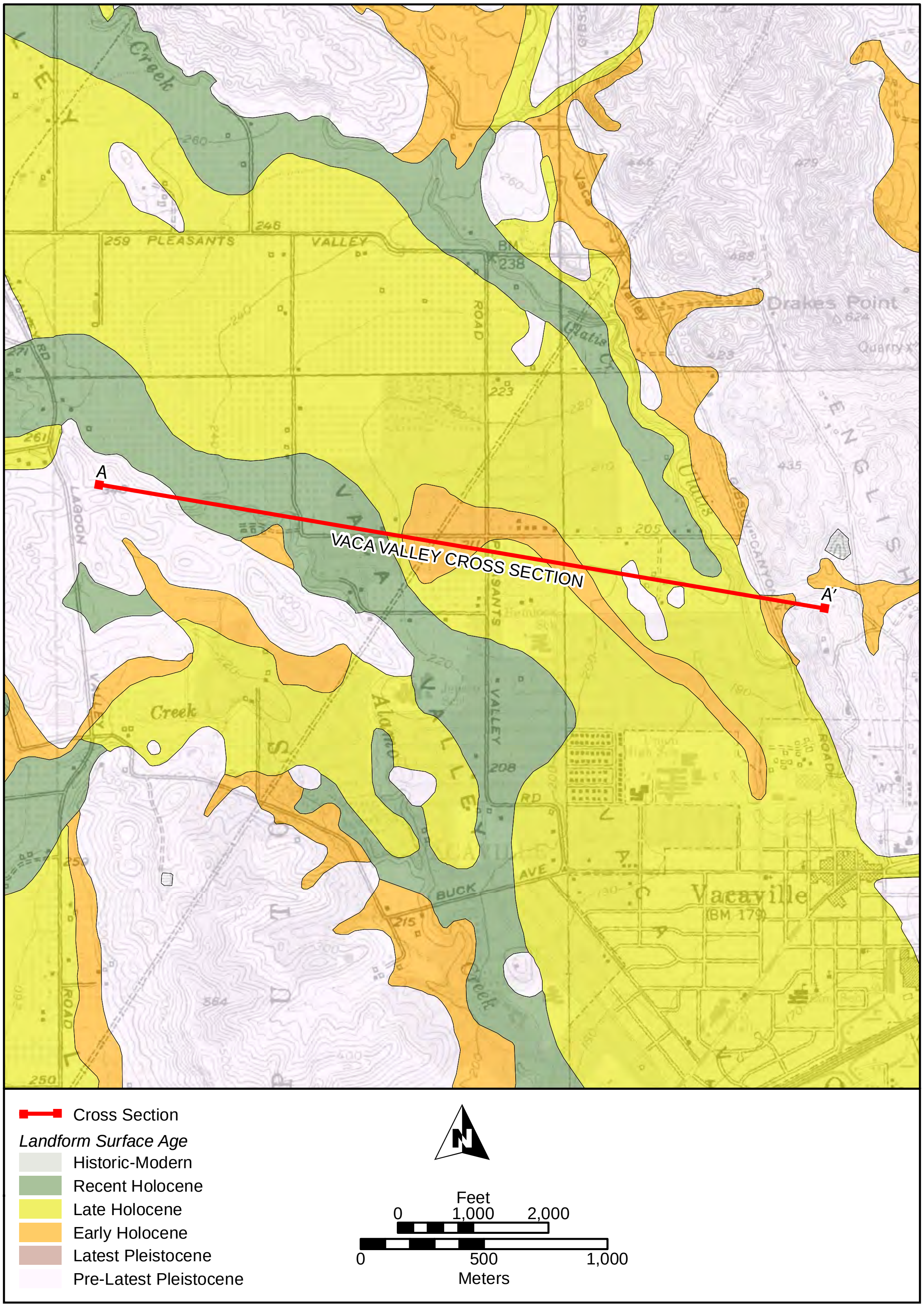


Figure 6.6. Vaca Valley cross-section location map.

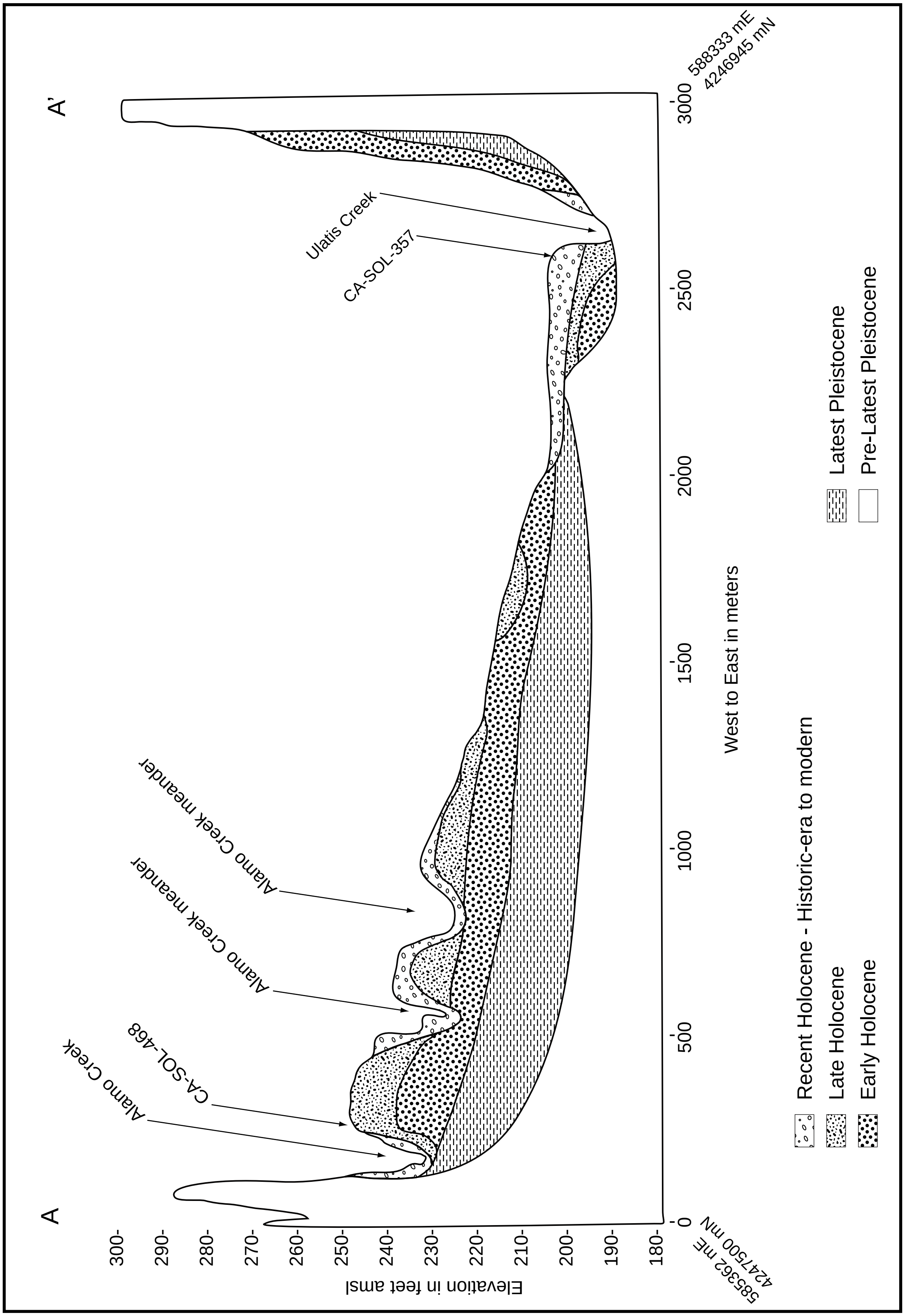


Figure 6.7. Vaca Valley idealized stratigraphic cross-section.

discovered in close proximity to each other beneath Late Holocene to Historic-era to modern deposits at the southeast end of Lagoon Valley where Laguna Creek passes through the hills to join Alamo Creek before it flows onto the Alluvial Plain. The stratigraphic relationships between landform units in Lagoon Valley are presented in Figures 6.8 and 6.9.

English Hills

Similar to the Vaca Mountains, the English Hills have an overall very low sensitivity for buried archaeological deposits because they are underlain primarily by pre-Latest Pleistocene landform units. Due to tectonic uplift, the channels that drain the east side of the English Hills have continually risen in comparison to their base-level. This resulted in channel entrenchment, preventing widespread deposition throughout most of the Holocene. Early Holocene Rincon soils with low sensitivity are mapped adjacent to the creeks in the English Hills although more Recent Holocene deposits may be present within the incised arroyos of these channels as channel deposits or inset terraces. These younger deposits have an elevated sensitivity for buried archaeological sites.

Alluvial Plain

Based on the soils map, the Alluvial Plain has a variable sensitivity for buried archaeological deposits. Although few archaeological data are available specifically from the Alluvial Plain, the general ages of landform units can be fairly confidently applied

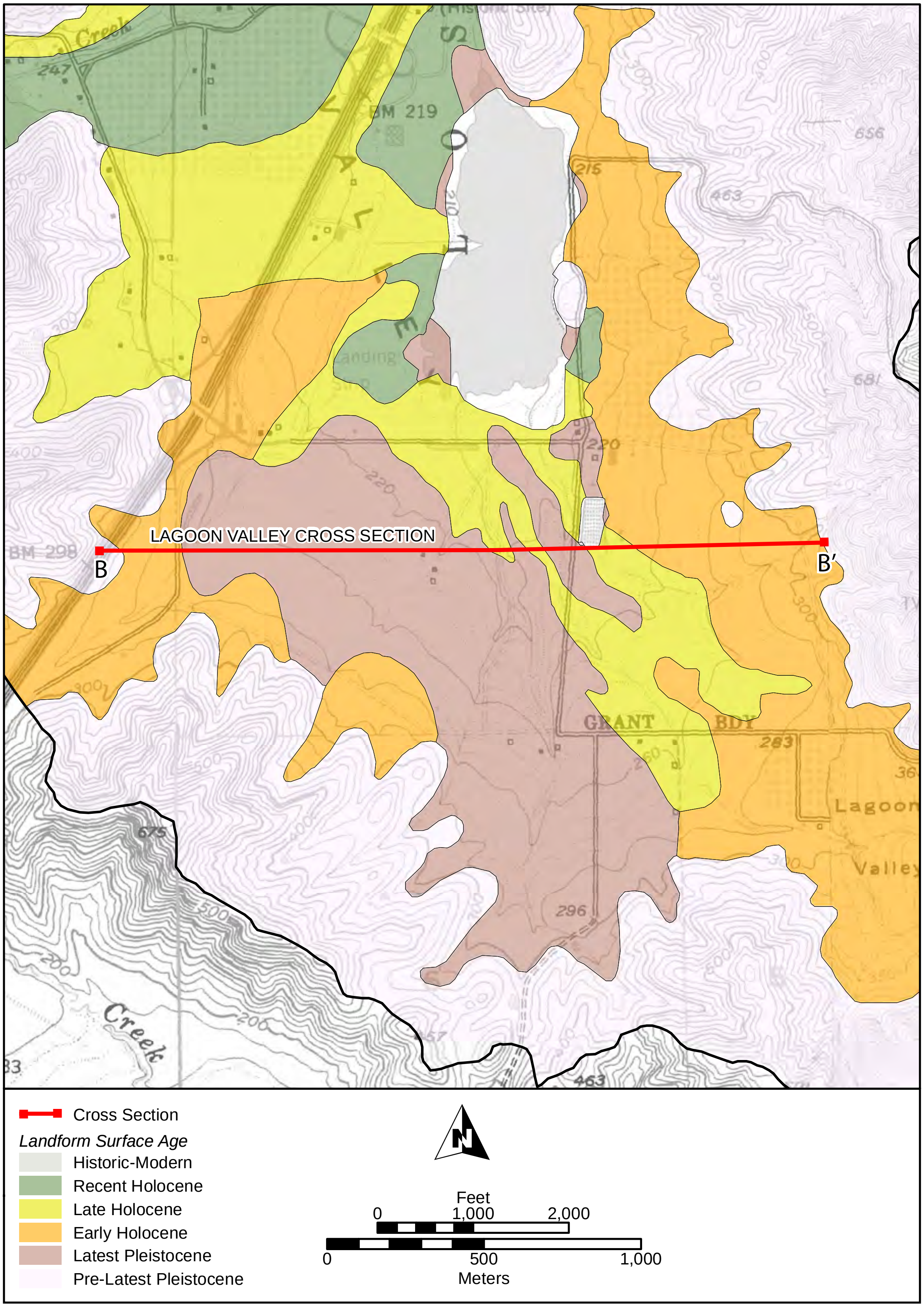


Figure 6.8. Lagoon Valley cross-section location map.

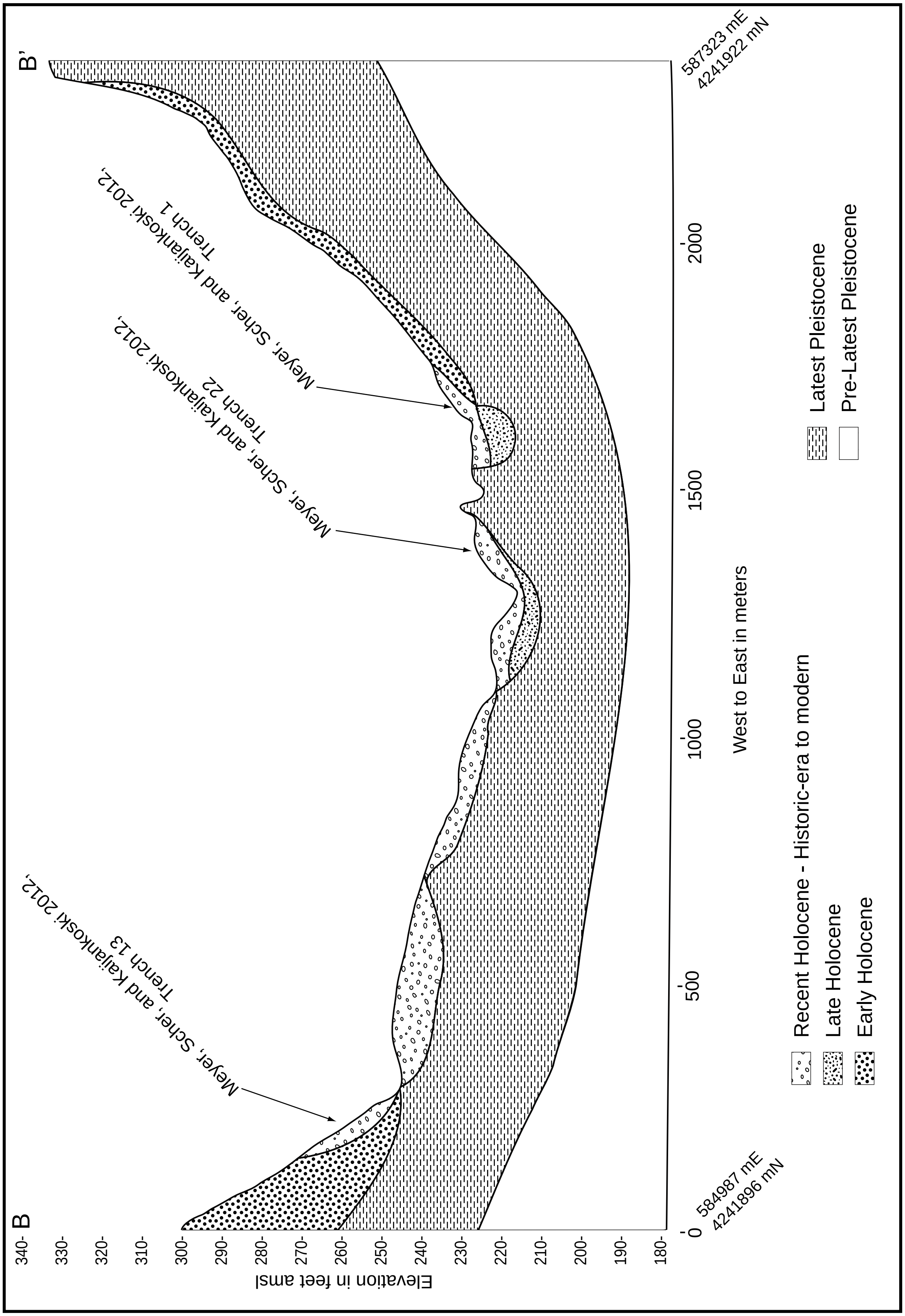


Figure 6.9. Lagoon Valley idealized stratigraphic cross-section.

here as the same soils and geologic units are mapped elsewhere in the study area. Due at least in part to uplift, the western portion of the Alluvial Plain is mapped as Latest Pleistocene and older deposits that have a very low sensitivity for buried archaeological sites. Younger, Late Holocene and Recent Holocene landforms are mapped and tend to occur adjacent to present-day and recent stream channels including possible former tributaries of Putah Creek (e.g., Dixon Ridge). If Middle Holocene landforms are present in the study area, they are most likely to be buried beneath the Alluvial Plain, particularly in the southeast portion, which is the lowest topographically. The stratigraphic relationships between landform units on the Alluvial Plain are presented in Figures 6.10 and 6.11.

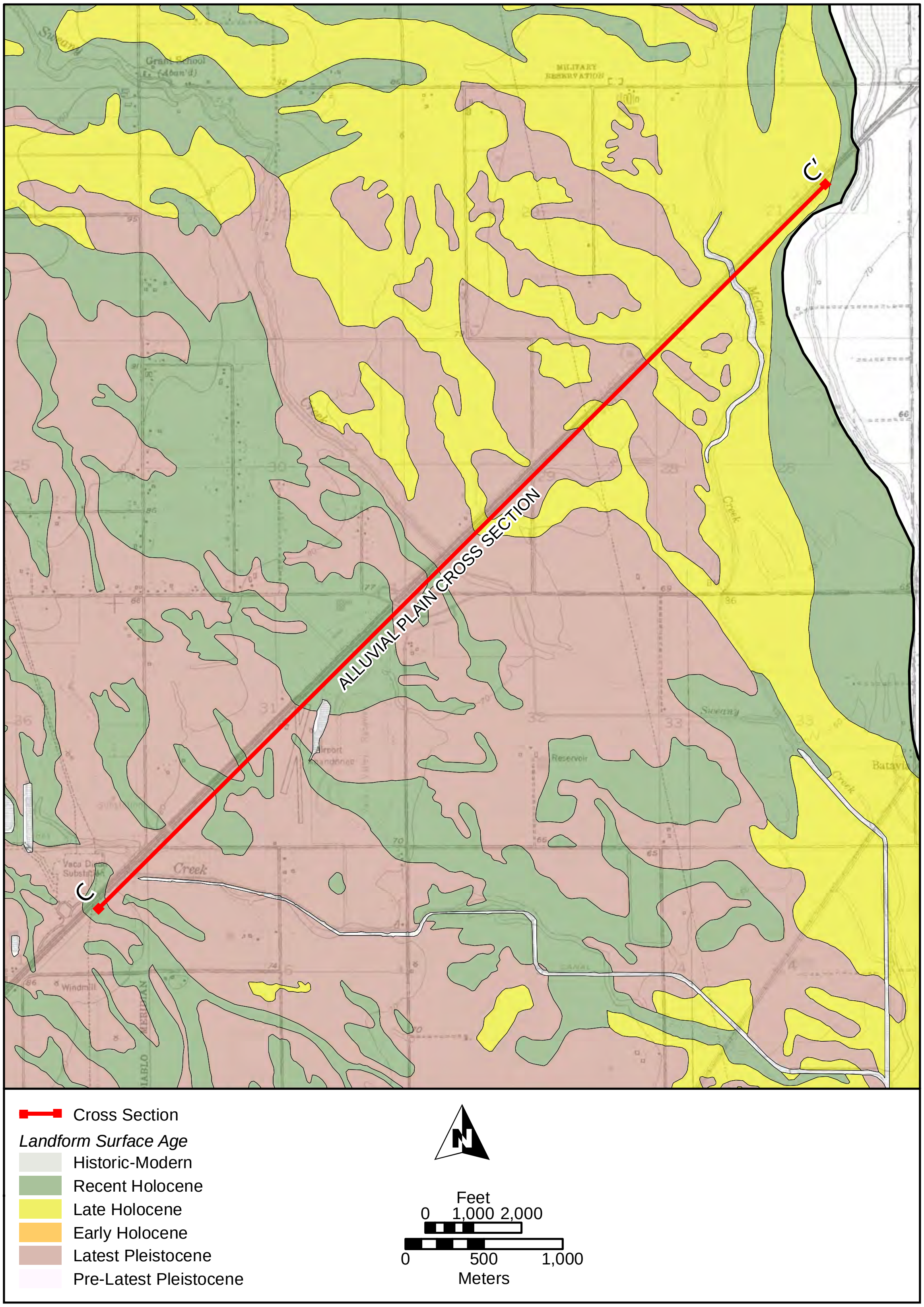


Figure 6.10. Alluvial Plain cross-section location map.

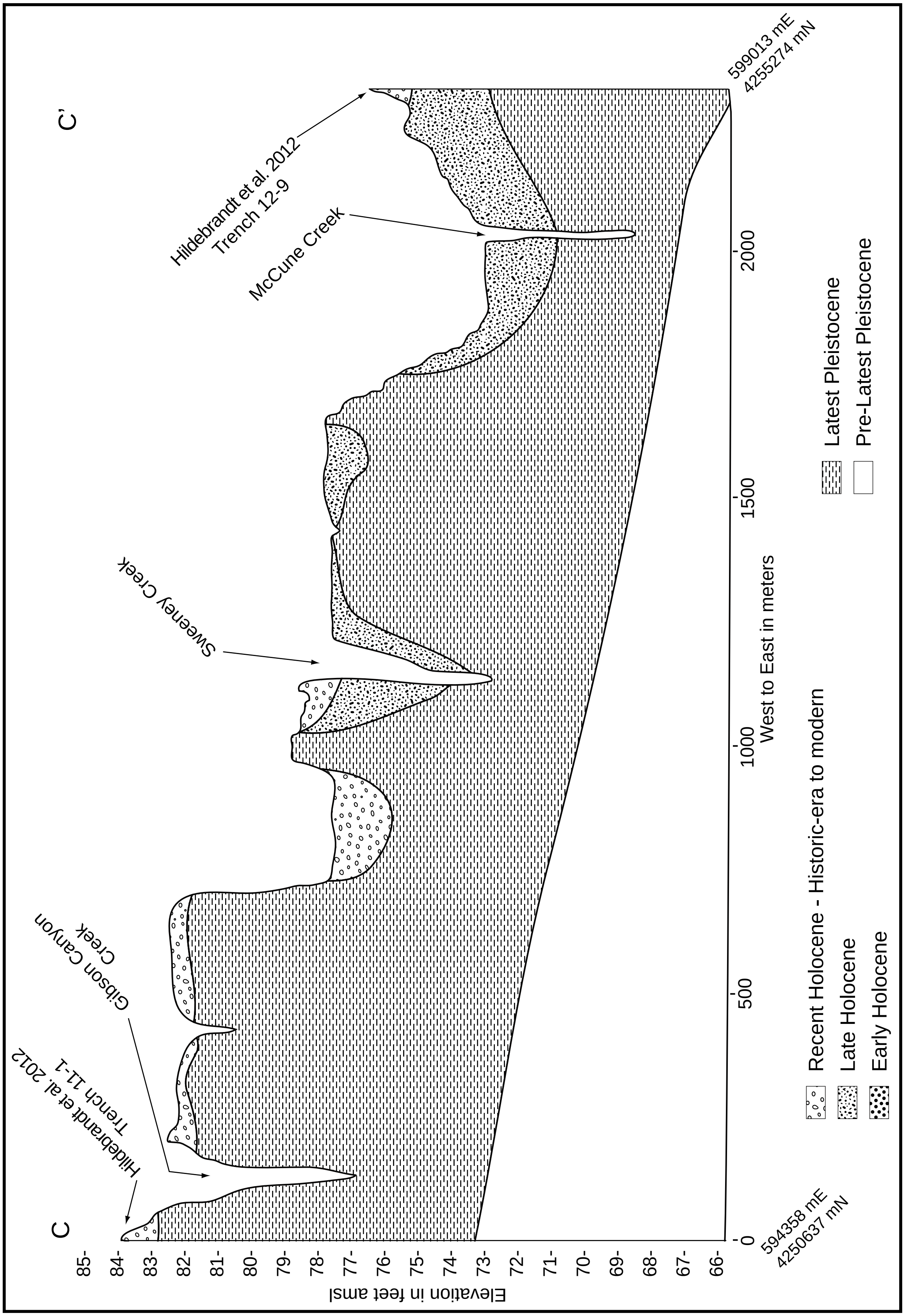


Figure 6.11. Alluvial Plain idealized stratigraphic cross-section.

CHAPTER 7: CONCLUSIONS

To better assess the potential for buried prehistoric archaeological sites, this study examined the nature, timing, and extent of Latest Pleistocene- and Holocene-age depositional landforms within the Ulatis Creek Watershed. This was accomplished through a detailed analysis of stratigraphic, radiocarbon, and obsidian hydration evidence to identify and define a soil chronosequence and produce a refined landform surface age map. The patterns of landscape change observed in the study area are similar to those described elsewhere and have implications for the completeness and visibility of the archaeological record in the Ulatis Creek Watershed and surrounding region. This research provides a geoarchaeological landscape context for the Ulatis Creek Watershed that can be used to help address these issues in future cultural resources management planning and archaeological studies of prehistoric culture history. However, future research could address gaps in the data to further improve the temporal and spatial resolution of landscape changes and the buried site sensitivity assessment.

REGIONAL COMPARISON

The landscape history of the Ulatis Creek Watershed is similar to stratigraphic sequences observed in other locations throughout central California. Studies in Solano, Santa Clara, and Contra Costa counties, as well as elsewhere in central California, suggest that the timing of major depositional events was similar throughout the region during the Latest Pleistocene and Early Holocene, but occurred with more variable timing during the Late Holocene. Major depositional episodes occurred throughout the region at 12,000 and 7,000 years ago and variably at roughly 4,000, 3,300, 2,750, 1,000 and 650 years ago (Meyer 1996; Meyer and Rosenthal 1997; Rosenthal and Meyer 2004a; Meyer and Rosenthal 2007; Hildebrandt et al. 2012).

In comparison, from the Ulatis Creek Watershed there is clear evidence for widespread deposition before 15,000 and around 12,000, between 4,000 and 2,000, and 800 years ago. It is also possible that more spatially restricted deposition occurred around 7,000 years ago or during the Middle Holocene that has not yet been identified. This study suggests that Middle Holocene landscape changes may also vary locally, possibly on the basis of elevation and/or location within a drainage system (e.g., upper or lower reach).

ARCHAEOLOGICAL AND MANAGEMENT IMPLICATIONS

This study adds to the current understanding of environmental and geomorphic conditions in the Ulatis Creek Watershed that have influenced both the nature of culture change and the preservation of the archaeological record through time. The landscape history and surface age map provided in Chapter 6 can be used to address this bias by identifying where sites from different time periods, including the Early and Middle Holocene, are likely to be found in either surface or buried contexts. It is true that fewer sites from earlier time periods have so far been identified in the study area. However, the landforms that earlier sites will be found on are generally underrepresented at the ground surface, suggesting that earlier sites may also be underrepresented in the known archaeological record.

Although less than 5 percent (11 out of 249 studies) of the archaeological studies previously conducted in the Ulatis Creek Watershed have explicitly searched for buried sites, close to 14 percent (8 out of 58) of the previously recorded prehistoric sites or just over 5 percent (9 out of 156) of all known archaeological sites, are buried. At least eight buried prehistoric sites have been identified in Vaca and Lagoon Valleys and it is highly likely that additional buried sites are present and will be exposed by earth-moving activities.

This suggests that human populations within the Ulatis Creek Watershed may have been relatively high throughout prehistory, which may well have influenced human behavior, locational decisions, and accelerated social interactions. Therefore, future archaeological research in the Ulatis Creek Watershed should evaluate the potential influence of large-scale landscape changes on prehistoric human settlement, subsistence, and demographic patterns in the area, and consider the larger implications of these changes on cultural change and the overall structure of the archaeological record.

This research can also be used by cultural resources managers for planning purposes to address the issue of archaeological visibility and possibly raise the discovery probability of sites by helping managers and archaeologists to devise and apply appropriate site identification methods in different areas of the Watershed. This will aid in the management of sites by improving chances of early identification of buried sites, and therefore allow for sites to be avoided, or for appropriate mitigation efforts to be implemented. However, the results of this study and the surface age map only provide a general starting point for the planning process because individual project areas may need to be assessed in greater detail depending on the nature of a given project and the overall extent of the sensitive landforms that may be impacted by project-related activities.

DATA GAPS AND DIRECTIONS FOR FUTURE RESEARCH

Although many of the goals of this study were achieved, gaps exist in the available data that were not addressed. Because future research may help address some of these issues and improve upon these results, the following data gaps should be noted by those who seek to use these results.

First, while certain problems inherent in the soils data used for mapping and stratigraphic inferences are acknowledged, they have not been fully addressed or resolved by this study. The digital soil survey and map data provide abundant information and offer a ready means to identify and map the age of surface landforms. However, the limitations of the scale and accuracy of these maps must be kept in mind.

From observations in the study area it appears that the soils map is most likely to be inaccurate where two landforms meet. In particular, the Yolo and Brentwood soil series, representing Recent Holocene and Late Holocene landforms respectively, were found to be inconsistently mapped, possibly due to their close physical and temporal relationship and the overall scale of mapping. For example, the Laguna Creek Site is located on a Late Holocene alluvial fan that is mapped as a floodplain with Yolo (Recent Holocene) soils, and SOL-357 is on a floodplain mapped with Brentwood (Late Holocene) soils, but is actually located on an inset terrace that appears to have Recent Holocene deposits at the surface. Future research could attempt to correct for some of these map inconsistencies, for example, on the basis of break in slope; however, this would be better accomplished at the scale of specific projects to provide more detailed assessments at the individual site level.

Second, the assessment of sensitivity for buried archaeological resources in this study is based solely on surface landform age. Future research could significantly refine the sensitivity assessment with a more detailed predictive model that uses additional environmental variables, such as proximity to a fresh water source and slope, and, potentially, human decision making variables.

Third, there is a lack of data from the Alluvial Plain. Future research can address this issue either through the addition of data from that area over time or by supplementing with data from other nearby areas. This could be accomplished through similar assessments of already available data from other nearby areas for comparison purposes.

Finally, the use of watersheds as analytical units and further detailed comparison by stream reach or stream order within the Ulatis Creek Watershed and other nearby areas may provide insight into spatial variation in response to environmental change and the record of landscape evolution (Constantine, Pasternack, and Johnson 2003:870). It is known that sediment yield and magnitude of alluvial deposition and erosion vary between upstream and downstream reaches and that differences in sediment yield across stream orders may result in different responses to environmental change across the drainage basin (Constantine, Pasternack, and Johnson 2003:870; Ritter 2006:240).

This approach was used in the Central Great Plains by Mandel (1995) who found that higher order streams are more likely to contain alluvium that spans the Holocene in comparison to lower order streams which typically only contain alluvium that is Late Holocene or younger (Rapp and Hill 2006:74). In other words, the exact timing, nature, and magnitude of landscape changes may vary across the basin by stream reach. For example, channel entrenchment and erosion in upstream reaches may have resulted in more extensive deposition in downstream reaches and/or in larger drainage basins during the Middle Holocene in the study area.

CONCLUSION

Holocene landscape changes have imposed a significant bias on the archaeological record of the Ulatis Creek Watershed. Through a better understanding of the nature, timing, and extent of these landscape changes the results of this study can be used by archaeologists and cultural resource managers to address this bias. This will help to better identify and manage sites and address questions of culture history. Additionally, similar sized watersheds in the surrounding region will likely have similar landscape evolution histories and the results of this of this study may be applicable in these areas.

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APPENDICES

APPENDIX A:

QUATERNARY GEOLOGIC DEPOSITS IN THE STUDY AREA

Map Symbol	Unit Name	Age	Location in Study Area	Source(s)
Af	Artificial fill	Historic-era to Modern	Along major roads (e.g., Interstate 80)	Knudsen et al. 2000, Witter et al. 2006
Alf	Artificial levee	Historic-era to Modern	Along canals and artificial levees	Knudsen et al. 2000
br	Bedrock	Pre-Quaternary	Uplands of the Vaca Mtns. and English Hills	Knudsen et al. 2000, Witter et al. 2006
Qa	Latest Pleistocene to Holocene alluvium, undifferentiated	Latest Pleistocene to Holocene	Generally same as Qf; located in small valleys/headwater areas of streams	Knudsen et al. 2000, Witter et al. 2006
Qf*	Latest Pleistocene to Holocene alluvial fan deposits	Latest Pleistocene 30,000 - 10,000 BP (Deposits for which age can't be determined: may be relatively undissected or thin Holocene deposits that form a veneer over Late Pleistocene deposits)	Highly spatially restricted and are located on the upper portions of alluvial fans adjacent to the Vaca Mtns.and English Hills. (Some areas mapped as Qhf by Witter et al. 2006)	Knudsen et al. 2000, Witter et al. 2006 (Qhf)
Qha	Holocene alluvium, undifferentiated	Holocene <10,000 BP	Along Laguna Creek; some along Ulatis; Dry Arroyo; very small amounts	Knudsen et al. 2000, Witter et al. 2006; Wiegers, Sowers, and Witter (2006, 2007)
Qhb	Holocene Basin deposits	Holocene <10,000 BP	Only in Lagoon Valley around the lake up to about the 200 ft. contour interval	Knudsen et al. 2000, Witter et al. 2006; Wiegers, Sowers, and Witter (2006)
Qhc	Modern stream channel deposits	<150 BP	Mapped along the stream courses at Laguna Creek, Alamo Creek, Ulatis Creek, English Creek, Sweeney Creek; in only a few places is this unit mapped where a perennial stream is not indicated on the topo map	Knudsen et al. 2000, Witter et al. 2006; Wiegers, Sowers, and Witter (2006, 2007)
Qhf*	Holocene alluvial fan deposits	Holocene <10,000 BP	Partial portion of Lagoon Valley; most of Vaca Valley valley floor; large portion of the Alluvial Plain; topographically low areas following creeks. (Additional areas mapped by Witter et al. 2006)	Knudsen et al. 2000, Witter et al. 2006; Wiegers, Sowers, and Witter (2006, 2007)

Map Symbol	Unit Name	Age	Location in Study Area	Source(s)
Qhff	Holocene alluvial fan deposits, fine facies	Holocene <10,000 BP	Mapped along the SE edge of the study area approaching Cache Slough below 50 ft. elevation	Knudsen et al. (2000)
Qhl* **(Qhly)**	Holocene alluvial fan deposits	Holocene <10,000 BP (Knudsen et al. 2000); Latest Holocene <1,000 BP (Witter et al. 2006)	Mapped primarily adjacent to presently active perennial creeks. (Mapped as Qhl by Knudsen et al. 2000 and Qhly by Witter et al. 2006)	Knudsen et al. 2000, Witter et al. 2006; Wiegers, Sowers, and Witter (2006, 2007)
Qls	Landslide deposits	Pleistocene to Holocene	Throughout the uplands including at the base of the slope where it meets the flood plain; primarily on the steeper portions of the Eastern slope of Vaca Mtns. and the English Hills	Wiegers, Sowers, and Witter 2006, 2007
Qpf*	Latest Pleistocene alluvial fan deposits	Latest Pleistocene 30,000 - 10,000 BP	At the edges of Vaca and Lagoon valleys and on portions of the Alluvial Plain to the east of the English Hills; back from recently active streams; age is indicated by greater dissection. (A small additional area is mapped by Witter et al. 2006)	Knudsen et al. 2000, Witter et al. 2006; Wiegers, Sowers, and Witter (2006, 2007)
Qtr	Travertine	Holocene <10,000 BP	Adjacent to two small stream channels at the top of Gates Canyon where Alamo Creek emerges from the Vaca Mtns.	Wiegers, Sowers, and Witter 2007

*Mapped differently between Knudsen et al. (2000) and Witter et al. (2006). Wiegers, Sowers, and Witter (2006, 2007) follow Witter et al. (2006)

APPENDIX B:

SOIL SERIES IN THE STUDY AREA

Soil Series	Geomorphic Position	Map Symbol	Soil Types	Acres by Soil Series	% of Total Acreage by Soil Series
Altamont	Oldest, highest basins, on uplifted terraces, deeply disected/eroded, shallow to bedrock	AcC	Altamont clay, 2 to 9 percent slopes	**3,651**	**3.95**
		AcE	Altamont clay, 9 to 30 percent slopes		
		AcF2	Altamont clay, 30 to 50 percent slopes eroded		
Antioch-San Ysidro	Old alluvial fans and terraces	AoA	Antioch-San Ysidro complex, 0 to 2 percent slopes	**285**	**0.31**
		AsA	Antioch-San Ysidro complex, thick surface, 0 to 2 percent slopes		
Brentwood	Alluvial floodplains and fans	BrA	Brentwood clay loam, 0 to 2 percent slopes	**7,906**	**8.55**
		BrC	Brentwood clay loam, 2 to 9 percent slopes		
Bressa-Dibble	Uplands/Mountains, shallow to bedrock	114n	Bressa-Dibble complex, 30 to 50 percent slopes	**159**	**0.17**
Capay	Basin rims, basin floors, inset channel positions	Ca	Capay silty clay loam	**17,451**	**18.86**
		Cc	Capay clay		
Clear Lake	Basin floors, swales of drainageways	CeA	Clear Lake clay, 0 to 2 percent slopes	**2,973**	**3.21**
Conejo	Alluvial fans	Co	Conejo gravelly loam	**8**	**0.01**
Corning	Oldest, highest terraces, deeply dissected/eroded	CvD2	Corning gravelly loam, 2 to 15 percent slopes, eroded	**7,188**	**7.77**
		CvE2	Corning gravelly loam, 15 to 30 percent slopes, eroded		

Soil Series	Geomorphic Position	Map Symbol	Soil Types	Acres by Soil Series	% of Total Acreage by Soil Series
Diablo-Ayar	Uplands and older terraces	DaE2	Diablo-Ayar clays, 9 to 30 percent slopes, eroded	**70**	**0.08**
Dibble-Los Osos	Uplands/Mountains, shallow to bedrock, eroded	DbC	Dibble-Los Osos loams, 2 to 9 percent slopes	**8,401**	**9.08**
		DbE	Dibble-Los Osos loams, 9 to 30 percent slopes		
		DbF2	Dibble-Los Osos loams, 30 to 50 percent slopes, eroded		
		DlE	Dibble-Los Osos clay loams, 9 to 30 percent slopes		
		DlF2	Dibble-Los Osos clay loams, 30 to 50 percent slopes, eroded		
Gaviota	Uplands/Mountain ridges, shallow to bedrock, eroded	GaG2	Gaviota sandy loam, 30 to 75 percent slopes, eroded	**214**	**0.23**
Maymen-Los Gatos	Uplands/Mountains, shallow to bedrock, eroded	MeG3	Maymen-Los Gatos loams, 15 to 75 percent slopes, severely eroded	**4,090**	**4.42**
Millsholm	Uplands/Mountains, shallow to bedrock/eroded	MmE	Millsholm loam, 15 to 30 percent slopes	**6,085**	**6.58**
		MmG2	Millsholm loam, 30 to 75 percent slopes, eroded		
		MnC	Millsholm loam, moderately deep variant, 2 to 9 percent slopes		
		MnE	Millsholm loam, moderately deep variant, 9 to 30 percent slopes		
Pescadero	Basin floors, on dissected valley plains	Pc	Pescadero clay loam	**1,167**	**1.26**
		Pe	Pescadero clay		

Soil Series	Geomorphic Position	Map Symbol	Soil Types	Acres by Soil Series	% of Total Acreage by Soil Series
Reiff	Alluvial fans and floodplains	Ra	Reiff fine sandy loam	**200**	**0.22**
Rincon	Older alluvial fans, proximal and mid-slope	RnC	Rincon loam, 2 to 9 percent slopes	**2,948**	**3.19**
		RoA	Rincon clay loam, 0 to 2 percent slope		
		RoC	Rincon clay loam, 2 to 9 percent slopes		
Riverwash	Channels, erosional	Rw	N/A	**213**	**0.23**
San Ysidro	Old terraces, dissected	SeA	San Ysidro sandy loam, 0 to 2 percent slopes	**15,958**	**17.25**
		SeB	San Ysidro sandy loam, 2 to 5 percent slopes		
		SfA	San Ysidro sandy loam, thick surface , 0 to 2 percent slopes		
Solano	Basin rims, on dissected valley plains	Sh	Solano loam	**1,081**	**1.17**
Solano-Pescadero	Basin rims and floors, on dissected valley plains	Sk	Solano-Pescadero complex	**536**	**0.58**
Sycamore	Alluvial fans and floodplains	Sr	Sycamore silty clay loam	**243**	**0.26**
Trimmer	Uplands/Mountains, eroded	TrE	Trimmer loam, 9 to 30 percent slopes	**655**	**0.71**
		TsF2	Trimmer cobbly clay loam, shallow variant , 15 to 50 percent slopes , eroded		

Soil Series	Geomorphic Position	Map Symbol	Soil Types	Acres by Soil Series	% of Total Acreage by Soil Series
Yolo	Levies, floodplains, fans	Yo	Yolo loam	**10,553**	**11.41**
		Yr	Yolo loam, clay substratum		
		Ys	Yolo silty clay loam		
N/A	Ponds and other water features	W	N/A	**464**	**0.50**
N/A	Borrow pits	BP	N/A	**14**	**0.02**

APPENDIX C:

PREHISTORIC SITES IN THE STUDY AREA

Primary Number	Trinomial (Name)	Prehistoric, Historic or Multi-Component	Surface or Buried Site	7.5 Minute Quad	Mapped Soil Series	Mapped Soil Type	Dated?	Basis for age determination	Description
P-48-000038	SOL-30/H (Pena Adobe)	Multi-Component	Surface	Fairfield North	Brentwood & Clear Lake	BrA, CeA	Yes	Radiocarbon & Hydration	midden containing lithics, stone beads, charmstones, shell beads and ornaments, as well as historic artifacts such as glass beads, nails, and pottery
P-48-000043	SOL-35	Prehistoric	Surface	Elmira	Yolo	Yo	No		isolated burial
P-48-000045	SOL-37	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DbF2	No		bedrock mortars
P-48-000047	SOL-39	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DbF2	No		bedrock mortars
P-48-000048	SOL-40	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DbF2	No		bedrock mortars
P-48-000049	SOL-41	Prehistoric	Surface	Fairfield North	Dibble-Los Osos, Brentwood, Rincon	DbE, BrC, RoC	No		bedrock mortars, possible burial
P-48-000050	SOL-42	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DbF2	No		bedrock mortars
P-48-000051	SOL-43	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DbC	No		lithic scatter and ground stone, possible habitation midden
P-48-000052	SOL-44	Prehistoric	Surface	Elmira	Dibble-Los Osos	DbF2	No		bedrock mortars
P-48-000055	SOL-47	Prehistoric	Surface	Fairfield North	Brentwood	BrA	No		possible midden with numerous lithics
P-48-000056	SOL-48	Prehistoric	Surface	Fairfield North	Millsholm	MmG2	No		midden with bedrock mortars
P-48-000057	SOL-49	Prehistoric	Surface	Fairfield North	Dibble-Los Osos, Millsholm	DbF2, MmG2	No		midden

Primary Number	Trinomial (Name)	Prehistoric, Historic or Multi-Component	Surface or Buried Site	7.5 Minute Quad	Mapped Soil Series	Mapped Soil Type	Dated?	Basis for age determination	Description
P-48-000058	SOL-50	Prehistoric	Surface	Fairfield North	Millsholm	MmG2	No		cupules
P-48-000098	SOL-256	Prehistoric	Surface	Mt. Vaca	Dibble-Los Osos	DbE	No		midden, possible burial
P-48-000107	SOL-266	Prehistoric	Surface	Mt. Vaca	Dibble-Los Osos, Brentwood	BrA, DbC	No		midden with lithics
P-48-000108	SOL-267	Prehistoric	Surface	Mt. Vaca	Brentwood, Yolo	BrA, Yo	No		obsidian surface scatter
P-48-000111	SOL-270/H (The Cook Site)	Multi-Component	Buried	Fairfield North	Brentwood, Yolo	Yo, BrA	Yes	Radiocarbon & Hydration	midden including faunal remains, lithics, charmstones, and ground stone
P-48-000118	SOL-277/H	Multi-Component	Surface	Fairfield North	Dibble-Los Osos	DIE	No		bedrock milling stations and historic-era artifacts
P-48-000122	SOL-281	Prehistoric	Surface	Mt. Vaca	Dibble-Los Osos	DbE	No		bedrock mortars and midden
P-48-000153	SOL-318	Prehistoric	Surface	Elmira	Brentwood	BrA	No		prehistoric burials
P-48-000154	SOL-320/H (Town Hall Midden)	Multi-Component	Surface	Elmira	Brentwood	BrA	Yes	Radiocarbon & Hydration	midden with burials and other features as well as charmstones, FAR, faunal and food remains, obsidian, and historic-era artifacts
P-48-000157	SOL-324	Prehistoric	Buried	Fairfield North	Yolo	Yo	Yes	Radiocarbon & Hydration	habitation site with burials
P-48-000159	SOL-326/H	Multi-Component	Surface	Fairfield North	Dibble-Los Osos	DbF2	No		bedrock mortars and historic-era artifacts
P-48-000160	SOL-327/H	Multi-Component	Surface	Fairfield North	Dibble-Los Osos	DbF2	No		historic ranch and prehistoric artifacts

Primary Number	Trinomial (Name)	Prehistoric, Historic or Multi-Component	Surface or Buried Site	7.5 Minute Quad	Mapped Soil Series	Mapped Soil Type	Dated?	Basis for age determination	Description
P-48-000161	SOL-328	Prehistoric	Surface	Fairfield North	Millsholm	MmG2	No		bedrock mortars, some debitage
P-48-000162	SOL-329	Prehistoric	Surface	Fairfield North	Millsholm	MmG2	No		midden with one bedrock mortar and debitage
P-48-000163	SOL-330	Prehistoric	Surface	Fairfield North	Millsholm	MmG2	No		milling station
P-48-000164	SOL-331/H	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DIE	No		lithics and historic-era artifacts
P-48-000165	SOL-332	Prehistoric	Surface	Fairfield North	Brentwood	BrA	No		milling station and lithics
P-48-000166	SOL-333	Prehistoric	Surface	Fairfield North	Millsholm	MmG2	No		milling station
P-48-000167	SOL-334	Prehistoric	Surface	Allendale	Rincon	RoA	Yes	Hydration	midden including lithics and ground stone
P-48-000170	SOL-337	Prehistoric	Surface	Fairfield North	Millsholm	MmG2	No		bedrock mortar
P-48-000171	SOL-338	Prehistoric	Surface	Fairfield North	Millsholm	MmG2	No		bedrock mortar
P-48-000405	SOL-351	Prehistoric	Surface	Winters	Yolo	Yo	No		artifact scatter
P-48-000406	SOL-357 (Burton Estates)	Prehistoric	Buried	Elmira	Brentwood	BrA	Yes	Radiocarbon & Hydration	midden including burials, FAR, charcoal, faunal remains, lithics, baked clay
P-48-000419	None assigned (Isolate)	Prehistoric	Surface	Elmira	Yolo	Yo	No		isolated obsidian artifact
P-48-000421	None assigned	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DIF2	No		bedrock mortar

Primary Number	Trinomial (Name)	Prehistoric, Historic or Multi-Component	Surface or Buried Site	7.5 Minute Quad	Mapped Soil Series	Mapped Soil Type	Dated?	Basis for age determination	Description
P-48-000424	SOL-402	Prehistoric	Surface	Mt. Vaca	Millsholm, Brentwood, Rincon	RoA, MmE, BrA	No		midden with FAR and debitage.
P-48-000425	SOL-403	Prehistoric	Surface	Mt. Vaca	Rincon	RoC	No		midden including debitage and FAR
P-48-000507	SOL-412	Prehistoric	Surface	Elmira	Yolo	Yo	No		midden
P-48-000567	SOL-425/H (Shaw Burial Site)	Multi-Component	Surface	Elmira	Brentwood	BrA	Yes	Radiocarbon & Hydration	burial ground that may be associated with the ethnographic village of Ululato including a hearth feature, beads, shell, lithics, ground stone, faunal remains, ochre, baked clay, and charcoal as well as Historic-era artifacts including brick, concrete, and other debris that may represent structural remains
P-48-000573	None assigned	Prehistoric	Surface	Allendale	Rincon, Dibble-Los Osos	RoC, DbF2	No		midden with lithics
P-48-000707	SOL-436	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DIE, DIF2	No		bedrock mortar
P-48-000726	SOL-443	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DIF2	No		bedrock mortar
P-48-000727	SOL-444	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DIE	No		bedrock mortar
P-48-000728	SOL-445	Prehistoric	Surface	Fairfield North	Dibble-Los Osos	DIF2	No		bedrock mortars
P-48-000766	SOL-451 (Encinosa Site)	Prehistoric	Surface	Fairfield North	Brentwood	BrA	Yes	Hydration	burials and associated artifacts
P-48-000790	None assigned	Prehistoric	Surface	Fairfield North	San Ysidro	SeB	No		isolated chert biface margin

Primary Number	Trinomial (Name)	Prehistoric, Historic or Multi-Component	Surface or Buried Site	7.5 Minute Quad	Mapped Soil Series	Mapped Soil Type	Dated?	Basis for age determination	Description
P-48-000813	None assigned	Prehistoric	Surface	Fairfield North	Brentwood	BrA or RoA	No		isolated obsidian artifact
P-48-000816	SOL-466 (Ulatis Site)	Prehistoric	Buried	Elmira	Brentwood	BrA	No		includes burials, debitage, faunal remains and FCR
P-48-000856	SOL-467	Prehistoric	Surface	Allendale & Dixon	Yolo, Clear Lake, Capay, San Ysidro	Yo, CeA, Ca, SeA	No		disturbed surface scatter of chert and obsidian debitage
P-48-000860	SOL-468	Prehistoric	Buried	Fairfield North	Yolo	Yo	Yes	Radiocarbon & Hydration	midden including debitage, handstones, FAR, bifaces, cores, faunal remains
P-48-000861	SOL-469	Prehistoric	Buried	Fairfield North	Brentwood, Yolo	Yo & BrA	No		FAR and one obsidian flake
P-48-000863	None assigned (Ulatis DB#1)	Prehistoric	Buried	Mt. Vaca	Yolo	Yo	No		FAR and one chert flake
P-48-000867	SOL-471 (Mallow Creek Site)	Prehistoric	Surface	Fairfield North	San Ysidro, Capay	Ca, SeB	Yes	Hydration	prehistoric site with lithics
None assigned	None assigned (Laguna Creek Site)	Prehistoric	Buried	Fairfield North	Yolo	Yo	Yes	Radiocarbon & Hydration	includes FCR, debitage, flaked stone tools, modified stone, and a handstone
None assigned	None assigned (3 Isolates)	Prehistoric	Surface	Allendale	Rincon, Corning	RoA, CvD2	No		three obsidian isolates
None assigned	None assigned (C-1302)	Prehistoric	Surface	Dozier	Capay or San Ysidro	Ca, SeB	No		midden including debitage, a scraper, charcoal, faunal remains, baked clay, fresh water clam shells and land snails

APPENDIX D:

STRATIGRAPHIC DATA

Locations of Stratigraphic Data Analyzed

Loc. No.	Location	Strati-graphic Profiles	Type	Mapped Sfc. Soil	Inferred Sfc. Landform	Inferred Buried Sfc. 1	Inferred Buried Sfc. 2	Citation
1	Laguna Site	4	SOL I-80 area 8 trenches and creek exposure	Yolo	Late Holocene	Early Holocene	N/A	Hildebrandt et al. 2012, Scher 2012
2	SOL I-80 area 9 (negative)	2	trenching	Yolo	Recent Holocene	Late Holocene	N/A	Hildebrandt et al. 2012
3	SOL I-80 area 10 (negative)	6	trenching	Brentwood	Recent Holocene	Late Holocene	Early Holocene	Hildebrandt et al. 2012
4	SOL I-80 area 11 (negative)	2	trenching	Yolo, San Ysidro	Recent Holocene	Latest Pleistocene	Pre-Latest Pleistocene	Hildebrandt et al. 2012
5	SOL I-80 area 12 (negative)	9	trenching	Yolo, Capay	Recent Holocene	Late Holocene	Early Holocene	Hildebrandt et al. 2012
6	SOL-468/SOL-469	28	trenching	Yolo	Late Holocene	Early Holocene	Latest Pleistocene	Whitaker and Kaijankoski 2009
7	SOL-324 (Jones & Stokes excavation and creek exposure)	2	Jones & Stokes excavation and creek exposure	Yolo	Recent Holocene	Late Holocene	N/A	Jones & Stokes 2001, Scher 2012
8	SOL-357	1	Creek exposure	Brentwood	Recent Holocene	Late Holocene	N/A	Scher 2012
9	SOL-466	1	trenching	Brentwood	Historic-era to modern	Recent Holocene	Late Holocene	Meyer 2008
10	SOL-334	1	excavation	Rincon	Early Holocene	N/A	N/A	Wohlgemuth, Ruby, and Kaijankoski 2010
11	P-863	23	trenching	Yolo, Brentwood	Recent Holocene	Late Holocene	Early Holocene?	Kaijankoski and Meyer 2009
12	Vaca Hospital (negative)	4	trenching	Yolo	Recent Holocene	Late Holocene	N/A	Kiajankoski and Scher 2011

Loc. No.	Location	Strati-graphic Profiles	Type	Mapped Sfc. Soil	Inferred Sfc. Landform	Inferred Buried Sfc. 1	Inferred Buried Sfc. 2	Citation
13	SOL-451	13	trenching	Brentwood	Late Holocene	Early Holocene	N/A	Meyer and Morgan 2007
14	SOL-320/H	2	excavation	Millsholm, Brentwood	Late Holocene	N/A	N/A	Rosenthal, Carpenter, and Whitaker 2009
15	SOL-425/H	1	excavation	Brentwood	Late Holocene	N/A	N/A	Rosenthal, Carpenter, and Whitaker 2009
16	SOL-270	3	excavation	Yolo, Brentwood	Recent Holocene	Late Holocene	N/A	McGonagle 1964
17	SOL-30/H	10	SOL I-80 excavation and area 8 trenches	Brentwood	Recent Holocene	Late Holocene	N/A	Hildebrandt et al. 2012
18	Lagoon Valley (negative)	22	trenching	Recent Holocene, Late Holocene, Early Holocene, Latest Pleistocene	Historic-era to modern, Recent Holocene, Early Holocene, Latest Pleistocene	Recent Holocene, Late Holocene, Early Holocene, Latest Pleistocene	Early Holocene, Latest Pleistocene	Meyer, Scher, and Kaijankoski 2012
19	Upper Laguna Creek (negative)	1	Creek exposure	Yolo	Recent Holocene	Late Holocene	N/A	Scher 2012
20	San Ysidro exposures (negative)	2	creek exposures	San Ysidro	Recent Holocene	Latest Pleistocene	N/A	Scher 2012

Stratigraphic Descriptions From Present Study

No.	Location	Min. Depth (cm)	Max. Depth (cm)	Stratum	Soil Horizon	Color Type-Munsell Designation	Color Name (Munsell or General)	Structure Grade	Structure Size	Structure Type	Gravel %	Gravel Size	Gravel Shape
1	Lagoon Valley, Laguna Creek, near CA-SOL-324	0	20	III	AC	10 YR 5/2	Grayish brown			m	25-75	S-L	SR-WR
1	Lagoon Valley, Laguna Creek, near CA-SOL-324	20	60	II	2A1	10YR 4/3	Brown	1	f to m	gr and sbk	<10	S	R
1	Lagoon Valley, Laguna Creek, near CA-SOL-324	60	120	II	2A2	10YR 5/6 and 10YR 4/3	Yellowish brown to brown	1	f to m	gr	<10	S	R
1	Lagoon Valley, Laguna Creek, near CA-SOL-324	120	160	I	3Ab	2.5Y 5/2 and 10YR 5/6	Grayish brown with yellowish brown mottles	1	f to c	sbk	0-<10	S	R
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	0	30	IV	AC	2.5Y 5/3	Light olive brown	m to 1	m	gr	>10	S	SR-R
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	30	100	III	2Ab	10YR 3/1	Very dark gray	1	f to m	sbk	<10	S	SR-R
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	100	180	III	2C	10YR 3/2	Very dark grayish brown	m			<10	S	SR-R
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	180	250	II	3Ab	10YR 3/2 and 10YR 4/3	color?	1 to 2	f	sbk	<10		
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	250	280	I	4Btkb	10YR 3/3	color?	3	m	abk	<10		
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	280	350	I	4Btb	10YR 3/4	Dark yellowish brown	3	m to c	abk	<10		
3	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	0	80	V	AC1	10YR 5/4	Yellowish brown	m to 1	m	sbk	<10	S	SR-WR
3	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	80	90	IV	2C	10YR 5/4	Yellowish brown	1	m	sbk	>10-25	S-L	SR-WR
3	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	90	100	III	3AC	10YR 5/4	Yellowish brown	m to 1	m	sbk	<10	S	SR-WR
3	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	100	130	II	4AC	10YR 5/2	Grayish brown	1	m	sbk and gr	0-<10	S	SR-WR
3	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	130	160	I	5Ab	10YR 3/1	Very dark gray	1 to 2	m	sbk	<10	S	R-WR

No.	Location	Consistence Moist	Consistence Dry	Texture 1	Clay Film Amount	Clay Film Visibility	Clay Film Location	Contact Transition	Contact Shape	Additional Comments
1	Lagoon Valley, Laguna Creek, near CA-SOL-324	fr		SiL				a	w	some root holes, small-large cobbles, mostly sandstone, glass (modern and historic), uneven boundary
1	Lagoon Valley, Laguna Creek, near CA-SOL-324	fr		SiCL				d	s	
1	Lagoon Valley, Laguna Creek, near CA-SOL-324	fr		SiCL-SiL				g	s	increased mottling otherwise the same as above
1	Lagoon Valley, Laguna Creek, near CA-SOL-324	fr		SiCL				BOE	BOE	mottling, groundstone, obsidian flakes, odd toolstone biface, what else?
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	fr		SiL				a	w	modern cap
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site		sh	SiCL				g	s	historic surface
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	fr		SiL				g	s	
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	fi		SiCL				g	s	caco3, discontinuous clay films
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	fi		SiCL-CL	1-2	d	pf, cobr	d	s	
2	Lagoon Valley, Laguna Creek, near Laguna Creek Site	fr		SiCL-CL	2	d	pf, co	BOE	BOE	
3	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	fr		SiL-SiCL				c	w	
3	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	fr		SL				c	w	coarser with channel gravels
3	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	fr		SiL-SiCL				c	w	same as AC above
3	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	fr		SiCL				c	w	
3	Lagoon Valley, Laguna Creek, upstream of CA-SOL-270	fr to fi		SiCL-CL				BOE	BOE	

No.	Location	Min. Depth (cm)	Max. Depth (cm)	Stratum	Soil Horizon	Color Type-Munsell Designation	Color Name (Munsell or General)	Structure Grade	Structure Size	Structure Type	Gravel %	Gravel Size	Gravel Shape
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	0	100	VII	AC		brown	1	f	gr	<10	s	
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	100	130	VI	2Ab		dark yellowish brown	1	f to m	sbk	<10		
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	130	270	VI	2AC		yellowish brown	1	f	sbk	<10		
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	270	360	V	3AC		grayish brown	1	f	sbk	<10		
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	360	460	IV	4Ab1		Very dark grayish brown	1	f to m	sbk	<10		
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	460	520	IV	4Ab2		Black	2	m	sbk	<10		
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	520	550	III	4C		dark yellowish brown	m to sg			<10		
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	550	580	II	5C		brown				50-75	S-M	SR-WR
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	580	600	I	6R		gray						
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	0	20	V	AC	10YR 4/3	Brown	m to 1	f	gr	<10	S	SA-SR
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	20	35	IV	2Ab	10YR 4/2	Dark grayish brown	1	vf	sbk	<10	S	SA-R
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	35	60	IV	2Btb	10YR 4/2	Dark grayish brown	2	m to c	abk	<10	S	SA-R
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	60	80	III	3ABtb	2.5Y 5/4	Light olive brown	2	c	sbk	<10		
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	80	110	III	3Btkb	2.5Y 5/4	Light olive brown	2	m	sbk	<10		
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	110	170	II	4Btb	2.5Y 5/4	Light olive brown	2	f	abk	<10	M	R
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	170	200	I	5Btb	2.5Y 4/2	Dark grayish brown	2	m	sbk	<10	S to M	R

No.	Location	Consistence Moist	Consistence Dry	Texture 1	Clay Film Amount	Clay Film Visibility	Clay Film Location	Contact Transition	Contact Shape	Additional Comments
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	fr		SiL				c	s	historic-era to modern cap
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	fr		SiL				g	s	Yolo?
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	vfr		SiL				c	s	
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	fr						a	w	cumulic, mottled, some oxidation
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	fr		SiCL				g	s	artifacts reworked midden?
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	fr		SiCL				a	s	midden. SOL-357
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	vfr		SL-S				a	s	
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357	lo		S				a	w	
4	Vaca Valley, Ulatis Creek, location of CA-SOL-357			C				BOE	BOE	decomposing shale bedrock
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	fr		SCL				a	w	historic-era/modern cap
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)		vh	CL				c	s	historic-era sfc?
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)		vh	CL	2	f	pf, cobr	a	w	small-medium caco3 nodules at base
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	fr		SL-SCL	1	f	cobr	g	s	iron manganese, fine abandoned root holes
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	fr		SL-SCL	3	d	pf, cobr	a	w	caco3 filaments on/in pores and iron manganese, almost continuous CF
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	fi		SL	1	d	cobr	c	w	iron manganese
5	Alluvial Plain, Gibson Canyon Creek (exposure 1)	fr		SCL-CL	3	p	pf, cobr	BOE	BOE	iron manganese

No.	Location	Min. Depth (cm)	Max. Depth (cm)	Stratum	Soil Horizon	Color Type-Munsell Designation	Color Name (Munsell or General)	Structure Grade	Structure Size	Structure Type	Gravel %	Gravel Size	Gravel Shape
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	0	25	III	AC	10YR 5/3	Brown	m to 1	f	sbk	0		
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	25	60	II	2Btw	10YR 4/2	Dark grayish brown	2	m	sbk	<10	S	SR-R
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	60	90	II	2Btkb	2.5Y 5/3	Light olive brown	3	m to c	sbk	<10		
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	90	135	I	3Btb	10YR 5/4	Yellowish brown	3	m to vc	abk	0		
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	135	180	I	3BCb	10YR 5/4	Yellowish brown	2	m to vc	sbk	0		

No.	Location	Consistence Moist	Consistence Dry	Texture 1	Clay Film Amount	Clay Film Visibility	Clay Film Location	Contact Transition	Contact Shape	Additional Comments
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	vfi		SiCL				a	w	faint oxidation
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	fi		CL	1-2	f	cobr	a	s	
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	vfi		SCL	2	d	cobr	a	i	small to large caco3 nodules
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	fi		SCL	3	p	pf, po, cobr	g	s	nearly continuous CF that increase with depth
6	Alluvial Plain, Gibson Canyon Creek (exposure 2)	fi		SCL	2	f	cobr	BOE	BOE	

APPENDIX E:

SOIL PROFILE AND DESCRIPTION NOMENCLATURE

SOIL PROFILE AND DESCRIPTION NOMENCLATURE

Adapted mainly from: Birkeland, Machette, and Haller 1991, NRCS 2002 Soil Science Society of America 2008, and Soil Survey Staff 1993. The latter three can be found online. For further details on soil profile and description nomenclature see these sources, among others.

SOIL PROFILE NOMENCLATURE

Three kinds of symbols are used in combination to designate horizons and layers—capital letters, lower case letters, and Arabic numbers. Capital letters are used to designate master horizons and layers, lower case letters are used as suffixes to indicate specific characteristics of the master horizon and layer, and Arabic numerals are used both as suffixes to indicate vertical subdivisions within a horizon or layer and as prefixes to indicate discontinuities. Genetic horizons are not the equivalent of the diagnostic horizons of the U.S. soil taxonomy.

Stratum

A distinct deposit or unrelated layer identified on the basis of physical composition, superposition, relative soil development, and/or textural transitions (i.e., upward-fining sequences) characteristic of discrete depositional cycles. Strata are assigned a Roman numeral beginning with the oldest or lowermost stratum (e.g., I - bedrock) and ending with the youngest or uppermost stratum (e.g., IV – modern soil).

Soil Horizon

A layer of soil, approximately parallel to the surface, which has distinct characteristics produced by soil-forming processes.

Commonly Used Master Horizon Designations

O horizon— Layers dominated by organic material.

A horizon— Mineral horizons that formed at the surface or below an O horizon that exhibit obliteration of all or much of the original rock structure and are characterized by an accumulation of humified organic matter intimately mixed with the mineral fraction and not dominated by properties characteristic of E or B horizons (i); or have properties resulting from cultivation, pasturing, or similar kinds of disturbance (ii).

E horizon— Mineral horizons in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these, that leaves a concentration of sand and silt particles of quartz or other resistant materials. Generally located stratigraphically beneath the A horizon and above the B horizon.

B horizon— Horizons that formed below an A, E, or O horizon and are dominated by obliteration of all or much of the original rock structure and show one or more of the following: (1) illuvial accumulation of silicate clay, iron, aluminum, humus, carbonates, gypsum, or silica, alone or in combination; (2) evidence of removal of carbonates; (3) residual concentration of sesquioxides (any oxide with three oxygen atoms for every two metal atoms); (4) coatings of sesquioxides that make the horizon conspicuously lower in value, higher in chroma, or redder in hue than overlying and underlying horizons without apparent illuviation of iron; (5) alteration that forms silicate clay or liberates oxides or both and that forms granular, blocky, or prismatic structure.

C horizon— Horizons or layers, excluding hard bedrock, that are little affected by pedogenic processes and lack properties of O, A, E, or B horizons. The material of C horizons may be either like or unlike that from which the solum (set of related soil horizons) presumably formed. The C horizon may have been modified even if there is no evidence of pedogenesis.

R layer— Hard bedrock including granite, basalt, quartzite and indurated limestone or sandstone that is sufficiently coherent to make hand digging impractical.

Commonly Used Subordinate Distinctions Within Master Horizons

b – Identifiable buried genetic horizons in a mineral soil. Not used with C horizons.

g – Strong gleying in which iron has been reduced and removed during soil formation or in which iron has been preserved in a reduced state because of saturation with stagnant water.

k – Accumulation of pedogenic carbonates, commonly calcium carbonate.

p – Plowing or other artificial disturbance of the surface layer.

q – Accumulation of secondary silica.

r – Weathered or soft bedrock including saprolite; partly consolidated soft sandstone, siltstone or shale; or dense till that roots penetrate only along joint planes and are sufficiently incoherent to permit hand digging with a spade.

ss – Presence of slickensides (i.e., pressure faces created by shrinking and swelling of clay-rich soils).

t – Accumulation of silicate clay that either has formed in the horizon and is subsequently translocated or has been moved into it by illuviation (i.e., argillic horizon).

w – Development of color or structure in a horizon but with little or no apparent illuvial accumulation of materials.

PRIMARY SOIL PROPERTIES DESCRIBED

Horizon Depth

Records depths for both the upper and lower boundary of each horizon. Units used are specified and measurements generally begin from ground surface.

Color

Scientific description of color is determined using a Munsell Soil Color Chart. Both the Munsell notation and color name are given e.g., 10YR 3/4 Dark yellowish brown.

Structure

Structure is the naturally occurring arrangement of soil particles into aggregates that results from pedogenic processes, which is described on the basis of grade, size, and type. Type indicates the shape of the aggregates, grade indicates the strength of the expression of the type, and size indicates the size of the aggregates. Structureless soils are either single-grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage). Abbreviations include:

Grade	Size in mm (varies by type)	Type
1 – weak. Units are barely observable in place or in a hand sample.	vf—very fine (<1 to < 10 mm)	gr— granular. Spheroidal shaped aggregates with faces that do not conform to adjoining ped faces.
2 – moderate. Units well-formed and evident in place or in a hand sample.	f—fine (1 to 20 mm)	sbk– sub-angular blocky. Approximately equidimensional blocks with planar faces that conform to adjoining ped faces, with rounded face intersections.
3 – strong. Units are distinct in place (undisturbed soil), and separate cleanly when disturbed.	m—medium (2 to 50 mm)	abk– angular blocky. Approximately equidimensional blocks with planar faces that conform to adjoining ped faces, with sharp face intersections.
m – massive, structureless.	c—coarse (5 to 100 mm)	pr— prismatic. Particles are arranged about a vertical line, and ped is bounded by planar, vertical faces that conform to adjoining faces; with flat top.
sg–single-grain, structureless.	vc—very coarse (>10 to >100 mm)	cpr— columnar. Particles are arranged about a vertical line, and ped is bounded by planar, vertical faces that conform to adjoining faces; with rounded top.
		pl— platy. Particles arranged around a horizontal plane.

Gravel Content

Gravel content is described primarily by amount in percentage, size, and roundness as follows:

Percentage	Size	Roundness
0	S – Small	A – Angular
<10	M – Medium	SA – Subangular
>10	L – Large	SR – Subrounded
25		R – Rounded
50		WR – Well rounded
75		

Consistence

This is a measure of the adherence of the soil particles to the fingers, the cohesion of soil particles to one another, and the resistance of the soil mass to deformation. Because this property varies with moisture content, different classifications are given for soils that are dry, moist, or wet. Terms commonly used to describe consistence are:

Dry Consistence	Moist Consistence
lo – loose. Noncoherent; does not hold together in a mass	lo – loose. Noncoherent; does not hold together in a mass.
so – soft. Weakly coherent; easily crushes to powder or single grain under gentle pressure between thumb and forefinger.	vfr – very friable. Weakly coherent; easily crushed under gentle pressure and can be pressed into a lump.
sh – slightly hard. Easily broken between thumb and forefinger.	fr – friable. Crushes easily under gentle to moderate pressure between thumb and forefinger but resistance is no distinct.
h – hard. Can be broken in the hands without difficulty, but difficult to break between thumb and forefinger.	fi – firm. Crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
vh – very hard. Can be broken in the hands with difficulty.	vfi – very firm. Crushes under strong pressure; barely crushes between thumb and forefinger.
eh – extra hard. Cannot be broken in hands.	efi – extremely firm. Crushes under very strong pressure; cannot be crushed between thumb and forefinger.

Texture

Particle size classification of a soil, generally given in terms of the USDA system which uses the term "loam" for a soil having equal properties of sand, silt, and clay. The basic textural classes and the abbreviations used to describe them include:

C—clay
CL—clay loam
L—loam
LS—loamy sand
S—sand
SC—sandy clay
SCL—sandy clay loam
SL—sandy loam
Si—silt
SiC—silty clay
SiCL—silty clay loam
SiL—silt loam

Clay Film

A coating of oriented clay on the surface of a sand grain, pebble, soil aggregate, or ped. Primary characteristics described are: amount, visibility, and location. Abbreviations for description include:

Amount	Visibility	Location
0—very few (<5%)	f—faint. Visible only with 10X magnification. Little contrast with the adjacent material in color, texture, and other properties.	pf—clay films occur on ped faces.
1—few (5-25%)	d—distinct. Visible without magnification, although magnification or tests may be needed for positive identification. The feature contrasts enough with the adjacent material that a difference in color, texture, or other properties is evident.	po—clay films line tubular or interstitial pores.
2—common (25-50%)	p—prominent. Conspicuous without magnification when compared with a surface broken through the soil. Color, texture, or some other property or combination of properties contrasts sharply with properties of the adjacent material, or the feature is thick enough to be conspicuous.	br—oriented clay occurs as bridges holding mineral grains together.
3—many (50-90%)		co—colloid coats mineral grains.
4—continuous (90-100%)		cobr – films coating and bridging sand grains.

Lower Contact or Boundary

Describes the lower boundary of each stratum or soil horizon, indicating the thickness of the transition and general shape or topography as follows:

Transition		Shape
a – abrupt	(< 2 cm thick)	s—smooth. Boundary is parallel to surface of the soil.
c – clear	(2 to 5 cm thick)	w—wavy. Width of undulation is > than depth.
g – gradual	(5 to 15 cm thick)	i—irregular. Depth of undulation is > than width.
d –diffuse	(> 15 cm thick)	b—broken. Parts of boundary are unconnected to others.

APPENDIX F:

OBSIDIAN HYDRATION DATA

Obsidian Hydration Database

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
1	Laguna Creek Site (P-48-000897)	Trench 8-9	Biface	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
2	Laguna Creek Site (P-48-000897)	Trench 8-9	Biface Frag	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
3	Laguna Creek Site (P-48-000897)	Trench 8-9	Flake Tool	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
4	Laguna Creek Site (P-48-000897)	Trench 8-9	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
5	Laguna Creek Site (P-48-000897)	Trench 8-9	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
6	Laguna Creek Site (P-48-000897)	Trench 8-9	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
7	Laguna Creek Site (P-48-000897)	Trench 8-9	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
8	Laguna Creek Site (P-48-000897)	Trench 8-9	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
9	Laguna Creek Site (P-48-000897)	Trench 8-9	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
10	Laguna Creek Site (P-48-000897)	Trench 8-9	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
11	Laguna Creek Site (P-48-000897)	Trench 8-9	Lanceolate Point	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
12	Laguna Creek (near SOL-324)	Exposure 1	Debitage	Napa (visual)	Origer 2011	Scher 2012
13	Laguna Creek (near SOL-324)	Exposure 1	Debitage	Napa (visual)	Origer 2011	Scher 2012

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
1	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**NVB**	Null		Yolo	Late Holocene	Early Holocene	Buried
2	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**3.4**	OK	**1,722**	Yolo	Late Holocene	Early Holocene	Buried
3	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**3.4**	OK	**1,722**	Yolo	Late Holocene	Early Holocene	Buried
4	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**2.4**	OK	**858**	Yolo	Late Holocene	Early Holocene	Buried
5	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**DH**	Null					
6	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**2.9**	OK	**1,253**	Yolo	Late Holocene	Early Holocene	Buried
7	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**2.8**	OK	**1,168**	Yolo	Late Holocene	Early Holocene	Buried
8	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**NVB**	Null					
9	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**2.6**	OK	**1,007**	Yolo	Late Holocene	Early Holocene	Buried
10	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**2.6**	OK	**1,007**	Yolo	Late Holocene	Early Holocene	Buried
11	Laguna Creek Site (P-48-000897)	200-220cmbs, 2ABtb	**8.7**	OUTLIER	**11,277**	Yolo	Late Holocene	Early Holocene	Buried
12	Laguna Creek (near SOL-324)	120-160 cmbs, 3Ab	**1.7**	OK	**431**	Yolo	Recent Holocene	Late Holocene	Buried
13	Laguna Creek (near SOL-324)	120-160 cmbs, 3Ab	**6.7**	OUTLIER	**6,688**	Yolo	Recent Holocene	Late Holocene	Buried

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
14	Laguna Creek (near SOL-324)	Exposure 1	Debitage	Napa (visual)	Origer 2011	Scher 2012
15	Laguna Creek (near Laguna Creek Site)	Exposure 2	Debitage	Napa (visual)	Origer 2011	Scher 2012
16	Laguna Creek (near Laguna Creek Site)	Exposure 2	Debitage	Napa (visual)	Origer 2011	Scher 2012
17	SOL-357	Exposure 1 (SOL-357)	Debitage	Napa (visual)	Origer 2011	Scher 2012
18	SOL-357	Exposure 1 (SOL-357)	Uniface Fragment	Napa (visual)	Origer 2011	Scher 2012
19	SOL-357	Burial 7-001	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
20	SOL-357	Burial 7-002	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
21	SOL-357	Burial 14-001	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
22	SOL-357	Burial 15-001	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
23	SOL-357	Burial 38-001	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
24	SOL-357	Burial 41-001	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
25	SOL-357	Bur 63/116-001	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
14	Laguna Creek (near SOL-324)	120-160 cmbs, 3Ab	**2.6**	OK	**1,007**	Yolo	Recent Holocene	Late Holocene	Buried
15	Laguna Creek (near Laguna Creek Site)	250-280cmbs, 4ABtkb	**25+**	Rejected		Yolo	Recent Holocene	Early Holocene	Buried
16	Laguna Creek (near Laguna Creek Site)	250-280cmbs, 4ABtkb	**3.6**	OK	**1,931**	Yolo	Recent Holocene	Early Holocene	Buried
17	SOL-357	490cmbs, 3Ab2	**3.7**	OK	**2,040**	Brentwood	Recent Holocene	Late Holocene	Buried
18	SOL-357	490cmbs, 3Ab2	**3.7**	OK	**2,040**	Brentwood	Recent Holocene	Late Holocene	Buried
19	SOL-357	Not Reported	**2.6**	OK	**1,007**	Brentwood	Recent Holocene	Late Holocene	Buried
20	SOL-357	Not Reported	**2.3**	OK	**788**	Brentwood	Recent Holocene	Late Holocene	Buried
21	SOL-357	Not Reported	**2.9**	OK	**1,253**	Brentwood	Recent Holocene	Late Holocene	Buried
22	SOL-357	Not Reported	**4.9**	OK	**3,577**	Brentwood	Recent Holocene	Late Holocene	Buried
23	SOL-357	Not Reported	**3.1**	OK	**1,432**	Brentwood	Recent Holocene	Late Holocene	Buried
24	SOL-357	Not Reported	**3.5**	OK	**1,825**	Brentwood	Recent Holocene	Late Holocene	Buried
25	SOL-357	Not Reported	**3.0**	OK	**1,341**	Brentwood	Recent Holocene	Late Holocene	Buried

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
26	SOL-357	Burial 86-001	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
27	SOL-357	Burial 101-001	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
28	SOL-357	Burial 130-001	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
29	SOL-357	Burial 141-006	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
30	SOL-357	Burial 141-006	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
31	SOL-357	Burial 141-008	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
32	SOL-357	Burial 141-009	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
33	SOL-357	Burial 141-009	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
34	SOL-357	Burial 162-001	Core	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
35	SOL-357	Burial 172-001	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
36	SOL-357	Burial 240-001	Projectile Point, Corner-Notched	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
37	SOL-357	Burial 240-002	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
38	SOL-357	Burial 240-002	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
26	SOL-357	Not Reported	**2.3**	OK	**788**	Brentwood	Recent Holocene	Late Holocene	Buried
27	SOL-357	Not Reported	**1.6**	OK	**381**	Brentwood	Recent Holocene	Late Holocene	Buried
28	SOL-357	Not Reported	**1.5**	OK	**335**	Brentwood	Recent Holocene	Late Holocene	Buried
29	SOL-357	Not Reported	**UNR**	Null		Brentwood	Recent Holocene	Late Holocene	Buried
30	SOL-357	Not Reported	**2.5**	OK	**931**	Brentwood	Recent Holocene	Late Holocene	Buried
31	SOL-357	Not Reported	**2.6**	OK	**1,007**	Brentwood	Recent Holocene	Late Holocene	Buried
32	SOL-357	Not Reported	**3.5**	OK	**1,825**	Brentwood	Recent Holocene	Late Holocene	Buried
33	SOL-357	Not Reported	**12.8**	Rejected	**24,411**	Brentwood	Recent Holocene	Late Holocene	Buried
34	SOL-357	Not Reported	**2.4**	OK	**858**	Brentwood	Recent Holocene	Late Holocene	Buried
35	SOL-357	Not Reported	**1.5**	OK	**335**	Brentwood	Recent Holocene	Late Holocene	Buried
36	SOL-357	Not Reported	**2.3**	OK	**788**	Brentwood	Recent Holocene	Late Holocene	Buried
37	SOL-357	Not Reported	**3.0**	OK	**1,341**	Brentwood	Recent Holocene	Late Holocene	Buried
38	SOL-357	Not Reported	**37.2**	Rejected	**206,178**	Brentwood	Recent Holocene	Late Holocene	Buried

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
39	SOL-357	Burial 240-003	Biface	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
40	SOL-357	Burial 269-001	Projectile Point, Side-Notched	No Source Data	Biosystems 1992	Not Reported (Slaymaker & Associates)
41	SOL-30/H	Unit 1 001	Debitage	Napa (visual)	Origer 2005	Not Reported (LSA)
42	SOL-30/H	Unit 1 002A	Debitage	Napa (visual)	Origer 2005	Not Reported (LSA)
43	SOL-30/H	Unit 1 002B	Debitage	Napa (visual)	Origer 2005	Not Reported (LSA)
44	SOL-30/H	Unit 1 002C	Debitage	Napa (visual)	Origer 2005	Not Reported (LSA)
45	SOL-30/H	Unit 1 002D	Debitage	Napa (visual)	Origer 2005	Not Reported (LSA)
46	SOL-30/H	Unit 1 003A	Debitage	Napa (visual)	Origer 2005	Not Reported (LSA)
47	SOL-30/H	Unit 1 003B	Debitage	Napa (visual)	Origer 2005	Not Reported (LSA)
48	SOL-30/H	Unit 1 004A	Debitage	Napa (visual)	Origer 2005	Not Reported (LSA)
49	SOL-30/H	Unit 1 004B	Debitage	Napa (visual)	Origer 2005	Not Reported (LSA)
50	SOL-30/H	Unit 1 004C	Debitage	Napa (visual)	Origer 2005	Not Reported (LSA)
51	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
39	SOL-357	Not Reported	**4.6**	OK	**3,153**	Brentwood	Recent Holocene	Late Holocene	Buried
40	SOL-357	Not Reported	**2.3**	OK	**788**	Brentwood	Recent Holocene	Late Holocene	Buried
41	SOL-30/H	0-10cmbs	**NVB**	Null		Unclear	Unclear	Unclear	Surface
42	SOL-30/H	10-20cmbs	**1.3**	Rejected		Unclear	Unclear	Unclear	Surface
43	SOL-30/H	10-20cmbs	**1.3**	Rejected		Unclear	Unclear	Unclear	Surface
44	SOL-30/H	10-20cmbs	**1.2**	Rejected		Unclear	Unclear	Unclear	Surface
45	SOL-30/H	10-20cmbs	**NVB**	Null		Unclear	Unclear	Unclear	Surface
46	SOL-30/H	30-40cmbs	**1.4**	Rejected		Unclear	Unclear	Unclear	Surface
47	SOL-30/H	30-40cmbs	**1.2**	Rejected		Unclear	Unclear	Unclear	Surface
48	SOL-30/H	40-50cmbs	**1.1**	Rejected		Unclear	Unclear	Unclear	Surface
49	SOL-30/H	40-50cmbs	**1.1**	Rejected		Unclear	Unclear	Unclear	Surface
50	SOL-30/H	40-50cmbs	**1.2**	Rejected		Unclear	Unclear	Unclear	Surface
51	SOL-30/H	20-30cmbs	**NVB**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
52	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
53	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
54	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
55	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
56	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
57	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
58	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
59	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
60	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
61	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
62	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
63	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
64	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
52	SOL-30/H	20-30cmbs	**1.7**	OK	**431**	Brentwood	Recent Holocene	Recent Holocene	Surface
53	SOL-30/H	20-30cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
54	SOL-30/H	20-30cmbs	**1.4**	OK	**292**	Brentwood	Recent Holocene	Recent Holocene	Surface
55	SOL-30/H	40-50cmbs	**NVB**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface
56	SOL-30/H	40-50cmbs	**DH**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface
57	SOL-30/H	40-50cmbs	**1.2**	OK	**215**	Brentwood	Recent Holocene	Recent Holocene	Surface
58	SOL-30/H	40-50cmbs	**1.1**	OK	**180**	Brentwood	Recent Holocene	Recent Holocene	Surface
59	SOL-30/H	70-80cmbs	**1.1**	OK	**180**	Brentwood	Recent Holocene	Recent Holocene	Surface
60	SOL-30/H	70-80cmbs	**DH**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface
61	SOL-30/H	70-80cmbs	**DH**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface
62	SOL-30/H	70-80cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
63	SOL-30/H	20-30cmbs	**DH**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface
64	SOL-30/H	20-30cmbs	**2.3**	OK	**788**	Brentwood	Recent Holocene	Recent Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
65	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
66	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
67	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
68	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
69	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
70	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
71	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
72	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
73	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
74	SOL-30/H	CU 2	Debitage BAND 2	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
75	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
76	SOL-30/H	CU 2	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
77	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
65	SOL-30/H	20-30cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
66	SOL-30/H	20-30cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
67	SOL-30/H	40-50cmbs	**NVB**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface
68	SOL-30/H	40-50cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
69	SOL-30/H	40-50cmbs	**1.1**	OK	**180**	Brentwood	Recent Holocene	Recent Holocene	Surface
70	SOL-30/H	40-50cmbs	**1.6**	OK	**381**	Brentwood	Recent Holocene	Recent Holocene	Surface
71	SOL-30/H	40-50cmbs	**2.5**	OK	**931**	Brentwood	Recent Holocene	Recent Holocene	Surface
72	SOL-30/H	50-60cmbs	**2.6**	OK	**1,007**	Brentwood	Recent Holocene	Recent Holocene	Surface
73	SOL-30/H	60-70cmbs		Null		Brentwood	Recent Holocene	Recent Holocene	Surface
74	SOL-30/H	60-70cmbs	**1.9**	BAND2	**538**	Brentwood	Recent Holocene	Recent Holocene	Surface
75	SOL-30/H	60-70cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
76	SOL-30/H	60-70cmbs	**DH**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface
77	SOL-30/H	20-30cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
78	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
79	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
80	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
81	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
82	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
83	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
84	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
85	SOL-30/H	CU 4	Projectile Point	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
86	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
87	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
88	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
89	SOL-30/H	CU 4	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
90	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
78	SOL-30/H	20-30cmbs	**NVB**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface
79	SOL-30/H	20-30cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
80	SOL-30/H	20-30cmbs	**1.2**	OK	**215**	Brentwood	Recent Holocene	Recent Holocene	Surface
81	SOL-30/H	40-50cmbs	**1.2**	OK	**215**	Brentwood	Recent Holocene	Recent Holocene	Surface
82	SOL-30/H	40-50cmbs	**DH**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface
83	SOL-30/H	40-50cmbs	**1.4**	OK	**292**	Brentwood	Recent Holocene	Recent Holocene	Surface
84	SOL-30/H	40-50cmbs	**1.9**	OK	**538**	Brentwood	Recent Holocene	Recent Holocene	Surface
85	SOL-30/H	40-50cmbs	**1.2**	OK	**215**	Brentwood	Recent Holocene	Recent Holocene	Surface
86	SOL-30/H	70-80cmbs	**1.6**	OK	**381**	Brentwood	Recent Holocene	Recent Holocene	Surface
87	SOL-30/H	70-80cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
88	SOL-30/H	70-80cmbs	**2.0**	OK	**596**	Brentwood	Recent Holocene	Recent Holocene	Surface
89	SOL-30/H	70-80cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
90	SOL-30/H	30-70cmbs	**NVB**	Null		Brentwood	Recent Holocene	Recent Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
91	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
92	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
93	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
94	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
95	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
96	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
97	SOL-30/H	CU 1	Debitage	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
98	SOL-30/H	CU 1	Biface	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
99	SOL-30/H	CU 2	Flake Tool	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
100	SOL-30/H	CU 2	Flake Tool	Napa (XRF by Richard Hughes)	Origer 2011	Hildebrandt et al. 2012
101	SOL-324	Unit 1 001	Debitage	Napa (visual)	Origer 2011	Not Reported (LSA)
102	SOL-324	Unit 1 001	Debitage BAND 2	Napa (visual)	Origer 2011	Not Reported (LSA)
103	SOL-324	Unit 1 002A	Debitage	Napa (visual)	Origer 2011	Not Reported (LSA)

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
91	SOL-30/H	30-70cmbs	**1.1**	OK	**180**	Brentwood	Recent Holocene	Recent Holocene	Surface
92	SOL-30/H	30-70cmbs	**1.2**	OK	**215**	Brentwood	Recent Holocene	Recent Holocene	Surface
93	SOL-30/H	30-70cmbs	**1.4**	OK	**292**	Brentwood	Recent Holocene	Recent Holocene	Surface
94	SOL-30/H	30-60cmbs	**1.5**	OK	**335**	Brentwood	Recent Holocene	Recent Holocene	Surface
95	SOL-30/H	30-60cmbs	**1.9**	OK	**538**	Brentwood	Recent Holocene	Recent Holocene	Surface
96	SOL-30/H	30-60cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
97	SOL-30/H	30-60cmbs	**1.3**	OK	**252**	Brentwood	Recent Holocene	Recent Holocene	Surface
98	SOL-30/H	30-60cmbs	**1.2**	OK	**215**	Brentwood	Recent Holocene	Recent Holocene	Surface
99	SOL-30/H	48-70cmbs	**1.8**	OK	**483**	Brentwood	Recent Holocene	Recent Holocene	Surface
100	SOL-30/H	60-70cmbs	**1.8**	OK	**483**	Brentwood	Recent Holocene	Recent Holocene	Surface
101	SOL-324	10-20cmbs	**2.4**	Rejected	**858**	Unclear	Unclear	Unclear	Surface
102	SOL-324	10-20cmbs	**2.1**	Rejected	**657**	Unclear	Unclear	Unclear	Surface
103	SOL-324	60-80cmbs	**1.3**	Rejected	**252**	Unclear	Unclear	Unclear	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
104	SOL-324	Unit 1 002B	Debitage	Napa (visual)	Origer 2011	Not Reported (LSA)
105	SOL-324	Unit 1 003	Debitage	Napa (visual)	Origer 2011	Not Reported (LSA)
106	SOL-324	Unit 1 004	Debitage	Napa (visual)	Origer 2011	Not Reported (LSA)
107	SOL-324	Unit 1 005A	Debitage	Napa (visual)	Origer 2011	Not Reported (LSA)
108	SOL-324	Unit 1 005B	Debitage	Napa (visual)	Origer 2011	Not Reported (LSA)
109	SOL-324	Unit 33	Unknown	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001
110	SOL-324	Unit 33	Unknown	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001
111	SOL-324	Unit 33	Unknown	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001
112	SOL-324	Unit 33	Unknown	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001
113	SOL-324	Unit 33	Unknown	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001
114	SOL-324	Unit 33	Unknown	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001
115	SOL-324	Unit 33	Unknown	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001
116	SOL-324	Unit 33	Unknown	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
104	SOL-324	60-80cmbs	**1.5**	Rejected	**335**	Unclear	Unclear	Unclear	Surface
105	SOL-324	190-200cmbs	**1.8**	Rejected	**483**	Unclear	Unclear	Unclear	Surface
106	SOL-324	200-209cmbs	**1.2**	Rejected	**215**	Unclear	Unclear	Unclear	Surface
107	SOL-324	218-230cmbs	**1.8**	Rejected	**483**	Unclear	Unclear	Unclear	Surface
108	SOL-324	218-230cmbs	**3.1**	Rejected	**1,432**	Unclear	Unclear	Unclear	Surface
109	SOL-324	Not Reported, Stratum II (2Ab)	**3.0**	OK	**1,341**	Yolo	Recent Holocene	Late Holocene	Buried
110	SOL-324	Not Reported, Stratum II (2Ab)	**2.2**	OK	**721**	Yolo	Recent Holocene	Late Holocene	Buried
111	SOL-324	Not Reported, Stratum II (2Ab)	**1.7**	OK	**431**	Yolo	Recent Holocene	Late Holocene	Buried
112	SOL-324	Not Reported, Stratum II (2Ab)	**2.1**	OK	**657**	Yolo	Recent Holocene	Late Holocene	Buried
113	SOL-324	Not Reported, Stratum II (2Ab)	**2.5**	OK	**931**	Yolo	Recent Holocene	Late Holocene	Buried
114	SOL-324	Not Reported, Stratum II (2Ab)	**2.5**	OK	**931**	Yolo	Recent Holocene	Late Holocene	Buried
115	SOL-324	Not Reported, Stratum II (2Ab)	**2.5**	OK	**931**	Yolo	Recent Holocene	Late Holocene	Buried
116	SOL-324	Not Reported, Stratum II (2Ab)	**2.6**	OK	**1,007**	Yolo	Recent Holocene	Late Holocene	Buried

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
117	SOL-324	Unit 33	Unknown	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001
118	SOL-324	Unit 33	Second reading	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001
119	SOL-324	Unit 33	Unknown	Napa (XRF, not reported by whom)	Not Reported	Jones and Stokes 2001
120	SOL-471	N54/E121	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
121	SOL-471	N21/E42	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
122	SOL-471	N21/E42	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
123	SOL-471	N21/E42	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
124	SOL-471	N21/E42	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
125	SOL-471	N21/E42	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
126	SOL-471	N21/E42	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
127	SOL-471	N21/E42	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
128	SOL-471	N21/E42	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
129	SOL-471	N28/W23	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
117	SOL-324	Not Reported, Stratum II (2Ab)	**2.7**	OK	**1,086**	Yolo	Recent Holocene	Late Holocene	Buried
118	SOL-324	Not Reported, Stratum II (2Ab)	**6.7**	OUTLIER	**6,688**	Yolo	Recent Holocene	Late Holocene	Buried
119	SOL-324	Not Reported, Stratum II (2Ab)	**UNR**	Null		Yolo	Recent Holocene	Late Holocene	Buried
120	SOL-471	Surface	**3.4**	Rejected	**1,722**	Capay, San Ysidro	Unclear	Unclear	Surface
121	SOL-471	10-20cmbs	**2.2**	Rejected	**721**	Capay, San Ysidro	Unclear	Unclear	Surface
122	SOL-471	10-20cmbs	**2.7**	Rejected	**1,086**	Capay, San Ysidro	Unclear	Unclear	Surface
123	SOL-471	10-20cmbs	**2.7**	Rejected	**1,086**	Capay, San Ysidro	Unclear	Unclear	Surface
124	SOL-471	10-20cmbs	**2.8**	Rejected	**1,168**	Capay, San Ysidro	Unclear	Unclear	Surface
125	SOL-471	40-50cmbs	**2.4**	Rejected	**858**	Capay, San Ysidro	Unclear	Unclear	Surface
126	SOL-471	40-50cmbs	**2.5**	Rejected	**931**	Capay, San Ysidro	Unclear	Unclear	Surface
127	SOL-471	40-50cmbs	**3.1**	Rejected	**1,432**	Capay, San Ysidro	Unclear	Unclear	Surface
128	SOL-471	40-50cmbs	**5.1**	Rejected	**3,875**	Capay, San Ysidro	Unclear	Unclear	Surface
129	SOL-471	10-20cmbs	**3.1**	Rejected	**1,432**	Capay, San Ysidro	Unclear	Unclear	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
130	SOL-471	N28/W23	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
131	SOL-471	N28/W23	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
132	SOL-471	N28/W23	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
133	SOL-471	N28/W23	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
134	SOL-471	N28/W23	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
135	SOL-471	N28/W23	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
136	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
137	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
138	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
139	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
140	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
141	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
142	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
130	SOL-471	10-20cmbs	**4.1**	Rejected	**2,505**	Capay, San Ysidro	Unclear	Unclear	Surface
131	SOL-471	20-30cmbs	**4.4**	Rejected	**2,884**	Capay, San Ysidro	Unclear	Unclear	Surface
132	SOL-471	60-70cmbs	**3.4**	Rejected	**1,722**	Capay, San Ysidro	Unclear	Unclear	Surface
133	SOL-471	70-80cmbs	**2.8**	Rejected	**1,168**	Capay, San Ysidro	Unclear	Unclear	Surface
134	SOL-471	70-80cmbs	**3.9**	Rejected	**2,266**	Capay, San Ysidro	Unclear	Unclear	Surface
135	SOL-471	70-80cmbs	**4.6**	Rejected	**3,153**	Capay, San Ysidro	Unclear	Unclear	Surface
136	SOL-471	Surface	**2.7**	Rejected	**1,086**	Capay, San Ysidro	Unclear	Unclear	Surface
137	SOL-471	10-20cmbs	**3.1**	Rejected	**1,432**	Capay, San Ysidro	Unclear	Unclear	Surface
138	SOL-471	20-30cmbs	**2.9**	Rejected	**1,253**	Capay, San Ysidro	Unclear	Unclear	Surface
139	SOL-471	20-30cmbs	**3.2**	Rejected	**1,526**	Capay, San Ysidro	Unclear	Unclear	Surface
140	SOL-471	20-30cmbs	**3.3**	Rejected	**1,623**	Capay, San Ysidro	Unclear	Unclear	Surface
141	SOL-471	20-30cmbs	**3.4**	Rejected	**1,722**	Capay, San Ysidro	Unclear	Unclear	Surface
142	SOL-471	30-40cmbs	**3**	Rejected	**1,341**	Capay, San Ysidro	Unclear	Unclear	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
143	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
144	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
145	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
146	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
147	SOL-471	N83/E139	Unknown	Napa (visual)	Origer 2010	Barrow and Origer 2012
148	SOL-320/H	Davis St. Surface	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
149	SOL-320/H	Davis St. Unit 2	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
150	SOL-320/H	Davis St. Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
151	SOL-320/H	Davis St. Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
152	SOL-320/H	Davis St. Unit 3, Burial 2-1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
153	SOL-320/H	Davis St. Unit 3, Burial 2-1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
154	SOL-320/H	Davis St. Unit 3, Burial 2-1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
155	SOL-320/H	Davis St. Unit 3, Burial 2-1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
143	SOL-471	30-40cmbs	**3.1**	Rejected	**1,432**	Capay, San Ysidro	Unclear	Unclear	Surface
144	SOL-471	40-50cmbs	**2.5**	Rejected	**931**	Capay, San Ysidro	Unclear	Unclear	Surface
145	SOL-471	50-60cmbs	**2.9**	Rejected	**1,253**	Capay, San Ysidro	Unclear	Unclear	Surface
146	SOL-471	50-60cmbs	**3.9**	Rejected	**2,266**	Capay, San Ysidro	Unclear	Unclear	Surface
147	SOL-471	60-70cmbs	**1.8**	Rejected	**483**	Capay, San Ysidro	Unclear	Unclear	Surface
148	SOL-320/H	Surface	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
149	SOL-320/H	70-90cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
150	SOL-320/H	10-20cmbs	**1.3**	OK	**252**	Brentwood	Late Holocene	Late Holocene	Surface
151	SOL-320/H	10-20cmbs	**2.5**	OK	**931**	Brentwood	Late Holocene	Late Holocene	Surface
152	SOL-320/H	20-50cmbs	**1.5**	OK	**335**	Brentwood	Late Holocene	Late Holocene	Surface
153	SOL-320/H	20-50cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
154	SOL-320/H	20-50cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
155	SOL-320/H	20-50cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
156	SOL-320/H	Davis St. Unit 3, Burial 2-1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
157	SOL-320/H	Davis St. Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
158	SOL-320/H	Davis St. Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
159	SOL-320/H	Davis St. Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
160	SOL-320/H	Davis St. Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
161	SOL-320/H	Davis St. Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
162	SOL-320/H	Davis St. Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
163	SOL-320/H	Davis St. Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
164	SOL-320/H	Davis St. Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
165	SOL-320/H	Vasquez Unit 1	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
166	SOL-320/H	Vasquez Unit 1	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
167	SOL-320/H	Vasquez Unit 1	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
168	SOL-320/H	Vasquez Unit 1	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
156	SOL-320/H	20-50cmbs	**2.3**	OK	**788**	Brentwood	Late Holocene	Late Holocene	Surface
157	SOL-320/H	0-10cmbs	**1.7**	OK	**431**	Brentwood	Late Holocene	Late Holocene	Surface
158	SOL-320/H	0-10cmbs	**1.8**	OK	**483**	Brentwood	Late Holocene	Late Holocene	Surface
159	SOL-320/H	0-10cmbs	**2.2**	OK	**721**	Brentwood	Late Holocene	Late Holocene	Surface
160	SOL-320/H	10-20cmbs	**1.6**	OK	**381**	Brentwood	Late Holocene	Late Holocene	Surface
161	SOL-320/H	10-20cmbs	**1.7**	OK	**431**	Brentwood	Late Holocene	Late Holocene	Surface
162	SOL-320/H	10-20cmbs	**1.8**	OK	**483**	Brentwood	Late Holocene	Late Holocene	Surface
163	SOL-320/H	10-20cmbs	**1.9**	OK	**538**	Brentwood	Late Holocene	Late Holocene	Surface
164	SOL-320/H	10-20cmbs	**1.9**	OK	**538**	Brentwood	Late Holocene	Late Holocene	Surface
165	SOL-320/H	0-10cmbs	**1.8**	OK	**483**	Brentwood	Late Holocene	Late Holocene	Surface
166	SOL-320/H	10-20cmbs	**2.5**	OK	**931**	Brentwood	Late Holocene	Late Holocene	Surface
167	SOL-320/H	10-20cmbs	**2.6**	OK	**1,007**	Brentwood	Late Holocene	Late Holocene	Surface
168	SOL-320/H	10-20cmbs	**1.5**	OK	**335**	Brentwood	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
169	SOL-320/H	Vasquez Unit 1	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
170	SOL-320/H	Vasquez Unit 1	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
171	SOL-320/H	Vasquez Unit 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
172	SOL-320/H	Vasquez Unit 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
173	SOL-320/H	Vasquez Unit 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
174	SOL-320/H	Vasquez Unit 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
175	SOL-320/H	Vasquez Unit 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
176	SOL-320/H	Vasquez Unit 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
177	SOL-320/H	Vasquez Unit 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
178	SOL-320/H	Vasquez Unit 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
179	SOL-320/H	Vasquez Unit 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
180	SOL-320/H	Vasquez Unit 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
181	SOL-320/H	Vasquez Unit 2	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
169	SOL-320/H	10-20cmbs	**2.2**	OK	**721**	Brentwood	Late Holocene	Late Holocene	Surface
170	SOL-320/H	10-20cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
171	SOL-320/H	10-20cmbs	**1.6**	OK	**381**	Brentwood	Late Holocene	Late Holocene	Surface
172	SOL-320/H	10-20cmbs	**1.6**	OK	**381**	Brentwood	Late Holocene	Late Holocene	Surface
173	SOL-320/H	10-20cmbs	**1.9**	OK	**538**	Brentwood	Late Holocene	Late Holocene	Surface
174	SOL-320/H	10-20cmbs	**1.9**	OK	**538**	Brentwood	Late Holocene	Late Holocene	Surface
175	SOL-320/H	10-20cmbs	**2.2**	OK	**721**	Brentwood	Late Holocene	Late Holocene	Surface
176	SOL-320/H	20-30cmbs	**1.1**	OK	**180**	Brentwood	Late Holocene	Late Holocene	Surface
177	SOL-320/H	20-30cmbs	**1.4**	OK	**292**	Brentwood	Late Holocene	Late Holocene	Surface
178	SOL-320/H	20-30cmbs	**2.2**	OK	**721**	Brentwood	Late Holocene	Late Holocene	Surface
179	SOL-320/H	20-30cmbs	**3.2**	OK	**1,526**	Brentwood	Late Holocene	Late Holocene	Surface
180	SOL-320/H	20-30cmbs	**4.4**	OK	**2,884**	Brentwood	Late Holocene	Late Holocene	Surface
181	SOL-320/H	0-10cmbs	**5.0**	OK	**3,725**	Brentwood	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
182	SOL-320/H	Vasquez Unit 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
183	SOL-320/H	Vasquez Unit 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
184	SOL-320/H	Vasquez Unit 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
185	SOL-320/H	Vasquez Unit 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
186	SOL-320/H	Vasquez Unit 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
187	SOL-320/H	Vasquez Unit 2	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
188	SOL-320/H	Vasquez Unit 2	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
189	SOL-320/H	Vasquez Unit 2	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
190	SOL-320/H	Vasquez Unit 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
191	SOL-320/H	Vasquez Unit 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
192	SOL-320/H	Vasquez Unit 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
193	SOL-320/H	Vasquez Unit 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
194	SOL-320/H	Vasquez Unit 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
182	SOL-320/H	10-20cmbs	**1.6**	OK	**381**	Brentwood	Late Holocene	Late Holocene	Surface
183	SOL-320/H	10-20cmbs	**1.6**	OK	**381**	Brentwood	Late Holocene	Late Holocene	Surface
184	SOL-320/H	10-20cmbs	**1.8**	OK	**483**	Brentwood	Late Holocene	Late Holocene	Surface
185	SOL-320/H	10-20cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
186	SOL-320/H	10-20cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
187	SOL-320/H	20-30cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
188	SOL-320/H	20-30cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
189	SOL-320/H	20-30cmbs	**2.9**	OK	**1,253**	Brentwood	Late Holocene	Late Holocene	Surface
190	SOL-320/H	20-30cmbs	**1.6**	OK	**381**	Brentwood	Late Holocene	Late Holocene	Surface
191	SOL-320/H	20-30cmbs	**1.9**	OK	**538**	Brentwood	Late Holocene	Late Holocene	Surface
192	SOL-320/H	20-30cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
193	SOL-320/H	20-30cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
194	SOL-320/H	20-30cmbs	**2.5**	OK	**931**	Brentwood	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
195	SOL-320/H	Vasquez Unit 3	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
196	SOL-320/H	Vasquez Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
197	SOL-320/H	Vasquez Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
198	SOL-320/H	Vasquez Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
199	SOL-320/H	Vasquez Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
200	SOL-320/H	Vasquez Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
201	SOL-320/H	Vasquez Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
202	SOL-320/H	Vasquez Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
203	SOL-320/H	Vasquez Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
204	SOL-320/H	Vasquez Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
205	SOL-320/H	Vasquez Unit 3	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
206	SOL-320/H	Vasquez Unit 4	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
207	SOL-320/H	Vasquez Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
195	SOL-320/H	20-30cmbs	**5.7**	OK	**4,841**	Brentwood	Late Holocene	Late Holocene	Surface
196	SOL-320/H	20-30cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
197	SOL-320/H	20-30cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
198	SOL-320/H	20-30cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
199	SOL-320/H	20-30cmbs	**2.3**	OK	**788**	Brentwood	Late Holocene	Late Holocene	Surface
200	SOL-320/H	20-30cmbs	**3.2**	OK	**1,526**	Brentwood	Late Holocene	Late Holocene	Surface
201	SOL-320/H	30-40cmbs	**1.6**	OK	**381**	Brentwood	Late Holocene	Late Holocene	Surface
202	SOL-320/H	30-40cmbs	**1.9**	OK	**538**	Brentwood	Late Holocene	Late Holocene	Surface
203	SOL-320/H	30-40cmbs	**2.2**	OK	**721**	Brentwood	Late Holocene	Late Holocene	Surface
204	SOL-320/H	30-40cmbs	**2.5**	OK	**931**	Brentwood	Late Holocene	Late Holocene	Surface
205	SOL-320/H	30-40cmbs	**2.5**	OK	**931**	Brentwood	Late Holocene	Late Holocene	Surface
206	SOL-320/H	10-30cmbs	**2.3**	OK	**788**	Brentwood	Late Holocene	Late Holocene	Surface
207	SOL-320/H	10-30cmbs	**1.9**	OK	**538**	Brentwood	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
208	SOL-320/H	Vasquez Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
209	SOL-320/H	Vasquez Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
210	SOL-320/H	Vasquez Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
211	SOL-320/H	Vasquez Unit 4	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
212	SOL-320/H	Vasquez Unit 4	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
213	SOL-320/H	Vasquez Unit 5	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
214	SOL-320/H	Vasquez Unit 5	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
215	SOL-320/H	Vasquez Unit 6	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
216	SOL-320/H	Vasquez Unit 6	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
217	SOL-320/H	Vasquez Unit 6	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
218	SOL-320/H	Vasquez Unit 6	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
219	SOL-320/H	Vasquez Unit 6	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
220	SOL-320/H	Vasquez Unit 6	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
208	SOL-320/H	10-30cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
209	SOL-320/H	10-30cmbs	**2.4**	OK	**858**	Brentwood	Late Holocene	Late Holocene	Surface
210	SOL-320/H	10-30cmbs	**2.5**	OK	**931**	Brentwood	Late Holocene	Late Holocene	Surface
211	SOL-320/H	10-30cmbs	**2.5**	OK	**931**	Brentwood	Late Holocene	Late Holocene	Surface
212	SOL-320/H	30-40cmbs	**6.5**	OUTLIER	**6,295**	Brentwood	Late Holocene	Late Holocene	Surface
213	SOL-320/H	20-30cmbs	**1.5**	OK	**335**	Brentwood	Late Holocene	Late Holocene	Surface
214	SOL-320/H	20-30cmbs	**1.6**	OK	**381**	Brentwood	Late Holocene	Late Holocene	Surface
215	SOL-320/H	0-10cmbs	**1.7**	OK	**431**	Brentwood	Late Holocene	Late Holocene	Surface
216	SOL-320/H	0-10cmbs	**2.2**	OK	**721**	Brentwood	Late Holocene	Late Holocene	Surface
217	SOL-320/H	20-30cmbs	**1.6**	OK	**381**	Brentwood	Late Holocene	Late Holocene	Surface
218	SOL-320/H	20-30cmbs	**3.5**	OK	**1,825**	Brentwood	Late Holocene	Late Holocene	Surface
219	SOL-320/H	20-30cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
220	SOL-320/H	20-30cmbs	**2.2**	OK	**721**	Brentwood	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
221	SOL-320/H	Vasquez Unit 6	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
222	SOL-320/H	Vasquez Unit 6	Core	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
223	SOL-320/H	Vasquez Unit 6	Flake Tool	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
224	SOL-320/H	Vasquez Unit 6	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
225	SOL-320/H	Vasquez Unit 6	Core	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
226	SOL-320/H	Vasquez Unit 6	Flake Tool	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
227	SOL-320/H	Vasquez Unit 6	Flake Tool	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
228	SOL-320/H	Vasquez Burial 3	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
229	SOL-320/H	Vasquez Burial 3	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
230	SOL-320/H	Vasquez Burial 3	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
231	SOL-320/H	Vasquez Burial 4	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
232	SOL-320/H	Vasquez Burial 4	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
233	SOL-320/H	Vasquez Burial 5	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
221	SOL-320/H	20-30cmbs	**2.8**	OK	**1,168**	Brentwood	Late Holocene	Late Holocene	Surface
222	SOL-320/H	20-30cmbs	**1.6**	OK	**381**	Brentwood	Late Holocene	Late Holocene	Surface
223	SOL-320/H	30-40cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
224	SOL-320/H	30-40cmbs	**2.7**	OK	**1,086**	Brentwood	Late Holocene	Late Holocene	Surface
225	SOL-320/H	40-50cmbs	**1.5**	OK	**335**	Brentwood	Late Holocene	Late Holocene	Surface
226	SOL-320/H	40-50cmbs	**1.8**	OK	**483**	Brentwood	Late Holocene	Late Holocene	Surface
227	SOL-320/H	40-50cmbs	**1.9**	OK	**538**	Brentwood	Late Holocene	Late Holocene	Surface
228	SOL-320/H	52cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
229	SOL-320/H	52cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
230	SOL-320/H	52cmbs	**3.0**	OK	**1,341**	Brentwood	Late Holocene	Late Holocene	Surface
231	SOL-320/H	84cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
232	SOL-320/H	84cmbs	**2.5**	OK	**931**	Brentwood	Late Holocene	Late Holocene	Surface
233	SOL-320/H	43cmbs	**1.9**	OK	**538**	Brentwood	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
234	SOL-425/H	Town Square Burial 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
235	SOL-425/H	Town Square Burial 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
236	SOL-425/H	Town Square Burial 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
237	SOL-425/H	Town Square Burial 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
238	SOL-425/H	Town Square Burial 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
239	SOL-425/H	Town Square Burial 6a	Flake reading 1	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
240	SOL-425/H	Town Square Burial 6a	Flake reading 2	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
241	SOL-425/H	Town Square Burial 6a	Flake reading 3	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
242	SOL-425/H	Town Square Burial 6b	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
243	SOL-425/H	Town Square Burial 6b	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
244	SOL-425/H	Town Square Burial 6b	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
245	SOL-425/H	Town Square Burial 6b	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
246	SOL-425/H	Town Square Burial 6b	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
234	SOL-425/H	51cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
235	SOL-425/H	51cmbs	**3.2**	OK	**1,526**	Brentwood	Late Holocene	Late Holocene	Surface
236	SOL-425/H	51cmbs	**3.5**	OK	**1,825**	Brentwood	Late Holocene	Late Holocene	Surface
237	SOL-425/H	51cmbs	**4.3**	OK	**2,755**	Brentwood	Late Holocene	Late Holocene	Surface
238	SOL-425/H	51cmbs	**4.8**	OK	**3,433**	Brentwood	Late Holocene	Late Holocene	Surface
239	SOL-425/H	55cmbs	**12.0**	Rejected	**21,455**	Brentwood	Late Holocene	Late Holocene	Surface
240	SOL-425/H	55cmbs	**7.3**	OUTLIER	**7,940**	Brentwood	Late Holocene	Late Holocene	Surface
241	SOL-425/H	55cmbs	**9.5**	Rejected	**13,446**	Brentwood	Late Holocene	Late Holocene	Surface
242	SOL-425/H	51cmbs	**2.7**	OK	**1,086**	Brentwood	Late Holocene	Late Holocene	Surface
243	SOL-425/H	51cmbs	**3.3**	OK	**1,623**	Brentwood	Late Holocene	Late Holocene	Surface
244	SOL-425/H	51cmbs	**3.5**	OK	**1,825**	Brentwood	Late Holocene	Late Holocene	Surface
245	SOL-425/H	51cmbs	**3.5**	OK	**1,825**	Brentwood	Late Holocene	Late Holocene	Surface
246	SOL-425/H	51cmbs	**3.6**	OK	**1,931**	Brentwood	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
247	SOL-425/H	Town Square Burial 6b	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
248	SOL-425/H	Town Square Burial 11	Core	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
249	SOL-425/H	Town Square Burial 11	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
250	SOL-425/H	Town Square Burial 11, vicinity	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
251	SOL-425/H	Town Square Burial 11, vicinity	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
252	SOL-425/H	Town Square Burial 11, vicinity	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
253	SOL-425/H	Town Square Burial 13	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
254	SOL-425/H	Town Square Burial 13	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
255	SOL-425/H	Town Square Burial 14	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
256	SOL-425/H	Town Square Burial 14	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
257	SOL-425/H	Town Square Burial 14	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
258	SOL-425/H	Town Square Burial 14	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
259	SOL-425/H	Town Square Burial 15	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
247	SOL-425/H	51cmbs	**3.6**	OK	**1,931**	Brentwood	Late Holocene	Late Holocene	Surface
248	SOL-425/H	73cmbs	**4.5**	OK	**3,017**	Brentwood	Late Holocene	Late Holocene	Surface
249	SOL-425/H	73cmbs	**4.0**	OK	**2,384**	Brentwood	Late Holocene	Late Holocene	Surface
250	SOL-425/H	50-80cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
251	SOL-425/H	50-80cmbs	**3.0**	OK	**1,341**	Brentwood	Late Holocene	Late Holocene	Surface
252	SOL-425/H	50-80cmbs	**5.5**	OK	**4,507**	Brentwood	Late Holocene	Late Holocene	Surface
253	SOL-425/H	72cmbs	**2.0**	OK	**596**	Brentwood	Late Holocene	Late Holocene	Surface
254	SOL-425/H	72cmbs	**4.3**	OK	**2,755**	Brentwood	Late Holocene	Late Holocene	Surface
255	SOL-425/H	76cmbs	**4.3**	OK	**2,755**	Brentwood	Late Holocene	Late Holocene	Surface
256	SOL-425/H	76cmbs	**3.6**	OK	**1,931**	Brentwood	Late Holocene	Late Holocene	Surface
257	SOL-425/H	76cmbs	**3.6**	OK	**1,931**	Brentwood	Late Holocene	Late Holocene	Surface
258	SOL-425/H	76cmbs	**5.0**	OK	**3,725**	Brentwood	Late Holocene	Late Holocene	Surface
259	SOL-425/H	79cmbs	**2.4**	OK	**858**	Brentwood	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
260	SOL-425/H	Town Square Burial 17	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
261	SOL-425/H	Town Square Burial 17	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
262	SOL-425/H	Town Square Burial 17	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
263	SOL-425/H	Town Square Burial 17	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
264	SOL-425/H	Town Square Burial 17	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
265	SOL-425/H	Town Square Burial 17	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
266	SOL-425/H	Town Square Feature 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
267	SOL-425/H	Town Square Feature 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
268	SOL-425/H	Town Square Feature 1	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
269	SOL-425/H	Town Square Feature 1	Flake Tool	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
270	SOL-425/H	Town Square Feature 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
271	SOL-425/H	Town Square Feature 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
272	SOL-425/H	Town Square Feature 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
260	SOL-425/H	89cmbs	**5.0**	OK	**3,725**	Brentwood	Late Holocene	Late Holocene	Surface
261	SOL-425/H	89cmbs	**3.5**	OK	**1,825**	Brentwood	Late Holocene	Late Holocene	Surface
262	SOL-425/H	89cmbs	**3.5**	OK	**1,825**	Brentwood	Late Holocene	Late Holocene	Surface
263	SOL-425/H	89cmbs	**3.7**	OK	**2,040**	Brentwood	Late Holocene	Late Holocene	Surface
264	SOL-425/H	89cmbs	**3.9**	OK	**2,266**	Brentwood	Late Holocene	Late Holocene	Surface
265	SOL-425/H	89cmbs	**3.9**	OK	**2,266**	Brentwood	Late Holocene	Late Holocene	Surface
266	SOL-425/H	85-105cmbs	**2.5**	OK	**931**	Brentwood	Late Holocene	Late Holocene	Surface
267	SOL-425/H	85-105cmbs	**2.9**	OK	**1,253**	Brentwood	Late Holocene	Late Holocene	Surface
268	SOL-425/H	85-105cmbs	**4.4**	OK	**2,884**	Brentwood	Late Holocene	Late Holocene	Surface
269	SOL-425/H	85-105cmbs	**2.5**	OK	**931**	Brentwood	Late Holocene	Late Holocene	Surface
270	SOL-425/H	20-40cmbs	**2.1**	OK	**657**	Brentwood	Late Holocene	Late Holocene	Surface
271	SOL-425/H	20-40cmbs	**3.3**	OK	**1,623**	Brentwood	Late Holocene	Late Holocene	Surface
272	SOL-425/H	20-40cmbs	**3.8**	OK	**2,151**	Brentwood	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
273	SOL-425/H	Town Square Feature 2	Flake	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
274	SOL-425/H	Town Square Feature 2	Flake reading 1	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
275	SOL-425/H	Town Square Feature 2	Flake reading 2	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
276	SOL-425/H	Town Square Disturbed Surface	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
277	SOL-425/H	Town Square Disturbed Surface	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
278	SOL-425/H	Town Square Disturbed Surface	Projectile Point	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
279	SOL-425/H	Town Square Disturbed Surface	Biface	Napa (visual)	Not Reported	Rosenthal, Carpenter, and Whitaker 2009
280	SOL-334	STU 1	Flake A	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
281	SOL-334	STU 1	Flake B	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
282	SOL-334	STU 1	Flake	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
283	SOL-334	STU 2	Flake A	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
284	SOL-334	STU 2	Flake B	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
285	SOL-334	STU 3	Flake A	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
273	SOL-425/H	20-40cmbs	**5.5**	OK	**4,507**	Brentwood	Late Holocene	Late Holocene	Surface
274	SOL-425/H	20-40cmbs	**10.5**	Rejected	**16,426**	Brentwood	Late Holocene	Late Holocene	Surface
275	SOL-425/H	20-40cmbs	**13.2**	Rejected	**25,960**	Brentwood	Late Holocene	Late Holocene	Surface
276	SOL-425/H	Surface	**4.8**	OK	**3,433**	Brentwood	Late Holocene	Late Holocene	Surface
277	SOL-425/H	Surface	**4.0**	OK	**2,384**	Brentwood	Late Holocene	Late Holocene	Surface
278	SOL-425/H	Surface	**2.4**	OK	**858**	Brentwood	Late Holocene	Late Holocene	Surface
279	SOL-425/H	Surface	**3.1**	OK	**1,432**	Brentwood	Late Holocene	Late Holocene	Surface
280	SOL-334	20-30cmbs	**6.1**	OK	**5,562**	Rincon	Early Holocene	Early Holocene	Surface
281	SOL-334	20-30cmbs	**7.5**	OK	**8,425**	Rincon	Early Holocene	Early Holocene	Surface
282	SOL-334	30-40cmbs	**8.0**	OK	**9,512**	Rincon	Early Holocene	Early Holocene	Surface
283	SOL-334	50-60cmbs	**2.6**	OK	**992**	Rincon	Early Holocene	Early Holocene	Surface
284	SOL-334	50-60cmbs	**8.9**	OK	**11,722**	Rincon	Early Holocene	Early Holocene	Surface
285	SOL-334	0-10cmbs	**2.7**	OK	**1,094**	Rincon	Early Holocene	Early Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
286	SOL-334	STU 3	Flake B	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
287	SOL-334	STU 3	Flake C	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
288	SOL-334	STU 3	Biface Margin	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
289	SOL-334	STU 3	Flake	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
290	SOL-334	STU 4	Flake	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
291	SOL-334	STU 4	Flake A	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
292	SOL-334	STU 4	Flake B	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
293	SOL-334	STU 4	Flake C	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
294	SOL-334	STU 4	Biface Margin	Napa (visual)	Carpenter 2008	Ruby 2010; Wohlgemuth, Ruby, and Kaijankoski 2010
295	SOL-334	Unit 7	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
296	SOL-334	Unit 7	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
297	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
298	SOL-334	Unit 1	Biface Fragment	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
286	SOL-334	0-10cmbs	**UNR**	Null		Rincon	Early Holocene	Early Holocene	Surface
287	SOL-334	0-10cmbs	**6.0**	OK	**5,328**	Rincon	Early Holocene	Early Holocene	Surface
288	SOL-334	0-10cmbs	**6.8**	OK	**6,950**	Rincon	Early Holocene	Early Holocene	Surface
289	SOL-334	10-20cmbs	**7.4**	OK	**8,181**	Rincon	Early Holocene	Early Holocene	Surface
290	SOL-334	0-10cmbs	**7.4**	OK	**8,181**	Rincon	Early Holocene	Early Holocene	Surface
291	SOL-334	30-40cmbs	**7.1**	OK	**7,405**	Rincon	Early Holocene	Early Holocene	Surface
292	SOL-334	30-40cmbs	**UNR**	Null		Rincon	Early Holocene	Early Holocene	Surface
293	SOL-334	30-40cmbs	**7.4**	OK	**8,093**	Rincon	Early Holocene	Early Holocene	Surface
294	SOL-334	30-40cmbs	**7.0**	OK	**7,321**	Rincon	Early Holocene	Early Holocene	Surface
295	SOL-334	0-20cmbs	**1.3**	OK	**252**	Rincon	Early Holocene	Early Holocene	Surface
296	SOL-334	0-20cmbs	**5.0**	OK	**3,725**	Rincon	Early Holocene	Early Holocene	Surface
297	SOL-334	10-20cmbs	**4.1**	OK	**2,505**	Rincon	Early Holocene	Early Holocene	Surface
298	SOL-334	10-20cmbs	**4.0**	OK	**2,384**	Rincon	Early Holocene	Early Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
299	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
300	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
301	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
302	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
303	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
304	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
305	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
306	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
307	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
308	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
309	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
310	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
311	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
299	SOL-334	20-30cmbs	**3.6**	OK	**1,931**	Rincon	Early Holocene	Early Holocene	Surface
300	SOL-334	20-30cmbs	**3.6**	OK	**1,931**	Rincon	Early Holocene	Early Holocene	Surface
301	SOL-334	20-30cmbs	**VW**	Null		Rincon	Early Holocene	Early Holocene	Surface
302	SOL-334	20-30cmbs	**7.0**	OK	**7,301**	Rincon	Early Holocene	Early Holocene	Surface
303	SOL-334	20-30cmbs	**DH**	Null		Rincon	Early Holocene	Early Holocene	Surface
304	SOL-334	20-30cmbs	**DH**	Null		Rincon	Early Holocene	Early Holocene	Surface
305	SOL-334	20-30cmbs	**DH**	Null		Rincon	Early Holocene	Early Holocene	Surface
306	SOL-334	20-30cmbs	**3.7**	OK	**2,040**	Rincon	Early Holocene	Early Holocene	Surface
307	SOL-334	20-30cmbs	**VW**	Null		Rincon	Early Holocene	Early Holocene	Surface
308	SOL-334	30-40cmbs	**2.8**	OK	**1,168**	Rincon	Early Holocene	Early Holocene	Surface
309	SOL-334	30-40cmbs	**3.8**	OK	**2,151**	Rincon	Early Holocene	Early Holocene	Surface
310	SOL-334	30-40cmbs	**6.4**	OK	**6,103**	Rincon	Early Holocene	Early Holocene	Surface
311	SOL-334	30-40cmbs	**4.8**	OK	**3,433**	Rincon	Early Holocene	Early Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
312	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
313	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
314	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
315	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
316	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
317	SOL-334	Unit 1	Debitage	Napa (visual)	Origer 2010	Wohlgemuth, Ruby, and Kaijankoski 2010
318	SOL-468	Trench 15 Upper Midden Control Sample	Flake A	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
319	SOL-468	Trench 15 Upper Midden Control Sample	Flake B	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
320	SOL-468	Trench 15 Upper Midden Control Sample	Flake C	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
321	SOL-468	Trench 15 Upper Midden Control Sample	Flake D	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
322	SOL-468	Trench 15 Upper Midden Control Sample	Flake E	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
323	SOL-468	Trench 15 Upper Midden Control Sample	Flake F	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
324	SOL-468	Trench 15 Upper Midden Control Sample	Flake F *Mean 2	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
312	SOL-334	30-40cmbs	**2.8**	OK	**1,168**	Rincon	Early Holocene	Early Holocene	Surface
313	SOL-334	30-40cmbs	**DH**	Null		Rincon	Early Holocene	Early Holocene	Surface
314	SOL-334	30-40cmbs	**VW**	Null		Rincon	Early Holocene	Early Holocene	Surface
315	SOL-334	30-40cmbs	**3.3**	OK	**1,623**	Rincon	Early Holocene	Early Holocene	Surface
316	SOL-334	30-40cmbs	**VW**	Null		Rincon	Early Holocene	Early Holocene	Surface
317	SOL-334	30-40cmbs	**3.6**	OK	**1,931**	Rincon	Early Holocene	Early Holocene	Surface
318	SOL-468	40-80cmbs	**4.7**	OK	**3,277**	Yolo	Late Holocene	Late Holocene	Surface
319	SOL-468	40-80cmbs	**2.9**	OK	**1,279**	Yolo	Late Holocene	Late Holocene	Surface
320	SOL-468	40-80cmbs	**5.4**	OK	**4,409**	Yolo	Late Holocene	Late Holocene	Surface
321	SOL-468	40-80cmbs	**3.6**	OK	**1,942**	Yolo	Late Holocene	Late Holocene	Surface
322	SOL-468	40-80cmbs	**3.6**	OK	**1,899**	Yolo	Late Holocene	Late Holocene	Surface
323	SOL-468	40-80cmbs	**3.6**	OK	**1,888**	Yolo	Late Holocene	Late Holocene	Surface
324	SOL-468	40-80cmbs	**4.4**	BAND2	**2,845**	Yolo	Late Holocene	Late Holocene	Surface

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
325	SOL-468	Trench 15 Upper Midden Control Sample	Flake G	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
326	SOL-468	Trench 15 Upper Midden Control Sample	Flake H	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
327	SOL-468	Trench 15 Upper Midden Control Sample	Flake I	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
328	SOL-468	Trench 15 Upper Midden Control Sample	Flake J	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
329	SOL-468	Trench 15 Lower Midden Control Sample	Flake A (2)	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
330	SOL-468	Trench 15 Lower Midden Control Sample	Flake B (2)	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
331	SOL-468	Trench 15 Lower Midden Control Sample	Flake C (2)	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
332	SOL-468	Trench 15 Lower Midden Control Sample	Flake D (2)	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
333	SOL-468	Trench 15 Lower Midden Control Sample	Flake D (2) *Mean 2	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
334	SOL-468	Trench 15 Lower Midden Control Sample	Flake E (2)	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
335	SOL-468	Trench 15 Lower Midden Control Sample	Flake F (2)	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
336	SOL-468	Trench 15 Lower Midden Control Sample	Flake G (2)	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
337	SOL-468	Trench 15 Lower Midden Control Sample	Flake G (2) *Mean 2	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
325	SOL-468	40-80cmbs	**4.0**	OK	**2,396**	Yolo	Late Holocene	Late Holocene	Surface
326	SOL-468	40-80cmbs	**3.0**	OK	**1,332**	Yolo	Late Holocene	Late Holocene	Surface
327	SOL-468	40-80cmbs	**3.0**	OK	**1,341**	Yolo	Late Holocene	Late Holocene	Surface
328	SOL-468	40-80cmbs	**5.3**	OK	**4,217**	Yolo	Late Holocene	Late Holocene	Surface
329	SOL-468	240-260cmbs	**5.8**	OK	**5,012**	Yolo	Late Holocene	Early Holocene	Buried
330	SOL-468	240-260cmbs	**5.8**	OK	**5,064**	Yolo	Late Holocene	Early Holocene	Buried
331	SOL-468	240-260cmbs	**5.8**	OK	**5,064**	Yolo	Late Holocene	Early Holocene	Buried
332	SOL-468	240-260cmbs	**5.9**	OK	**5,134**	Yolo	Late Holocene	Early Holocene	Buried
333	SOL-468	240-260cmbs	**6.2**	BAND2	**5,672**	Yolo	Late Holocene	Early Holocene	Buried
334	SOL-468	240-260cmbs	**UNR**	Null		Yolo	Late Holocene	Early Holocene	Buried
335	SOL-468	240-260cmbs	**UNR**	Null		Yolo	Late Holocene	Early Holocene	Buried
336	SOL-468	240-260cmbs	**4.3**	OK	**2,717**	Yolo	Late Holocene	Early Holocene	Buried
337	SOL-468	240-260cmbs	**5.6**	BAND2	**4,689**	Yolo	Late Holocene	Early Holocene	Buried

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
338	SOL-468	Trench 15 Lower Midden Control Sample	Flake H (2)	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
339	SOL-468	Trench 15 Lower Midden Control Sample	Flake I (2)	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
340	SOL-468	Trench 15 Lower Midden Control Sample	Flake I (2) *Mean 2	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
341	SOL-468	Trench 15 Lower Midden Control Sample	Flake J (2)	Napa (visual)	Carpenter 2009	Whitaker and Kaijankoski 2009
342	SOL-451	Trench 3	Flake A	Napa (XRF by Richard Hughes)	Carpenter 2009	Meyer and Morgan 2007
343	SOL-451	Trench 3	Flake B	Napa (XRF by Richard Hughes)	Carpenter 2009	Meyer and Morgan 2007
344	SOL-451	Trench 3	Flake C	Napa (XRF by Richard Hughes)	Carpenter 2009	Meyer and Morgan 2007
345	SOL-451	Trench 3	Biface	Napa (XRF by Richard Hughes)	Carpenter 2009	Meyer and Morgan 2007
346	SOL-451	Trench 3	Biface	Napa (XRF by Richard Hughes)	Carpenter 2009	Meyer and Morgan 2007
347	SOL-270	Pit D-9	Retouched Flake	No Source Data	Not Reported	McGonagle 1966
348	SOL-270	Pit D-9	Retouched Flake	No Source Data	Not Reported	McGonagle 1966
349	SOL-270	Pit D-9	Point, Type 1c	No Source Data	Not Reported	McGonagle 1966
350	SOL-270	Pit D-9	Point, Type 1	No Source Data	Not Reported	McGonagle 1966

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
338	SOL-468	240-260cmbs	**4.4**	OK	**2,858**	Yolo	Late Holocene	Early Holocene	Buried
339	SOL-468	240-260cmbs	**5.9**	OK	**5,134**	Yolo	Late Holocene	Early Holocene	Buried
340	SOL-468	240-260cmbs	**6.9**	BAND2	**7,052**	Yolo	Late Holocene	Early Holocene	Buried
341	SOL-468	240-260cmbs	**UNR**	Null		Yolo	Late Holocene	Early Holocene	Buried
342	SOL-451	20-60cmbs	**4.9**	OK	**3,519**	Brentwood	Late Holocene	Late Holocene	Surface
343	SOL-451	20-60cmbs	**4.2**	OK	**2,578**	Brentwood	Late Holocene	Late Holocene	Surface
344	SOL-451	20-60cmbs	**4.0**	OK	**2,336**	Brentwood	Late Holocene	Late Holocene	Surface
345	SOL-451	20-60cmbs	**3.9**	OK	**2,255**	Brentwood	Late Holocene	Late Holocene	Surface
346	SOL-451	20-60cmbs	**2.3**	OK	**775**	Brentwood	Late Holocene	Late Holocene	Surface
347	SOL-270	15-31cmbs	**1.2**	Rejected	**215**	Yolo, Brentwood	Unclear	Unclear	Unclear
348	SOL-270	31-46cmbs	**2.5**	Rejected	**931**	Yolo, Brentwood	Unclear	Unclear	Unclear
349	SOL-270	46-61cmbs	**3**	Rejected	**1,341**	Yolo, Brentwood	Unclear	Unclear	Unclear
350	SOL-270	46-61cmbs	**3.5**	Rejected	**1,825**	Yolo, Brentwood	Unclear	Unclear	Unclear

	Site	Sample Location (Unit, Trench, etc.)	Description	Source (sourcing)	Hydrated by	Reference
351	SOL-270	Pit D-9	Point, Type 1b	No Source Data	Not Reported	McGonagle 1966
352	SOL-270	Pit D-9	Blade Fragment	No Source Data	Not Reported	McGonagle 1966
353	SOL-270	Pit D-9	Point, Type 1	No Source Data	Not Reported	McGonagle 1966
354	SOL-270	Pit I-4	Point, Type 1b	No Source Data	Not Reported	McGonagle 1966
355	SOL-270	Pit I-4	Point, Type 1	No Source Data	Not Reported	McGonagle 1966
356	SOL-270	Pit I-4	Point Fragment	No Source Data	Not Reported	McGonagle 1966
357	SOL-270	Pit I-4	Retouched Flake	No Source Data	Not Reported	McGonagle 1966
358	SOL-270	Pit I-4	Point, Type 1b	No Source Data	Not Reported	McGonagle 1966
359	SOL-270	Pit I-4	Point Fragment	No Source Data	Not Reported	McGonagle 1966
360	SOL-270	Pit I-4	Retouched Flake	No Source Data	Not Reported	McGonagle 1966
361	SOL-270	Pit I-4	Blade Fragment	No Source Data	Not Reported	McGonagle 1966
362	SOL-270	Pit I-4	Blade Fragment	No Source Data	Not Reported	McGonagle 1966

	Site	Depth/Context	Mean Hydration Value	Use in Analysis	Rosenthal Rate Conversion	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred Sfc. Site Is On	Surface or Buried Site
351	SOL-270	61-76cmbs	**2.3**	Rejected	**788**	Yolo, Brentwood	Unclear	Unclear	Unclear
352	SOL-270	76-91cmbs	**2**	Rejected	**596**	Yolo, Brentwood	Unclear	Unclear	Unclear
353	SOL-270	107-117cmbs	**2.2**	Rejected	**721**	Yolo, Brentwood	Unclear	Unclear	Unclear
354	SOL-270	31-46cmbs	**2.4**	Rejected	**858**	Yolo, Brentwood	Unclear	Unclear	Unclear
355	SOL-270	31-46cmbs	**3**	Rejected	**1,341**	Yolo, Brentwood	Unclear	Unclear	Unclear
356	SOL-270	61-76cmbs	**1.6**	Rejected	**381**	Yolo, Brentwood	Unclear	Unclear	Unclear
357	SOL-270	91-107cmbs	**2.5**	Rejected	**931**	Yolo, Brentwood	Unclear	Unclear	Unclear
358	SOL-270	122-137cmbs	**2.2**	Rejected	**721**	Yolo, Brentwood	Unclear	Unclear	Unclear
359	SOL-270	122-137cmbs	**1**	Rejected	**149**	Yolo, Brentwood	Unclear	Unclear	Unclear
360	SOL-270	137-152cmbs	**4**	Rejected	**2,384**	Yolo, Brentwood	Unclear	Unclear	Unclear
361	SOL-270	152-168cmbs	**3.4**	Rejected	**1,722**	Yolo, Brentwood	Unclear	Unclear	Unclear
362	SOL-270	183-185cmbs	**2.7**	Rejected	**1,086**	Yolo, Brentwood	Unclear	Unclear	Unclear

Obsidian Hydration Results From Present Study

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March 24, 2011

Naomi Scher
P.O. Box 883
Cotati, CA 94931

Dear Naomi:

I write to report the results of obsidian hydration band analysis of two specimens from a deeply buried stratum in the west bank of Ulatis Creek at site CA-SOL-357 in Pleasants Valley, Solano County, California. This work was completed as part of your master's thesis research at Sonoma State University.

Procedures typically used by our lab for preparation of thin sections and measurement of hydration bands are described here. Specimens are examined to find two or more surfaces that will yield edges that will be perpendicular to the microslides when preparation of each thin section is done. Generally, two parallel cuts are made at an appropriate location along the edge of each specimen with a four-inch diameter circular saw blade mounted on a lapidary trimsaw. The cuts result in the isolation of small samples with a thickness of about one millimeter. The samples are removed from the specimens and mounted with Lakeside Cement onto etched glass micro-slides.

The thickness of each sample was reduced by manual grinding with a slurry of #600 silicon carbide abrasive on plate glass. Grinding was completed in two steps. The first grinding is stopped when each sample's thickness is reduced by approximately one-half. This eliminates micro-flake scars created by the saw blade during the cutting process. Each slide is then reheated, which liquefies the Lakeside Cement, and the samples are inverted. The newly exposed surfaces are then ground until proper thickness is attained.

Correct thin section thickness is determined by the "touch" technique. A finger is rubbed across the slide, onto the sample, and the difference (sample thickness) is "felt." The second technique used to arrive at proper thin section thickness is the "transparency" test where the micro-slide is held up to a strong source of light and the translucency of each sample is observed. The samples are reduced enough when it readily allows the passage of light. A cover glass is affixed over each sample when grinding is completed. The slides and paperwork are on file under File No. OOL-574.

The hydration bands are measured with a strainfree 60-power objective and a Bausch and Lomb 12.5-power filar micrometer eyepiece mounted on a Nikon Labophot-Pol polarizing microscope. Hydration band measurements have a range of +/- 0.2 microns due to normal equipment limitations. Six measurements are taken at several locations along the edge of each thin section, and the mean of the measurements is calculated and listed on the enclosed data page.

We used the hydration band measurements to calculate dates as described here. The effective hydration temperature (EHT) differences are taken into account between the control source's EHT and the subject specimens' EHT. EHT values are calculated using temperature data from the website, www.wrcc.dri.edu/summary/climsmut.html and following steps outlined by Rogers (2007). We are able to adjust the subject specimens' hydration band measurements and use them in the standard diffuse formula (Time = kx^2) to arrive at dates. "K" is the hydration rate constant and "x" is the hydration band measurement.

In this case, it appears, based on macroscopic examination, that the two specimens derived from source localities in Napa Valley (e.g., Napa Glass Mountain).

The EHT for the control obsidian source (Napa Glass Mountain) is 16.8, and the nearest weather station to your site is at Vacaville with an EHT of 19.6, or roughly three degrees warmer than the control source EHT. This means that obsidian at the site hydrates more quickly than the same source of obsidian would have at the control locality (Santa Rosa, Sonoma County). Because the EHT for the site is warmer we adjust the hydration band measurements downward by 6% per degree difference. Six percent has been found to be an appropriate adjustment based on several studies (Basgall 1990; Origer 1989). After adjusting the measurements for EHT differences, dates shown below were calculated.

Hydration band adjustments for EHT and dates

Specimen Number	Hydration Band (in microns)	EHT Adjusted Hydration Band	Date (in years before present)
1	3.7	3.1	1,474
2	3.7	3.1	1,474

Please don't hesitate to contact me if you have questions regarding this hydration work.

Sincerely,

Thomas M. Origer
Director

References

Basgall, M
1990 Hydration Dating of Coso Obsidian: Problems and Prospects. Paper presented at the 24th annual meeting of the Society for California Archaeology, Foster City, California.

Origer, T.
1989 Hydration Analysis of Obsidian Flakes Produced by Ishi During the Historic Period. Current Directions in California Obsidian Studies. Contributions of the University of California Archaeological Research Facility. Number 48. Berkeley, California.

Rogers, A.
2007 Effective hydration temperature of obsidian: a diffusion theory analysis of time-dependent hydration rates. Journal of Archaeological Science 34:656-665.

Submitter: N. Scher - Sonoma State University

March 2011

	Lab#	Sample#	Description	Unit	Depth	Remarks	Measurements	Mean	Source*
CA-SOL-357									
	1		Debitage		4.9m	None	3.6 3.7 3.7 3.8 3.8 3.8	3.7	NV (v)
	2		Uniface Fragment		4.9m	None	3.6 3.6 3.6 3.7 3.7 3.7	3.7	NV (v)

Lab Accession No: OOL-574

Technician: Thomas M. Origer

*Specimens were visually sourced
NV = Napa Valley

Submitter: N. Scher August 2011

	Lab#	Sample#	Description	Unit	Depth	Remarks	Measurements	Mean	Source*
Laguna Creek									
	1		Debitage	Exposure 1		none	1.7 1.7 1.7 1.7 1.8 1.8	1.7	NV(v)
	2		Debitage	Exposure 1		none	6.6 6.6 6.7 6.7 6.7 6.8	6.7	NV(v)
	3		Debitage	Exposure 1		none	2.5 2.6 2.6 2.6 2.6 2.8	2.6	NV(v)
	4		Debitage	Exposure 2		weathered	Approx. 25.0+	VW	NV(v)
	5		Debitage	Exposure 2		none	3.5 3.5 3.6 3.6 3.6 3.6	3.6	NV(v)

Lab Accession No: OOL-614 Technician: Thomas M. Origer

*(v) = specimens were visually sourced
NV = Napa Valley

Data Page 1 of 1

APPENDIX G:

RADIOCARBON DATA

Radiocarbon Database

	Project and/or Site	Sample Location (Unit, Trench, etc.)	Context 1	Context 2	Material Dated	Min. Depth (cm)	Max. Depth (cm)	Avg. Depth cm	^{14}C age	±	Min. Cal BP 2 Sigma	Cal BP (med. Prob.)	Max. Cal BP 2 Sigma
1	**SOL I-80, Laguna Creek Site**	Area-Trench 08-09, 2ABtb	Buried	Cultural	Charcoal (wild cucumber)	200	220	210	7,990	45	8,699	8,864	9,006
2	**SOL I-80**	Area-Trench 10-01, 2Ab, Ulatis Creek	Buried	Natural	Soil (SOC)	185	210	198	3,170	25	3,359	3,395	3,445
3	**SOL I-80**	Area-Trench 10-06, 3Ab, Ulatis Creek	Buried	Natural	Soil (SOC)	340	350	345	6,570	45	7,423	7,475	7,522
4	**SOL I-80**	Area-Trench 11-01, 3Btb, Gibson Canyon Creek	Buried	Natural	Soil (SOC)	300	320	310	19,100	170	22,343	22,802	23,348
5	**SOL I-80**	Area-Trench 12-06, 4ABtb, Dixon Ridge	Buried	Natural	Soil (SOC)	140	150	145	4,870	35	5,581	5,610	5,661
6	**SOL I-80, SOL-030/H, Pena Adobe**	CU-1, Feature 1, housepit	Surface	Cultural	Charcoal (manzanita)	30	70	50	215	25	147	175	304
7	**SOL I-80, SOL-030/H, Pena Adobe**	CU-2, Feature 2, pit	Surface	Cultural	Charcoal (manzanita)	48	70	59	430	25	462	501	523
8	**SOL-357**	Ulatis Creek Exposure, 4Ab2	Buried	Natural	Charcoal (wood)	480	500	490	950	30	794	855	926
9	**SOL-357**	Ulatis Creek Exposure, 2Ab	Buried	Natural	Soil (SOC)	100	130	115	1,640	30	1,482	1,539	1,613
10	**SOL-357**	Feature, Burial 210	Buried	Cultural	Shell bead F3a1	Unknown	Unknown	Unknown	1,760	35	918	1,023	1,147
11	**SOL-357**	Feature, Burial 208	Buried	Cultural	Shell bead F4d	Unknown	Unknown	Unknown	1,785	35	931	1,050	1,168
12	**SOL-357**	Feature, Burial 232	Buried	Cultural	Shell bead F4a	Unknown	Unknown	Unknown	1,810	35	954	1,080	1,206
13	**SOL-320/H**	Davis Street, Burial 2-1	Surface	Cultural	Charcoal (Wood)	20	40	30	170	40	124	173	295

	Project and/or Site	Rejected	Lab. No.	Reference	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred buried sfc. 1	Inferred buried sfc. 2	Inferred sfc. being dated
1	**SOL I-80, Laguna Creek Site**		OS-88582	Hildebrandt et al. 2012	Yolo	Late Holocene	Early Holocene		Early Holocene
2	**SOL I-80**		OS-88583	Hildebrandt et al. 2012	Brentwood	Recent Holocene	Late Holocene		Late Holocene
3	**SOL I-80**		OS-88589	Hildebrandt et al. 2012	Brentwood	Recent Holocene	Late Holocene		Early Holocene
4	**SOL I-80**		OS-89017	Hildebrandt et al. 2012	Yolo	Recent Holocene	Latest Pleistocene	Pre-Latest Pleistocene	Pre-Latest Pleistocene
5	**SOL I-80**		OS-89044	Hildebrandt et al. 2012	Yolo	Recent Holocene	Late Holocene	Late Holocene	Early Holocene
6	**SOL I-80, SOL-030/H, Pena Adobe**		OS-88584	Hildebrandt et al. 2012	Brentwood	Recent Holocene	Late Holocene		Recent Holocene
7	**SOL I-80, SOL-030/H, Pena Adobe**		OS-88585	Hildebrandt et al. 2012	Brentwood	Recent Holocene	Late Holocene		Recent Holocene
8	**SOL-357**		Beta-294321	Scher 2012	Brentwood	Recent Holocene	Late Holocene		Late Holocene
9	**SOL-357**	Rejected	Beta-294322	Scher 2012	Brentwood	Recent Holocene	Late Holocene		Recent Holocene
10	**SOL-357**		C-122454	Not reported	Brentwood	Recent Holocene	Late Holocene		Late Holocene
11	**SOL-357**		C-122453	Not reported	Brentwood	Recent Holocene	Late Holocene		Late Holocene
12	**SOL-357**		C-122455	Not reported	Brentwood	Recent Holocene	Late Holocene		Late Holocene
13	**SOL-320/H**		Beta - 199284	Rosenthal, Carpenter, and Whitaker 2009	Brentwood	Late Holocene	Late Holocene		Late Holocene

	Project and/or Site	Sample Location (Unit, Trench, etc.)	Context 1	Context 2	Material Dated	Min. Depth (cm)	Max. Depth (cm)	Avg. Depth cm	^{14}C age	±	Min. Cal BP 2 Sigma	Cal BP (med. Prob.)	Max. Cal BP 2 Sigma
14	**SOL-320/H**	Vasquez Deli excavation location, Feature 1	Surface	Cultural	Charcoal (Wood)	59	59	59	1,160	80	934	1,087	1,192
15	**SOL-425/H**	Burial 2	Surface	Cultural	Charcoal (Wood)	51	51	51	1,830	40	1,693	1,769	1,871
16	**SOL-425/H**	Feature 1	Surface	Cultural	Charcoal (Wood)	85	105	95	1,970	80	1,726	1,926	2,120
17	**SOL-270**	Burial 13	Unknown	Cultural	Shell bead G3b	Unknown	Unknown	Unknown	2,395	25	1,566	1,693	1,811
18	**SOL-270**	Burial 6	Unknown	Cultural	Shell bead G2a	Unknown	Unknown	Unknown	2,525	30	1,716	1,844	1,961
19	**SOL-270**	Burial 15	Unknown	Cultural	Shell bead G2a	Unknown	Unknown	Unknown	2,680	30	1,893	2,026	2,146
20	**SOL-270**	Burial 2	Unknown	Cultural	Shell bead F2b	Unknown	Unknown	Unknown	2,680	35	1,882	2,027	2,153
21	**SOL-468**	Trench 16, Stratum I, A horizon	Buried	Natural	Soil (SOC)	400	420	410	11,060	60	12,727	12,952	13,112
22	**SOL-468**	Trench 15, Stratum II, A horizon	Buried	Natural	Soil (SOC)	240	260	250	6,370	40	7,247	7,306	7,420
23	**SOL-324**	Unit 33, Stratum II	Buried	Cultural	Charcoal	230	240	235	3,390	40	3,554	3,636	3,723

	Project and/or Site	Rejected	Lab. No.	Reference	Soil Mapped at Sfc.	Inferred Sfc. Landform	Inferred buried sfc. 1	Inferred buried sfc. 2	Inferred sfc. being dated
14	**SOL-320/H**		Beta - 199285	Rosenthal, Carpenter, and Whitaker 2009	Brentwood	Late Holocene	Late Holocene		Late Holocene
15	**SOL-425/H**		Beta-193398	Rosenthal, Carpenter, and Whitaker 2009	Brentwood	Late Holocene	Late Holocene		Late Holocene
16	**SOL-425/H**		Beta-193399	Rosenthal, Carpenter, and Whitaker 2009	Brentwood	Late Holocene	Late Holocene		Late Holocene
17	**SOL-270**	Rejected	CAMS-82183	Groza 2002	Yolo, Brentwood	Recent Holocene	Late Holocene		Unclear
18	**SOL-270**	Rejected	CAMS-82184	Groza 2002	Yolo, Brentwood	Recent Holocene	Late Holocene		Unclear
19	**SOL-270**	Rejected	CAMS-82185	Groza 2002	Yolo, Brentwood	Recent Holocene	Late Holocene		Unclear
20	**SOL-270**	Rejected	CAMS-82186	Groza 2002	Yolo, Brentwood	Recent Holocene	Late Holocene		Unclear
21	**SOL-468**		Beta-261742	Whitaker and Kaijankoski 2009	Yolo	Late Holocene	Early Holocene	Latest Pleistocene	Latest Pleistocene
22	**SOL-468**		Beta-261741	Whitaker and Kaijankoski 2009	Yolo	Late Holocene	Early Holocene	Latest Pleistocene	Early Holocene
23	**SOL-324**		Not Reported	Jones and Stokes 2001	Yolo	Recent Holocene	Late Holocene		Late Holocene

Radiocarbon Results From Present Study

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Darden Hood
President

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March 27, 2011

Ms. Naomi Scher
Sonoma State University
PO Box 883
Cotati, CA 94931
USA

RE: Radiocarbon Dating Results For Samples Ulatis-01-A, Ulatis-01-B

Dear Ms. Scher:

Enclosed are the radiocarbon dating results for two samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. The report sheet contains the dating result, method used, material type, applied pretreatment and two-sigma calendar calibration result (where applicable) for each sample.

This report has been both mailed and sent electronically, along with a separate publication quality calendar calibration page. This is useful for incorporating directly into your reports. It is also digitally available in Windows metafile (.wmf) format upon request. Calibrations are calculated using the newest (2004) calibration database. References are quoted on the bottom of each calibration page. Multiple probability ranges may appear in some cases, due to short-term variations in the atmospheric 14C contents at certain time periods. Examining the calibration graphs will help you understand this phenomenon. Calibrations may not be included with all analyses. The upper limit is about 20,000 years, the lower limit is about 250 years and some material types are not suitable for calibration (e.g. water).

We analyzed these samples on a sole priority basis. No students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

Information pages are enclosed with the mailed copy of this report. They should answer most of questions you may have. If they do not, or if you have specific questions about the analyses, please do not hesitate to contact us. Someone is always available to answer your questions.

Thank you for prepaying the analyses. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
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REPORT OF RADIOCARBON DATING ANALYSES

Ms. Naomi Scher — Report Date: 3/27/2011

Sonoma State University — Material Received: 2/22/2011

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 294321 SAMPLE : Ulatis-01-A ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1020 to 1160 (Cal BP 930 to 790)	950 +/- 30 BP	-25.2 o/oo	950 +/- 30 BP
Beta - 294322 SAMPLE : Ulatis-01-B ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal AD 350 to 440 (Cal BP 1600 to 1510) AND Cal AD 490 to 520 (Cal BP 1460 to 1430)	1640 +/- 30 BP	-25.2 o/oo	1640 +/- 30 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

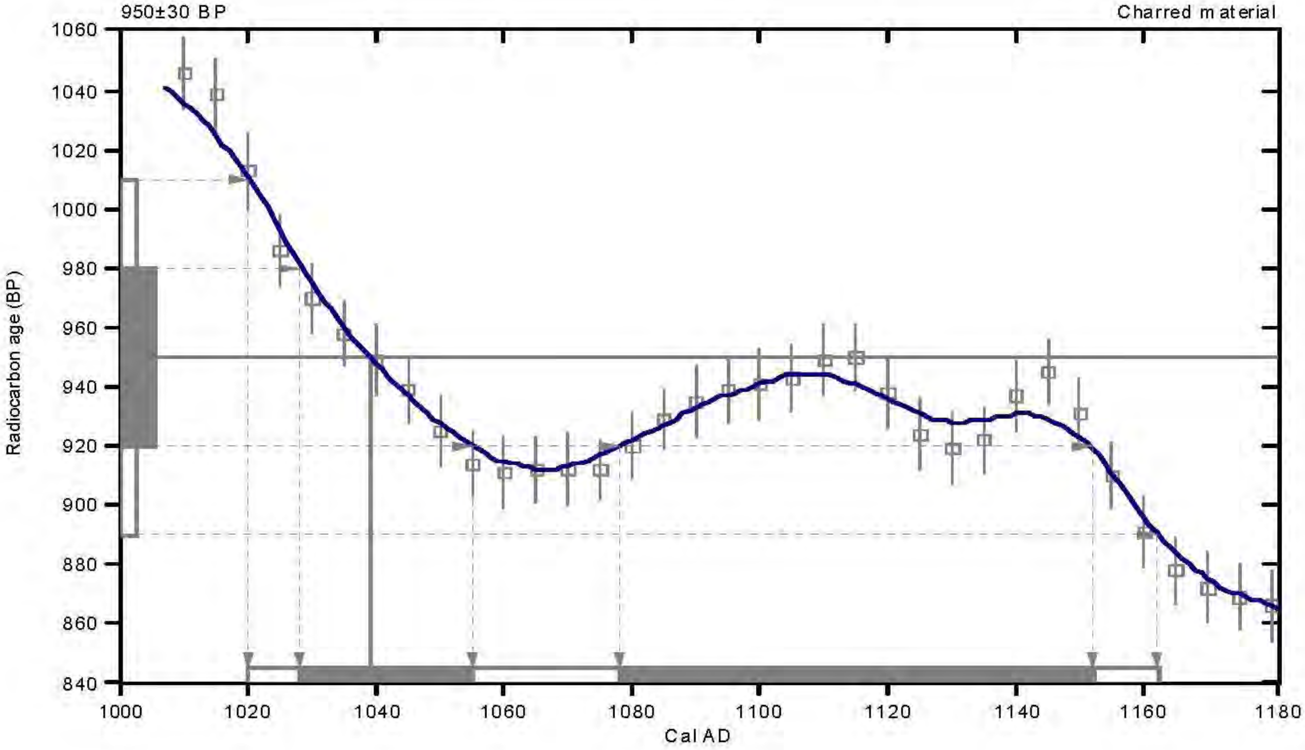
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.2:lab. mult=1)

Laboratory number:	**Beta-294321**
Conventional radiocarbon age:	**950±30 BP**
2 Sigma calibrated result: **(95% probability)**	**Cal AD 1020 to 1160 (Cal BP 930 to 790)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 1040 (Cal BP 910)
1 Sigma calibrated results: (68% probability)	Cal AD 1030 to 1060 (Cal BP 920 to 900) and Cal AD 1080 to 1150 (Cal BP 870 to 800)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.2:lab. mult=1)

Laboratory number: **Beta-294322**

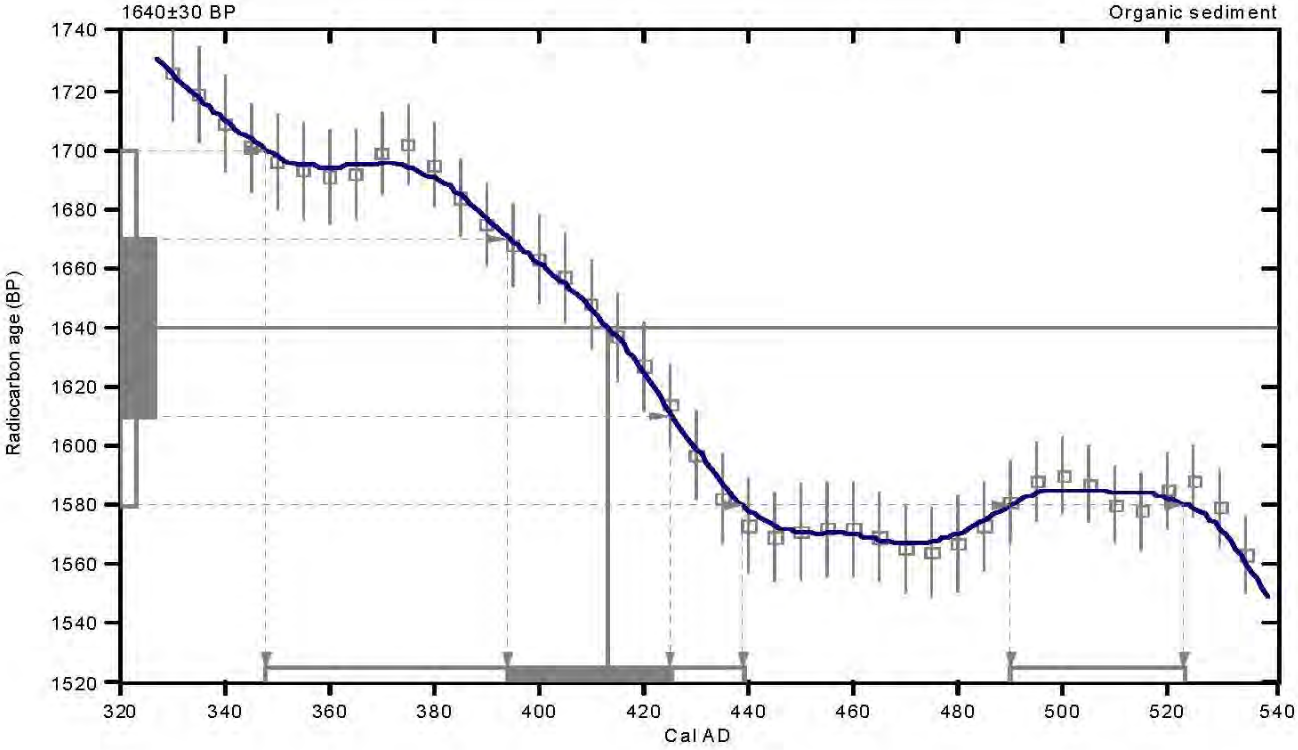
Conventional radiocarbon age: **1640±30 BP**

2 Sigma calibrated results: **Cal AD 350 to 440 (Cal BP 1600 to 1510) and**
(95% probability) **Cal AD 490 to 520 (Cal BP 1460 to 1430)**

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 410 (Cal BP 1540)

1 Sigma calibrated result: Cal AD 390 to 420 (Cal BP 1560 to 1520)
(68% probability)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
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