ARCHAEOLOGICAL RESOURCES ON LAU'AGAE RIDGE: A PHASE II CULTURAL RESOURCE EVALUATION OF SITE AS-21-100 (THE LAU'AGAE RIDGE QUARRY) FOR PHASE III OF THE ONENOA ROAD PROJECT LOCATED IN EAST VAIFANUA COUNTY, TUTUILA ISLAND, AMERICAN SAMOA
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FEDERAL HIGHWAY PROJECT NO. AS-NH-008(5)

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Abstract

Archaeological investigations have been conducted at Site AS-21-100 located along the Right-of-Way for Phase III the Onenoa Road Project. The site, located on the eastern end of Tutuila, extends from within the Right-of-Way, up the sloping terminus of the ridge, to the summit of the western end of Lau’agae Ridge.

During the current investigations, a 100% surface survey of Site AS-21-100 was undertaken. This survey identified and mapped the location of all component features within the site. Manual subsurface testing was conducted at several features located within the grading limits for the Right-of-Way. These excavations recovered predominantly historic debris though a few possible traditionally modified lithic flakes as well as a small amount of faunal material and possible marine shell midden were also recovered. In addition, backhoe testing was conducted at locations along the roadway at which box culverts were to be placed, although, no significant cultural deposits were encountered during this testing.

During the surface survey, several broken adze preforms and polished basalt fragments were recovered, consistent with the hypothesized use of this site as the quarry from which the inhabitants of the prehistoric village of Tulauta obtained their lithic resources. Therefore, basalt samples were collected from features at varying elevations across the site. Three of these samples were selected for analysis of their chemical composition, the results of which are presented in this document.

The results of these investigations have mitigated the impact of construction activities for Phase III of the Onenoa Road Project on Site AS-21-100. Therefore, Archaeological Consultants of Hawaii, Inc. has made the determination that construction activities have had "no adverse effect" on significant historic properties. The site remains significant to the interests of historic preservation.
Archaeological Resources on Lau‘agae Ridge:
A Phase II Cultural Resource Evaluation
of Site AS-21-100 (The Lau‘agae Ridge Quarry)
for Phase III of the Onoao Road Project Located in
East Vaiana County, Tutuila Island, American Samoa

Section 1: Introduction

At the request of Mr. George Poyesky of the Samoa
Maritime Company, Archaeological Consultants of Hawaii, Inc.
(ACH) conducted a Phase II Cultural Resource Evaluation of a
previously identified site (The Lau‘agae Ridge Quarry, Site
AS-21-100) located on property within and adjacent to the
Right-of-Way (ROW) for Phase III of the Onoao Road Federal
Highway Project No. AS-NH-008(5), in East Vaiana County, on
the island of Tutuila, American Samoa (see Map 1). The
purpose of a Phase II investigation is to evaluate the
significance of historic resources located on a property,
including its eligibility for inclusion in the National
Register of Historic Places, and to make recommendations
concerning the mitigation of future construction activities
upon possibly significant historic resources.

The Lau‘agae Ridge Quarry was initially identified by
Clark (1989) and designated as Site AS-21-100 by Clark and
Herdrich (1993). The subject property has also recently been
the subject of a Phase I cultural resource evaluation
(Franklin 1993). For the purposes of the current
investigations, the subject property is considered the parcel
on which Site AS-21-100 is located, including land both
within and outside of the ROW. During the Phase I
evaluation, the site was temporarily designated number 1442-1
(Franklin 1993) but the official designation of the site,
accepted by the American Samoa Historic Preservation Office
(ASHPO), is AS-21-100. This official designation will be
used throughout this text. During the current survey the
locations of all features within this site were re-identified
and subsurface testing was conducted at selected features
within the ROW and a zone of impact within and immediately
adjacent to the grading limits for the ROW. Information
concerning the significant historic resources located on the
subject property is presented in this report.

Section 2: Physical Setting

The subject property is located at geographic grid
coordinates 170°34′00"W and 14°15′10"S, and at UTM (Universal
Transverse Mercator) coordinates 546750mE and 8424300mN (see
Map 2). The subject property ranges in elevation from
between 30 and 269ft AMSL (above mean sea level) and is
approximately 40 to 125m from the coastline. The property
measures approximately 200m long and varies between 30 and
Map 1: Island Map of Tutuila

La‘ungaa Ridge Quarry: Site AS-21-100

source: University of Hawaii Press 1980
100m wide covering approximately 10,000 square meters (1 hectare, 100 are, 2.47 acres).

The subject property consists of a parcel located on the western end of Lau‘agae Ridge on Cape Matatula past the village of Tula on the eastern end of the island of Tutuila. This property, on which Site AS-21-100 is located, extends from within the ROW for the Onoana Road Project, up the sloping terminus of Lau‘agae Ridge, to the summit of the ridges' western end where the U.S. Geologic Survey Pin marking the summits’ 209ft elevation is located (see Maps 2 and 3 as well as Appendix D, Plate I).

The Atlas of American Samoa depicts the soils on the subject property as being of the Fa'aga family, a lithic hapludolls and rock outcrop association (Atlas 1981: Soils - Plate 3). Soils covering the rock outcrop were typical of the Leau'stony, silty clays. Located on the eastern end of the island, rainfall on the subject property averages approximately 100 inches a year and the mean annual temperature is approximately 82 degrees Fahrenheit (Clark and Herdrich 1988:5).

The majority of the subject property is under cultivation. This consists of a fairly large upper banana patch separated from a smaller lower banana patch by an interval of increased steepness approximately 10m wide (locations of the two cultivated areas are depicted on Map 5, Section 5.1). The lower banana patch is adjacent to the existing dirt road and is within the limits of grading for the proposed ROW while the upper banana patch along the sloping crest of the ridge extends to within 20m of the summit. Within the cultivated patches, banana (Musa sp.) is the most common plant. Interspersed between clumps of banana trees were papaya (Carica papaya), breadfruit (Artocarpus communis), and coconut (Cocos nucifera) trees as well as isolated ta'amu (Alocasia sp.) and taro (Colocasia esculenta). At the summit of this end of Lau‘agae Ridge, ground cover consists of ferns and vines under the cover of papata (Macaranga sp.), coconut, and other individual trees of unidentified species. Additional unidentified species of bushes and shrubs were located at the lower elevations adjacent to the dirt road.

Section 3: Historic Background

The prehistory of Samoa is intimately linked with that of its neighboring islands and Polynesia as a whole. It has been documented that a seafaring people, travelling from the islands of Southeast Asia, spread eastward throughout the islands of the South Pacific (Kirch & Green 1987 and Jennings 1979). These people developed a unique culture that has become known as the Lapita cultural complex and is named for
Map 3: Extent of Lau'agae Ridge Quarry (Site AS-21-100)
the distinctive pottery that was crafted by them until at least A.D. 200, although recent work has indicated the use of ceramics up to one thousand years later (Clark 1993 and Kirch & Hunt 1993). This cultural complex has become well documented over the past several years and will not be reviewed further in this paper.

The Lapita people are believed to be the first inhabitants of Samoa. Over the millennia, these original Lapita settlers developed a sub-culture unique to Samoa with its own mythology and cosmology. Within this cosmology, the eastern end of Tutuila has been described as the first part of the island settled and the village of Tula itself (located near the current subject property) the location where the first fine mat was woven.

Section 3.1 Previous Archaeology

Modern archaeological investigations in American Samoa began with Kikuchi in the early 1960's. His island wide survey relied on informant testimony and many of the sites recorded were not visited (Clark & Herdich 1988:7). Several more limited surveys were conducted in the 1970's and were reviewed by Clark (1980, 1981). His work will not be repeated in this document. Since 1985, the efforts of the Historic Preservation Program have instigated additional investigations on both Tutuila and in the Manua's.

One of the larger projects conducted was The Eastern Tutuila Archaeology Project carried out under the direction of Jeffrey T. Clark over two seasons, the first in 1986 (Clark & Herdich 1988) and the second in 1988 (Clark 1989). While these investigations focused on bays along the northern coast of Tutuila, it also provided a detailed review of previous studies. From these sources we learn of early dates recorded from the finds at the only known archaeological site in the vicinity of the current subject property, Site AS-21-1, known as Tulauta (unfortunately, after repeated requests to Eric Voight of the ASHPO, ACH was not able to secure copies of the reports concerning Tulauta; Frost 1976 and 1978, Gould et al. 1985, or Brophy 1986).

Tulauta is currently the most significant archaeological site known in the vicinity of the subject property. It is located just inland from the current location of Tula village and approximately 150m from the lower end of the site (AS-21-100) under investigation in the current study. Excavations at Tulauta recovered datable samples which yielded conflicting dates from the same stratigraphic layer. Following analysis of the lithic artifacts recovered by Frost, Clark asserts "... the early date that Frost presented, in the absence of pottery, stands in contradiction to what one would expect for the artifact assemblage of a site of this age." (Clark & Herdich 1988:29). After a
review of all of the information available it was Clark's conclusion that the early date obtained for Tulauta is in error (1989:51). This implies that the later age range (recalibrated by ACH to A.D. 1278-1431 according to Stuiver & Reimer's Radiocarbon Calibration Program Rev. 3.0.3 1993) is the more likely date of usage for the occupation layer encountered.

Clark also reported a discrepancy between Frost's investigations and the study conducted by Gould et al. (1985). While Frost collected few lithic flakes, the later study reported that flakes were abundant. This discrepancy may be the result of terminological or methodological differences between the two studies.

Based upon his comparison of the lithic material collected in the two studies of Tulauta, Clark determined, "... it is clear that while Tulauta was the site of some stone tool manufacturing activity, it was not itself a quarry site." (Clark & Herdrich 1988:30). Brophy (1986) attributed the source of basalt used at Tulauta to a nearby quarry she termed the Maupua Site. In contrast, based on informant testimony provided for the current investigations and according to Clark (1989:37) and Clark & Herdrich (1993:166), Maupua has been determined to be the location of a modern quarry from which material may have been used for the construction of breakwaters at Au'as'i Harbor. Other possible uses of the material include the construction of the original roads to Cape Matatula and Onenca prior to WWII as well as for their re-surfacing (which reportedly occurred in the 1960's) (per. comm. Mitch Shimisaki 1994). The actual location of the quarry, and probable source of lithic material used for stone tool manufacture at Tulauta, is along the western end of Lau'agae Ridge at Site AS-21-100.

Section 3.2: Settlement Pattern and Land Use History

In the Atlas of American Samoa, the subject property is depicted within a zone of resource production in which fruit trees predominate (Atlas 1981: Land and Coastal Use - Plate 3). This zone extends to the coast at Tula where the current population resides. The phenomenon of coastal settlement is believed to be a modern development, Davidson states:

The bulk of the modern population lives in coastal settlements, and this has been the case since the 1830's. There is abundant archaeological evidence, however, that coastal concentration was a response to the beginning of European contact, and that until the early nineteenth century the population was much more evenly distributed over both coastal and inland areas in a form of dispersed settlement, probably with clusters
around the residences of people of high status (Davidson in Jennings 1979:96).

This pattern likely holds true for the Tula area as well.

Prehistoric settlement has been documented in the uplands, along ridges and at the peaks of mountains (Clark and Herdrich 1993). While the predominant feature type along ridges are ti'a 'ave (or star mounds), permanent residential sites, defensive sites and resource exploitation sites were also identified. This information corroborates the theory that prior to western contact the population was dispersed across landscape.

Assuming the area of agricultural production has remained stable, in pre-contact times the village of Tulauta was likely the population center of the area having its agricultural production dispersed across the valley bottom until reaching the coast. Habitation would have concentrated at the village (mu'ū), identified by the inclusion of three types of features (a malae, a fale tele and a fale aitu) as well as having an 'aiga based social hierarchy. Clusters of outlying structures (pitonu'u) could also have been occupied (Davidson 1969).

When in the colonization of Tutuila the valley that contains the remains of Tulauta and the modern village of Tula was settled is unknown. Clark states the nearby 'Aoa Valley was occupied between 3000 and 1700 years ago (Clark & Herdrich 1988:173 and Clark 1993). In that valley the first settlers are believed to be from the Lapita culture due to the presence of pottery. Based on the lack of pottery recovered from excavations conducted at Tulauta as well as the disputed early date obtained for the site, it is unlikely that this area was permanently settled as early as 'Aoa Valley (though future finds could contradict this conclusion).

Section 4: Archaeological Methodology

Section 4.1: Research Design

Archaeological work conducted in the Samoan archipelago relates to large variety of research topics. The results of the current work has relevance or potential relevance for two specific research topics discussed below.

The first research topic has to do with the extent of interisland trade in the material used for stone tools. Recently, a number of authors have conducted elemental analyses on stone tools found throughout the Pacific and on source rock from known quarries on Tutuila. Best et al. (1992) have shown that stone tools found in Tonga, Fiji, the
Solomon Islands, the Tokelau Islands, and the Cook Islands have all originated from Tutuila quarries, and argue, in particular, that the ultimate source is the quarry known as Tataga-matau near Leone. In addition, Weisler (in Kirch & Hunt 1993) has conducted an analysis on stone tools in Manuʻa and compared them to rock found at Tataga-matau. While Weisler acknowledges the "need to collect sufficient samples to define the geochemical variability of adz quarry sources", he concluded that 50% percent of the tools analyzed were from Tataga-matau (Kirch & Hunt 1993:179).

Recently Clark, Wright and Herdrich (in press) have conducted a literature review and analyses of the chemical composition of basalt from all of the major quarries on Tutuila presently known to exist. One of the findings from those analyses is that there is an overlap between the elemental percentages found in stone at different quarries. As a result, they hypothesize that it may not be possible to pin-point the exact quarry from which any given tool originated, only that it came from a particular island. Weisler's analyses and the current investigations, however, have produced results suggesting the possibility that through trace element analyses individual quarries may be distinguished.

The second topic of concern is the pattern of settlement distribution. Previous research in Samoa has shown a settlement pattern that started with coastal settlement. At some point in time, as the population expanded, the loci of habitation moved inland until there was a shift, in the late prehistoric/early historic period, from those inland settlements back to coastal habitation areas (Davidson 1969, 1974). Although several archaeological investigations have been conducted on the eastern portion of Tutuila, as additional areas are surveyed, a more comprehensive understanding of settlement patterns and land use histories will be forthcoming.

The primary purpose of the current investigations was to mitigate the effect of road construction activities through the identification and evaluation of historic and prehistoric archaeological sites within the Right-of-Way (ROW) corridor for Phase III of the Onoea Road Project as required by Section 106 of the National Register of Historic Places as amended, particularly Part 800 concerning the protection of historic and cultural properties. This research is important in regards to both territorial and regional research goals.

**Territorial Goals**

Territorial goals include the following:

1) Development of an inventory of historic and prehistoric archaeological sites.

2) Evaluation of historic and prehistoric sites relative
to the criteria for the National Register of Historic places.

3) Nomination of eligible properties to the National Register of Historic Places.

4) Protection of significant historic and prehistoric archaeological properties from potentially negative impacts.

The research contained in this report contributes to these territorial goals in the following ways: 1) By conducting a systematic survey of the road corridor any historic or prehistoric sites within the corridor will be able to be identified, 2) By conducting a systematic evaluation of sites identified in the current survey area, a determination of their significance relative to the National Register of Historic Places criteria will be able to be made, 3) The evaluation of known sites is the first step in the process of nominating sites to the National Register of Historic Places, 4) An assessment of the impact of the road on sites identified as significant will be made and, where necessary, recommendations will be made for their protection. In addition, providing the location of significant archaeological sites will contribute to the protection of these sites in the event of future developments.

Regional Goals

Regional goals include the following:

1) Gaining an understanding of trade relationships between various island groups (Best et al. 1990; Weisler 1993; Clark, Wright & Herdich in review).

2) Polynesian Origins: Constructing a sequence of migration and colonization of island groups (Kirch & Green 1987).

3) Documenting settlement patterns as evidence of the evolutionary trajectory of island societies in order to gain an understanding of evolutionary mechanisms effecting the development of societies throughout the Pacific (Goldman 1970; Kirch 1984; Graves & Green 1993).

The research contained in this report contributes to these regional goals in the following ways: 1) The collected lithic material can be made available for analysis to determine whether they were of local origin or were made of exotic materials thereby indicating the existence and extent of interisland trade networks with these materials, 2) Future analysis of sites identified during the current study may provide important evidence for understanding the sequence of migration and colonization in the Pacific, 3) The identification and mapping of a quarry site such as Site AS-21-100 are important contributions in understanding the evolution of Samoan settlement patterns. A clearer understanding of Samoan settlement patterns will eventually
lead to a better understanding of regional evolutionary mechanisms and trajectories.

Due to the fact that this investigation is compliance oriented the investigators were not guided by an explicit theoretical orientation other than a very general scientific and evolutionary perspective. Also, given that this is a compliance investigation it was not guided by explicit hypothesis testing. However, some of the current findings may contribute to and have implications for hypotheses that are currently being discussed in the literature. The information collected during this survey has potential implications for the recent work discussed above concerning basalt tools and settlement patterns.

**Section 4.2: Field Methods**

Fieldwork was conducted August 15 through September 2, 1994 by a field crew under the direction of the Principal Investigator, Joseph Kennedy, M.A. with the assistance of field archaeologists Tim Lawrence, B.A., and James R. Moore, B.S.

There were three stages of field work during the current investigations, including: backhoe testing of locations at which box culverts were to be placed, the identification and mapping of all component features of Site AS-21-100, and subsurface testing of features within the grading limits of the ROW in order to determine the probable age and function of these features. These investigations were conducted in concert with the wishes of Eric Voight of the ASHPO in order to mitigate the effects of road construction upon these features.

In the original Scope-of-Work, which specified the extent of archaeological work required for Phase III of the Onenoa Road Project, it was recommended that the excavation and construction of four box culverts be monitored by a professional archaeologist. After a field inspection by, and consultations with, Eric Voight (ASHPO) it was decided that backhoe testing of the locations at which the culverts were to be placed in order to determine the presence or absence of significant cultural deposits would be more effective than monitoring. Therefore, trenches were excavated using a backhoe with a 15 inch bucket at the stations (STA) where culverts were to be placed. All soils removed from the excavations were raked in order to identify cultural materials present, the stratigraphy exposed was noted, and soils samples taken.

An additional requirement of the current investigations was that (according to Section 696.02 in the Scope-of-Work), "All features in the site shall be mapped". During Phase I of the cultural resource evaluation only features within the
grading limits of the ROW were mapped although it was known that a feature complex (Feature Complex A) continued up the sloping ridge to its summit. Therefore, in order to completely map the site, a 100' surface survey of the subject property was conducted by the three man field crew with individual members of the crew spaced approximately 5m apart. Sweeps were initiated at the U.S. Geologic Survey pin at the summit of the western end of Lau'aga Ridge and continued using north-south transects until reaching the existing dirt road at the base of the ridge. Features were flagged and numbered as they were encountered (note: several features were numbered prior to beginning formal sweeps thereby causing their numbering to appear haphazard). Feature locations were fixed on a topographic map by Stuart R. Sheeler using a full station transit and stadia (refer to Map 4 bound in a pocket at the back of this report). During this systematic reconnaissance, basalt samples were collected from each lithic scatter feature and several adze preforms were identified and collected.

Finally, additional testing of features previously identified (Franklin 1993) was required in order to mitigate the effects of road construction within the grading limits of the ROW. The extent of this testing, however, was limited by the fact the earth moving activities conducted by a nearby landowner had obliterated two of the features (Features B and C) which had formerly been considered possible habitation pavements.

Excavations were conducted using standard archaeological techniques. Individual local datums were established for test units which were excavated in arbitrary 10cm increments within individual stratigraphic layers. All soils were screened through nested one quarter and one eighth inch mesh and all cultural or possibly cultural materials collected. Soil samples were collected from every excavated level. All samples collected were placed in labeled, plastic zip-lock bags and transported to ACH's laboratory at Pupukea, Hawaii for analyses.

Section 5: Archaeological Findings

Section 5.1: Results of Backhoe Testing

Backhoe testing was conducted at the locations of four box culverts which were to be placed at the edge of the roadway along the unfinished segment of the road. Although several of the areas specified for monitoring may have been previously tested by PHRI (Franklin 1993), no maps showing the location of test trenches was provided in their letter report and the full extent of testing (locations, dimensions, and depths of STP's and/or trenches) is not clearly specified. During the current investigations it was learned
that several stations specified in the Scope-of-Work as requiring monitoring are along portions of the road which have already been completed (perhaps completed following PHRI’s investigations?). Therefore, backhoe trenching conducted by ACH was limited to the locations of box culverts along portions of the road that had yet to be finished.

**Trench 1:** This trench was placed at the location of the box culvert to be placed at STA 35+10 (see Map 4). The trench extended from the base of the embankment along the northern side of the road into the roadway. The trench reached a maximum length of approximately 3.5m and depth of 122cmsg. Excavation encountered a surface cover of detrital material and compacted road surface underlain by a thin, lens-like layer (Layer I) of dusky red (10R 3/2) very coarse loamy sand that was approximately 8cm thick and reached a maximum depth of 10cmsg. Layer I was underlain by a deposit (Layer II) of imported road fill consisting of a dark reddish brown (2.5YR 3/3) very coarse and very stony sand that measured approximately 25cm thick reaching a maximum depth of 36cmsg. The last layer encountered (Layer III) consisted of a very dusky red (2.5YR 2.5/2) somewhat stony, silty clay which was culturally sterile and was excavated to a maximum depth of approximately 122cmsg (see Figure 1).

Layer I was thought to have washed to its stratigraphic position (overlying the road fill, Layer II) from the nearby embankment on the northern side of the road. The only cultural materials were identified in Layers I and II and consisted of aluminum cans, glass bottles and broken glass which were considered to be modern debris.

**Trench 2:** This trench was placed at the location of the box culvert to be placed at STA 32+40 (see Map 4). The trench was excavated in a grassy area along the southern side of the road which was elevated above adjacent wetlands. The trench reached a maximum length of approximately 2.8m and depth of 183cmsg. Excavation encountered a surface cover of grass and detritus underlain by a layer (Layer I) dark reddish brown (5YR 3/3) silty clay. This layer was excavated until reaching the water table at a depth of approximately 180cmsg. It was determined to be modern fill based upon the modern aluminum cans recovered from the basal scoops of the backhoe.

**Trench 3:** This trench was placed at the location of the box culvert to be placed at STA 29+50 (see Map 4). The trench was excavated into the base of the embankment along the northern side of the road. The trench reached a maximum length of approximately 1.9m and depth of 179cmsg. Excavation encountered a surface which was lightly vegetated and partially covered in detrital material. A single stratigraphic deposit was encountered consisting of a dusky red (2.5YR 3/2) silty clay which reached a maximum depth of approximately 179cmsg. A single flake of charcoal was
Figure 1: Trench 1, West Face

Detrital material and compacted road surface

Layer I

Layer II

Layer III

unexcavated

Total Length of Trench 3.5m

Culvert next to STA 35 + 10

Layer I: 10R 3/2, very coarse loamy sand.
Layer II: 2.5YR 3/3, very coarse stony sand.
Layer III: 2.5YR 2.5/2, stony silty clay.
identified from this excavation unit which was otherwise devoid of cultural materials.

**Trench 4:** This trench was placed at the location of the box culvert to be placed at STA 22+00 (see Map 4). The trench was excavated between the base of a low, gravelly embankment along the southern side of the road where it passes the modern quarry at Maupua. The trench reached a maximum length of approximately 2.4m and depth of 149cm (see Figure 2). This excavation was placed along a portion of the road which had been destroyed by Hurricane Val and subsequently rebuilt by Samoa Maritime. It was also in this area that ACH placed a test unit which identified layers of mechanical fill believed to have been placed here during the initial construction of the gravel road (Kennedy 1988). Therefore, the purpose of this trench was to confirm that no significant cultural deposits were present to the depth at which construction was to occur. Given the information above, it was not unexpected that excavation encountered layers of mechanical fill and modern debris to the base of the unit. No significant cultural deposits were encountered.

**Section 5.2: Feature Descriptions**

During the Phase I survey of the site by PHRI (Franklin 1993), six features were identified within the ROW (or within the zone of impact for the ROW) and a multiple feature complex was identified on the slopes above the ROW. The number of features within the complex was not determined at the time because, being located outside of the ROW, it was beyond the scope of work. The multiple feature complex identified outside of the ROW during the Phase I survey was designated Feature A while the six features within the ROW were designated Features B through G. For the purposes of continuity, those designations have been adopted for this discussion.

During the current investigations, the multiple feature complex (Feature A) was determined to be composed of 12 individual features, now designated Features A1 through A12. All features will be individually described below.

**Feature A1:** This feature consists of a lithic scatter located at the peak of the western end of Lau'agae Ridge adjacent to a former U.S. Marine bunker (Feature A2) and National Geologic Survey marker pin (see Maps 4 and 5). The scatter measures approximately 10m long by 6m wide and is composed of angular basalt stones (20 to 40cm in diameter) and lithic debitage (5 to 30cm in dia.) (see Appendix D, Plate II). It is possible that this feature was larger prior to the construction of Feature A2 which appears to have impacted the eastern side of the scatter.
Figure 2: Trench 4, North Face

Layer I: 7.5YR 3/2, coarse, stony, loamy sand.
Layer II: 10YR 6/3, coarse stony sand.
Layer III: 5YR 2.5/1, coarse, stony, loamy sand.
Layer IV: 5YR 5/2, stony sand.
Layer V: 10YR 4/4, stony sand.
Feature A2: Feature A2 consists of a U.S. Marine bunker located at the peak of the western end of Lau’agae Ridge directly beneath the National Geologic Survey pin (see Map 5). On the surface, the structure consists of the tops of concrete walls forming a rectangular shaped bunker approximately 3m long by 2.5m wide (see Appendix D, Plate III). An entrance, partially filled with soil and rocks, is located on its southern side and several metal pipes (possibly ventilation pipes) extrude through the surface above the bunker. A thin (c. 20cm), concrete lined shaft was also noted at ground level. The underground size and extent of this feature was not investigated. This feature is believed to have been constructed at this location during World War II for its panoramic view of the coastline at Lau’agae.

Feature A3: Feature A3 consists of a lithic scatter located at the lower end of feature complex A (as well as that of the upper banana patch) in a spot where the slope begins to steepen (see Map 5). The scatter measures approximately 15m long by 10m wide and is composed of angular basalt stones (20 to 40cm in dia.) and lithicdebitage (5 to 30cm in dia.). The upper end of the feature has a denser concentration of lithic material implying that the lower end consists of material washed from above. Several pieces of broken coral were interspersed with the basalt pieces.

Feature A4: This feature consists of a lithic scatter located along the lower, western side of the complex along the top of the bank of a former road bed (see Map 5). The feature is roughly triangular in shape measuring approximately 10m on a side and is composed of angular basalt stones (20 to 40cm in dia.) and lithicdebitage (5 to 30cm in dia.) (see Appendix D, Plate IV). Coral pieces were also noted amongst the scatter.

Feature A5: Feature A5 consists of a paved terrace surrounded by a lithic scatter located immediately upslope from Feature A4 also along the top of the bank of the former road bed (see Map 5). The terrace consists of a single coarse alignment of angular basalt stones standing approximately 20 to 30cm above ground level (AGL) along its eastern side with a level surface behind paved with coral ill ill (see Appendix D, Plate V). The paved area measures approximately 8m long by 3m wide and is level with the sloping hillside on its back (western) side (see Figure 3). Extending from the paved area in every direction was a dense concentration lithic material composed of angular basalt stones (20 to 40cm in dia.) and lithicdebitage (5 to 30cm in dia.). The lithic material extended approximately 4m towards the east where it reached the top of the slope of the road cut (Feature A12) while on the northern side of the terrace it extended for more than 10m, becoming less dense as the slope ascended and steepened.
Figure 3: Top Plan, Feature A5, Site AS-21-100

level area covered with lithic debitage

top of slope

20-30cm AGL.

paved with coral and small debitage

bottom of slope

side view

slope

0 2m
Several adze preforms and polished adze fragments were collected from the surface in the vicinity of Feature A5 (refer to Table 2; Appendix A). Lithic material collected from this feature as well as other features within the site is discussed in Section 5.3.

**Feature A6**: Feature A6 consists of a lithic scatter located towards the lower end of the complex just southeast of Feature A5 (see Map 5). The scatter measures approximately 3m long by 2m wide and is composed of angular basalt stones (20 to 40cm in dia.) and lithic debitage (5 to 30cm in dia.).

**Feature A7**: Feature A7 consists of a lithic scatter located in the center the complex immediately east of Feature A6 (see Map 5). The scatter is roughly U-shaped measuring approximately 3m across with the "legs" extending approximately 15m from the apex of the "U" and is composed of angular basalt stones (20 to 40cm in dia.) and lithic debitage (5 to 30cm in dia.) (see Appendix D, Plate VI).

The branches of this scatter filled localized low spots, or swales, with a slightly elevated central ridge which separated the "legs" of the "U". The lower end of the southeastern "leg" was observed to consist of a dense concentration of angular basalt stones somewhat larger than found at other features of the complex (up to 60cm in dia.) and, apparently, included greater number of intact stones. Based on this cursory observation, it is possible that this feature represents the primary source of material for the entire site (a portion of the plug which has become exposed through weathering), although additional investigations would be required to confirm or deny this hypothesis.

**Feature A8**: Feature A8 consists of a lithic scatter located in the center of the complex immediately upslope from Feature A7 (see Map 5). The scatter is partially covered by a crudely built (day-use?) feature as well as modern debris. It measures approximately 10m long by 6m wide and is composed of a few angular basalt stones (20 to 40cm in dia.) but primarily lithic debitage (5 to 30cm in dia.) (see Appendix D, Plate VII).

**Feature A9**: This feature consists of a long, thin lithic scatter located along the western side of the complex immediately upslope from Feature A7 (see Map 5). The scatter measures approximately 15m long by 4m wide at its greatest and is composed of angular basalt stones (20 to 40cm in dia.) and lithic debitage (5 to 30cm in dia.) (see Appendix D, Plate VIII).

**Feature A10**: Feature A10 consists of a lithic scatter located along the western side of the Feature A complex, downslope from Feature A5 (see Map 5). This feature covers a level area immediately above where the slope steepens sharply,
falling to the sea. It is also separated from the remaining features of the complex by the historic military road, Feature A12. It measures approximately 10m long by 5m wide and is composed of angular basalt stones (20 to 40cm in dia.) and lithic debitage (5 to 30cm in dia.) (see Appendix D, Plate IX).

**Feature A11**: Feature A11 consists of a small lithic scatter located toward the eastern side of the complex, immediately upslope from Feature A9 (see Map 5). It measures approximately 5m in diameter and is composed of a few angular basalt stones (20 to 40cm in dia.) and scattered lithic debitage (5 to 30cm in dia.) (see Appendix D, Plate X).

**Feature A12**: This feature consists of a level bulldozed cut forming an historic road bed, roughly paved with coral clinkers. It is located along the western side of the sloping ridge that forms the western end of Lau'agae Ridge proper as well as the western side of the Feature A complex (see Map 5). It reaches an elevation of approximately 100ft AMSL where a circular shaped "landing" is located. This road was apparently built by U.S. Marines during World War II possibly to provide access to the bunker (Feature A2) at the summit of this end of Lau'agae Ridge. The lower end of the road bed was identified immediately upslope of Feature D, though it must have continued downslope toward Tula village, possibly providing the level area on which Feature E was subsequently constructed.

**Feature B**: This feature was initially identified by PHRI (Franklin 1993) and was described as a "pavement of coral heads and pieces". The approximate location of the southern end of this feature was re-identified, on the edge of the ROW at the lower end of the site, during the current investigations. The remains of what was believed to be this feature were located just north of Feature D and its approximate location is depicted on the plan map of the site (see Map 5).

While conducting a field inspection, Eric Voight (of the ASHPO) indicated that the majority of this feature (as well as all of Feature C) has been obliterated by earth moving activities conducted by a landowner living at the base of the ridge. What remained in the location at which Feature B was depicted on PHRI’s sketch map of the features was an irregular mound of coral clinkers perched on the top edge of a steeply sloping embankment (at least 50ft above the location from which soils had been removed). Although PHRI’s initial interpretation was that this feature represented a "habitation pavement", based upon the similarity of the materials forming this structure (coral "heads and pieces") and those of Feature A12 as well as the features’ proximity to the lower end of Feature A12, it is likely that this feature was associated with the historic Feature A12.
Feature C: This feature was initially identified by PHRI (Franklin 1993) and described as a habitation terrace constructed from basalt cobbles and boulders. PHRI's sketch map depicted this feature within the ROW on the western side of the northern end of Feature B (its former position is depicted on Map 5). During the current investigations, Eric Voight (ASHPO) indicated that this feature also has been obliterated by earth moving activities conducted by a landowner living at the base of the ridge. Because this feature no longer exists, it is impossible to make determinations concerning its age or function.

Feature D: Feature D was initially identified by PHRI (Franklin 1993) and described as a "linear mound" whose functional interpretation was tentatively given as "burial/agriculture". This feature is located beyond the upper edge of the small banana patch which is cultivated at the base of the sloping ridge along the current roadway (the lower banana patch) and just outside the ROW (see Map 5). The feature consists of a roughly oval shaped earthen mound measuring approximately 9.5m long by 3m wide and having a sloping surface which reaches a maximum height of 75cm AGL (above ground level) along its northern end.

A shovel test pit (STP) was excavated towards the southern end of the mound in order to determine the presence or absence of cultural materials (see Map 5). Shovel Test Pit-1 (STP-1) measured 56cm in diameter and reached a maximum depth of 65cm below surface (cmbs). A single stratigraphic deposit (Layer I) was identified consisting of a dusky red (2.5YR 3/2) silty clay. Layer I was determined to be sterile, containing no cultural materials of any kind. The lack of cultural material recovered from STP-1 and the mounds' proximity to the end of Feature A12 imply that this feature may be associated with earth moving activities conducted during the construction of the WWII military road.

Feature E: Feature E consists of a partially paved terrace located just above the grading limits for the ROW at the lower end of the site (see Map 5). The retaining wall of the terrace consists of 1 to 3 courses of angular basalt stones and coral pieces reaching a maximum height of approximately 70cm AGL. The retaining wall is on the downslope side of the feature and there is paving immediately behind this wall while the back side of the feature is level with the soil behind (see Figure 4). The terrace measures approximately 17m in length by 12m in width. In the approximate center of the leveled area of the terrace a low, single coarse alignment of stones is located beneath the semi-collapsed remains of a crude fale which had been constructed of 4 by 4's on three corners and a papata tree on the fourth, supporting a corrugated tin roof. The stone alignment with its semi-collapsed structure measure approximately 4m square. Another single coarse alignment of stones, partially embedded
(within stone fill at the terraces facing edge and soil towards the rear of the terrace) in the ground is located along the terraces western end. This alignment measures approximately 6m long and the stones are exposed a maximum of 30cm AGL.

Two test units were placed within this feature in order to determine its age and function. Test Unit 1 was placed underneath a portion of the collapsed structure in the center of the feature while Test Unit 2 was placed in the fill behind the western end of the retaining wall of the terrace (see Figure 4).

**Test Unit 1:** Prior to excavation, a datum was established on a nearby tree (Datum/Point E1) whose location was shot in by transit. This test unit measured 1m square and was excavated in incremental 10cm levels. Excavation encountered a surface cover of detrital material underlain by a layer (Layer I) very dusky red (2.5YR 2.5/2) stony, silty clay (see Figure 5). Three levels were excavated which contained modern debris, a very small amount of marine shell and faunal material as well as lithic flakes (see Appendix A; Tables 3, 4 and 5). About midway through Level 3 cultural material ceased to be recovered. Excavation continued as a Shovel Test Pit placed along the western face of the test unit to a depth of 76cmbd. No additional cultural materials were identified and no datable samples were recovered.

**Test Unit 2:** Prior to excavation, a datum was established on a nearby tree (Datum/Point E2) whose location was shot in by transit. This test unit measured 1m square and was excavated in incremental 10cm levels. Excavation encountered a surface cover of detrital material underlain by a layer (Layer I) dark reddish brown (2.5YR 3/3) stony, silty clay (see Figure 6). Six levels were excavated, five of which contained modern debris and all of which contained small amounts of marine shell and faunal material as well as lithic flakes (see Tables 3, 4 and 5). Excavation reached a maximum depth of 82cmbd and modern debris was encountered to a depth of 70cmbd, below the depth at which the base of the retaining wall of the terrace was embedded.

The results of these excavations revealed that this feature was constructed in the historic period, likely since the modifications made to the hillside by the U.S. Marines during the construction of the road (Feature A12). It is likely that this feature represents a day-use activity area which functioned in association with the currently cultivated banana patches nearby.

**Feature F:** This feature was initially identified by PHRI (Franklin 1993). It consists of a lithic scatter located at the lower end of the site, within the ROW and the lower banana patch, along the existing dirt road (see Map 5). The feature is roughly rectangular in shape measuring approximately 20m long by 15m wide and is composed of angular
Layer I: 2.5YR 2.5/2, stony silty clay.
Figure 6: Test Unit 2, Feature B, East Face

Maximum depth 82cmbd
West face same as above but no rocks
upper levels at southern face contain much debitage

Layer I: 2.5YR 3/3, stony silty clay

KEY
Rock

Lautagae Ridge Quarry: Site AS-2k-160
Archaeological Consultants of the Pacific, Inc. 1996
basalt stones (20 to 40cm in dia.) and lithic debitage (5 to 30cm in dia.). The density of lithic material at this feature was notably less concentrated than found at features in Complex A and became even less dense as one approached Feature G. Coral pieces were also noted among the scatter.

**Feature G:** This feature was initially identified by PHRI (Franklin 1993). This feature consists of scattered lithic material interspersed between modern stone and coral alignments surrounding the base of **ulu** (breadfruit) trees. It is located at the lower end of the site, partially within both the ROW and the lower banana patch, along the existing dirt road (see Map 5). This is distinguished from the adjacent Feature F by the inclusion of the modern alignments and, were it not for these modern formations, this light scattering of lithic material should have been considered an extension of Feature F. Isolated coral pieces were also noted amongst the scatter.

**Section 5.3: Lithic Analyses**

A variety of lithic materials were collected from Site AS-21-100 during the current investigations. These include basalt cores, broken adze preforms, numerous lithic waste flakes (of which three appeared to be re-touched and one had a polished side), and two polished adze preform fragments. The adze preforms were characterized to the extent possible and three basalt core samples were submitted for analysis of their chemical composition. In addition, lithic samples were collected from the nearby Maupua Quarry which is believed to have been utilized for modern construction activities and one of these samples was also submitted for analysis of its chemical composition.

During the course of the surface sweeps and the plotting of transit points conducted for the current investigations, twenty-one worked basalt pieces (including polished adze fragments, adze preforms and preform fragments) were collected from the surface of features within the site (refer to Table 2 in Appendix A). The majority of these items were collected from the vicinity of Feature A5 which may be indicative of the amount of time spent by the field crew near that location while hub points were plotted in that vicinity rather than increased density of artifactual material at that feature (indeed, all of the features from which preforms were collected were in the vicinity of locations which the field crew frequently passed or at which additional work such as the plotting of hubs was conducted). Most of the pieces collected appear to be the debris of lithic tool manufacture, having been broken or cracked in the early stages of manufacture.

The fact that a fairly large number of these artifacts were recovered from the surface suggests that Site AS-21-100
may have been utilized into the historic period. Two pieces which had reached near completion are depicted in Figures 7 and 8 (Artifacts LRQ-010 and LRQ-011).

Lithic samples were collected from features at various elevations within the site. These samples consisted of pieces of basalt which displayed evidence of alteration, possibly to produce cores from which tools would be manufactured. Three of these core samples were selected for analysis of their chemical composition along with the single sample from the modern Maupua Quarry. These analyses were conducted under the direction of John M. Sinton, Ph.D., of the Department of Geology and Geophysics, University of Hawaii at Manoa. The three samples from Site AS-21-100 that were submitted for analysis displayed uniformity in their chemical composition (refer to Table 6). According to Dr. Sinton, they are also similar to several other Eastern Tutuila quarry samples as reported by Best, Sheppard, Green and Parker (1992) (refer to Appendix B).

Prior to the current investigations, and unbeknownst to ACH, Clark had collected samples from Site AS-21-100 which were analyzed for their chemical composition by Best et al. The results of these analyses are also included in Table 6. Curiously, Sinton (who was unaware of the location from which the samples submitted by ACH were collected) describes the current samples as "nearly identical" (Sinton: Appendix B) with samples that Best et al. analyzed from the Le'aeno Quarry (Site AS-21-110) while not mentioning (other than the general similarity to other Eastern Tutuila quarry samples) any similarity to samples obtained from the same site on Lau'aga Ridge. It should be noted that in Best et al. Le'aeno is alternatively spelled "Laeano" and "Leaeno" and that the sample numbers from Lau'aga and Le'aeno appear to be non-sequential. This could explain the incongruity implied by Sinton's determinations of similarity.

It is also possible that the differences observed between the samples collected from Site AS-21-100 by Clark in 1988 and those collected by ACH in the current study (refer to Table 6) are due to differences in sample morphology. The samples collected by Clark and analyzed by Best et al. were described as "archaeological flakes" (1992:72) while the samples submitted for analysis by ACH were from minimally modified basalt cores. The sample submitted from the modern Maupua Quarry also appears similar to other samples from Eastern Tutuila in its major element oxides composition but there appear to be significant differences in the trace element composition between this sample and others collected by ACH from the Lau'aga Ridge Quarry (refer to Tables 6 and 7). It is clear that many more samples from quarry sites across Tutuila will have to be analyzed and comparisons should include the trace element compositions before information concerning the source of the material can be
Figure 7. Diagram of Artifact LRQ-010

Cross-Sectional View

Top (face)

Side

Bottom (base)

1 cm
applied to the anthropomorphic use and trade of this important commodity in pre-contact society.

Section 6: Discussion of the Findings at Site AS-21-100

The current investigations have documented the extent of the Lau’agae Ridge Quarry (Site AS-12-100) and basalt samples from the site have been analyzed to determine their chemical characteristics. This site has been determined to be the probable prehistoric source of lithic material used at the nearby site of Tulauta (AS-21-1). It was also determined that the area has been historically utilized by the U.S. Military and that at least one of the features in the site (Feature E) has likely been constructed since the WWII modifications to the hillside.

Chemical analyses of three basalt samples from features at varying elevations within the site were conducted. The results of these proved that all three samples were indeed from the same source and were similar to samples from other quarries in eastern Tutuila. In addition, a single sample from the nearby modern Maupua Quarry was chemically analyzed. These chemical determinations provide a “fingerprint” which can be used by future studies to compare lithic material from other archaeological sources.

Based upon the results of the current investigations, the probable activities occurring at the site, its periods of utilization, and the changes in utilization occurring at the site over time have been determined. Features A1, A3 through A11, F and G have been determined to be lithic tool manufacturing locations utilized prior to western contact. Features A2, A12 and D have been determined to be associated with historic military activities occurring during World War II. Feature F is believed to be a modern construction, possibly a modification of a level area constructed by the military in association with Feature A12. No determination could be made for Features B and C because they are no longer present.

During the field investigations, ACH considered the lithic activity area features to be one site and the historic features associated with military activities a second site. However, because both feature types occur on the same property, Eric Voight of the ASHPO instructed ACH to consider all features as one site. As a single site, Site AS-21-100 is significant to the interests of historic preservation under several criteria. The site reflects major trends in history (Criterion "A" of the National Register of Historic Places criteria), is an excellent example of a site type (Criterion "C" of the National Register of Historic Places criteria), and is likely to yield important scientific
information (Criterion "D" of the National Register of Historic Places criteria) (refer to Table 1).

At the time of the conclusion of the field work for the current investigations, Features B and C had been destroyed by earth moving activities conducted by a nearby landowner. At that time Features A1 through A12, D, E, F, and G were extant. If, following the archaeological investigations, construction proceeded according to plans, features located within the limits of grading for the ROW (Features F and G) would have been removed. It is also probable that features adjacent to the limits of grading (Features D and E) would have been impacted by the construction activities, although the extent of that impact is unknown.
Table 1: Site Summary and Significance Evaluation

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<th>Feature</th>
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**Functional Interpretations**

TH - Temporary Habitation  TM - Tool Manufacture  HM - Historic Military  NLP - No Longer Present

**Code For Significance Evaluation Criteria**

A - Site Reflects Major Trends in History  
B - Site is Associated with the Life of a Significant Person  
C - Site is an Excellent Example of a Site Type  
D - Site Likely to Yield Important Scientific Data
Conclusion

Archaeological investigations were conducted as part of a Phase II Cultural Resource Evaluation for Phase III of the Onenooa Road Federal Highway Project No. AS-NH-008(5). These investigations have concluded that there are no significant cultural properties present at the locations at which box culverts are to placed. In addition, during the current study, the locations of all component features at Site AS-21-100 were plotted, subsurface testing was conducted at features within the zone of impact of the grading limits for the Right-of-Way, and analysis of the chemical composition of lithic tool source material was conducted.

The results of these investigations have mitigated the impact of construction activities for Phase III of the Onenooa Road Project on Site AS-21-100. Therefore, Archaeological Consultants of Hawaii, Inc. has made the determination that construction activities have had "no adverse effect" on significant historic properties. The site remains significant to the interests of historic preservation.
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APPENDIX A

Tables
Table 2: ADZE PREFORMS (Site AS-21-100: Lau'agae Ridge Quarry)

<table>
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<th>Feature #</th>
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<td>LRQ-013</td>
<td>Basalt</td>
<td>Adze Preform</td>
<td>Sub-Triangular?</td>
<td>10.0x6.0x4.0</td>
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<tr>
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<td>A11</td>
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<tr>
<td></td>
<td>LRQ-018</td>
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<td>Depth</td>
<td>Artifact #</td>
<td>Material</td>
<td>Object</td>
<td>Color</td>
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<td>------------</td>
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</tr>
<tr>
<td>1</td>
<td>1/1</td>
<td>8-18</td>
<td>LRQ-022</td>
<td>Metal</td>
<td>Nails</td>
<td>Rusted</td>
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<tr>
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<td></td>
<td></td>
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<td>Metal</td>
<td>Piece</td>
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<td></td>
<td></td>
<td>LRQ-026</td>
<td>Metal</td>
<td>Hook?</td>
<td>Rusted</td>
</tr>
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<td>LRQ-027</td>
<td>Metal</td>
<td>Piece</td>
<td>Rusted</td>
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<td>1/3</td>
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<td></td>
<td></td>
<td></td>
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<td>Tin roof/Can?</td>
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<td>12-30</td>
<td>LRQ-030</td>
<td>Basalt</td>
<td>Lithic flake</td>
<td>Grey</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>LRQ-031</td>
<td>Styrofoam</td>
<td>Piece</td>
<td>White</td>
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<td></td>
<td></td>
<td></td>
<td>LRQ-032</td>
<td>Basalt</td>
<td>Lithic flake</td>
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<tr>
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<td></td>
<td>LRQ-033</td>
<td>Metal</td>
<td>Nails</td>
<td>Rusted</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>LRQ-034</td>
<td>Aluminium</td>
<td>Aluminium can?</td>
<td>Silver</td>
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<td></td>
<td></td>
<td></td>
<td>LRQ-035</td>
<td>Foil</td>
<td>Wrapper?</td>
<td>Grey</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>LRQ-036</td>
<td>Glass</td>
<td>Sherd</td>
<td>Colorless</td>
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<td>2</td>
<td>1/2</td>
<td>30-40</td>
<td>LRQ-037</td>
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<td>1/3</td>
<td>40-60</td>
<td>LRQ-039</td>
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<td>Rusted</td>
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<td></td>
<td></td>
<td>LRQ-040</td>
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<td>Piece</td>
<td>Rusted</td>
</tr>
<tr>
<td>2</td>
<td>1/4</td>
<td>50-60</td>
<td>LRQ-041</td>
<td>Metal</td>
<td>Nail</td>
<td>Rusted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LRQ-042</td>
<td>Metal</td>
<td>Bottle cap?</td>
<td>Rusted</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>LRQ-043</td>
<td>Metal</td>
<td>Foil</td>
<td>Trace</td>
</tr>
<tr>
<td>2</td>
<td>1/5</td>
<td>60-70</td>
<td>LRQ-044</td>
<td>Metal</td>
<td>Nail &amp; Washer</td>
<td>Rusted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LRQ-045</td>
<td>Metal</td>
<td>Piece</td>
<td>Rusted</td>
</tr>
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<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Layer/Level</td>
<td>I/1</td>
<td>I/2</td>
<td>I/3</td>
<td>I/1</td>
<td>I/2</td>
<td>I/3</td>
</tr>
<tr>
<td>Depth (cm bd)</td>
<td>8-18</td>
<td>18-28</td>
<td>28-38</td>
<td>12-30</td>
<td>30-40</td>
<td>40-50</td>
</tr>
</tbody>
</table>

**SHELL**

- *Gastropoda* 1.0 1.0 8.5
- *Turbo sp.* 0.5 6.5 24.5 8.5
- *Naria sp.* 0.5
- *Cyprea sp.* Trace 4.0 4.5 16.0
- *Murina sp.* 3.0 2.0 1.5
- *Nautilus sp.* 0.5
- *Conus sp.* 0.5 1.5 1.5
- *Siphonaria sp.* 1.5 3.5

**Bivalvia**

- *Pachypleura sp.* 0.5 0.5
- *Unidentified Marine* 1.0 0.5 9.0 4.0 0.5 1.0
- *Unidentified Terrestrial* 8.5 3.0 3.0 0.5 1.0 Trace

**OTHER**

- *Charcoal* 0.5 0.5 2.0 Trace 0.5
- *Coral* 485.0 79.0 1911.0 1240.0 626.0 155.0 56.0 14.0
- *Lithic flakes* 1299.0 1634.0 478.0 586.0 303.0 433.0 62.0 36.0 12.0
Table 5: RESULTS OF FAUNAL ANALYSIS

<table>
<thead>
<tr>
<th>Test Unit</th>
<th>TU1</th>
<th>TU2</th>
<th>TU3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer/Level</td>
<td>I/1</td>
<td>I/1</td>
<td>I/3</td>
</tr>
<tr>
<td>Depth (cmbd)</td>
<td>8-18</td>
<td>12-30</td>
<td>40-50</td>
</tr>
</tbody>
</table>

Chondrichthyes/Osteichthyes
- Balistid
- Diodontid

Amphibia
- Order Anura
  - Bufo marinus

Class Indeterminate
- Order and Family Indeterminate
  - Small Vertebrate
  - Medium Vertebrate
  - Large Vertebrate
  - Trace
TABLE 6
Chemical Compositions of Basalt Samples
From Quarries in Eastern Tutuila:
Major Element Oxides

<table>
<thead>
<tr>
<th>Sample</th>
<th>A5</th>
<th>A7</th>
<th>F</th>
<th>I</th>
<th>II.4</th>
<th>7</th>
<th>II.3</th>
<th>8</th>
<th>6</th>
<th>avg (9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>47.90</td>
<td>47.89</td>
<td>48.06</td>
<td>46.59</td>
<td>47.95</td>
<td>47.98</td>
<td>47.80</td>
<td>48.86</td>
<td>45.90</td>
<td>49.25</td>
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<tr>
<td>TiO₂</td>
<td>3.70</td>
<td>3.70</td>
<td>3.74</td>
<td>4.28</td>
<td>3.82</td>
<td>3.87</td>
<td>3.71</td>
<td>2.89</td>
<td>4.26</td>
<td>3.39</td>
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<tr>
<td>Al₂O₃</td>
<td>15.98</td>
<td>16.05</td>
<td>16.00</td>
<td>15.44</td>
<td>15.96</td>
<td>16.23</td>
<td>16.09</td>
<td>15.46</td>
<td>15.55</td>
<td>15.06</td>
</tr>
<tr>
<td>MnO</td>
<td>0.16</td>
<td>0.16</td>
<td>0.15</td>
<td>0.15</td>
<td>0.16</td>
<td>0.14</td>
<td>0.18</td>
<td>0.16</td>
<td>0.19</td>
<td>0.17</td>
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<tr>
<td>MgO</td>
<td>4.96</td>
<td>4.94</td>
<td>4.97</td>
<td>4.87</td>
<td>4.89</td>
<td>5.08</td>
<td>4.84</td>
<td>4.05</td>
<td>5.41</td>
<td>4.55</td>
</tr>
<tr>
<td>CaO</td>
<td>7.75</td>
<td>7.69</td>
<td>7.75</td>
<td>7.45</td>
<td>7.71</td>
<td>7.73</td>
<td>7.71</td>
<td>7.15</td>
<td>7.83</td>
<td>4.98</td>
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<tr>
<td>K₂O</td>
<td>1.49</td>
<td>1.48</td>
<td>1.48</td>
<td>1.42</td>
<td>1.51</td>
<td>1.45</td>
<td>1.61</td>
<td>1.74</td>
<td>1.35</td>
<td>1.58</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>0.72</td>
<td>0.73</td>
<td>0.72</td>
<td>0.70</td>
<td>0.73</td>
<td>0.71</td>
<td>0.76</td>
<td>1.21</td>
<td>0.64</td>
<td>0.78</td>
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<tr>
<td>LOI**</td>
<td>-0.19</td>
<td>0.00</td>
<td>-0.35</td>
<td>1.67</td>
<td>-0.34</td>
<td></td>
<td>0.08</td>
<td></td>
<td>0.48</td>
<td></td>
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</tbody>
</table>

Total  99.88  99.96  99.95  99.57  100.26  99.94  100.51  97.62  98.84  100.42

*Total Fe as Fe₂O₃
**Loss on ignition at 900°C

Sample - Sample designations for ACH 1994 indicate features from which samples were collected except in the case of the Maupun sample which was arbitrarily designated "I". Sample information obtained from Best et al. use numeric designations presented in that paper. Sample information from Tataga Matau is an average of nine samples as provided to ACH by Professor Siution.
Table 7

Chemical Compositions of Basalt Samples from Lau'agae Ridge Quarry and Maupua Quarry:
Trace Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Sample A7</th>
<th>Sample A5</th>
<th>Sample F</th>
<th>Sample I</th>
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<tr>
<td>Nb</td>
<td>47</td>
<td>47</td>
<td>48</td>
<td>60</td>
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<tr>
<td>Zr</td>
<td>390</td>
<td>391</td>
<td>392</td>
<td>473</td>
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<tr>
<td>Y</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>50</td>
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<tr>
<td>Sr</td>
<td>763</td>
<td>766</td>
<td>763</td>
<td>107</td>
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<tr>
<td>U</td>
<td>&lt;2.00</td>
<td>&lt;2.00</td>
<td>&lt;2.00</td>
<td>&lt;3.00</td>
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<tr>
<td>Rb</td>
<td>39</td>
<td>41</td>
<td>38</td>
<td>342</td>
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<tr>
<td>Th</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>45</td>
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<td>Pb</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>41</td>
</tr>
<tr>
<td>Zn</td>
<td>180</td>
<td>183</td>
<td>181</td>
<td>150</td>
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<td>Cu</td>
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<td>30</td>
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<td>Ni</td>
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<td>Co</td>
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<td>Mn</td>
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<td>&lt;5</td>
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<tr>
<td>V</td>
<td>242</td>
<td>251</td>
<td>248</td>
<td>198</td>
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<tr>
<td>Sc</td>
<td>19</td>
<td>20</td>
<td>19</td>
<td>21</td>
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</table>

Note: Samples designated A7, A5 and F were collected from the corresponding features at the Lau'agae Ridge Quarry (Site AS-21-100) while Sample I was collected from the modern Maupua Quarry.
APPENDIX B

Report on the Chemical Composition of Archaeological Samples
Report on Archaeological Samples
from Lau'agae Ridge Quarry (Site AS-21-100)

The three analyzed samples are very similar in chemical composition. The minor differences in the three samples can be attributed to either analytical error or to real variability within the source region. They all are similar enough to consider them to be from the same source, i.e. same lava flow or dike. In terms of classification, they are transitional between alkali basalt and hawaiite. Their chemical composition is consistent with formation from the later activity of the main Tutuila shield volcano. They are chemically distinct from post-erosional lavas of Samoa and also from the Leone Volcanics which mainly outcrop in the western part of Tutuila.

Chemical data for the Lau'agae Ridge Quarry samples are presented in Table 6 (Appendix A), along with data from selected other samples of archaeological interest from Samoa. The Lau'agae Ridge Quarry samples are nearly identical to what Best et al., (J. Polynesian Soc., v. 101) call the Le'aeno Quarry of east Tutuila. Only K2O differs significantly which can be attributed to analytical error. Hence the Lau'agae Ridge Quarry samples appear to represent a good match to the Le'aeno Quarry. Lau'agae Ridge Quarry and Le'aeno Quarry samples are chemically distinct from other east Tutuila quarry samples and also from the well-known Tataga Matau quarry of western Tutuila.

John M. Sinton
APPENDIX C

Comments of Faunal Identifications and Faunal Taxonomy
DATE: 30 September 1994

TO: Archaeological Consultants of Hawaii, Inc.,
   (ATTN.: Kehaulani Kennedy, Office Manager)

FROM: Alan C. Ziegler, Zoological Consultant

SUBJECT: Identification of faunal material from Tula-Onenoa,
American Samoa, (three bags from Test Units 1 and 2),
received 30 September 1994

I have identified this lot of faunal material to the lowest taxonomic
level possible for me, and am returning it all to you along with this
MEMO in one box by prepaid Certified First Class Mail, Return Receipt
Requested. In the case of such a small amount of material there is,
of course, no charge for this work.

I had sent various MEMO's relating to a number of sites in the past
that explained my identification and other procedures, so will refer
you to that previous pertinent correspondence rather than taking the
time to repeat all of the information here. Also, because there are
no new faunal categories among the current material, I am not sending
another copy of the 6 May 1994 revision of my Faunal Category List.
(Just let me know, however, if you do not now have access to past
MEMO's or the List, and I will be happy to send copies.)

I guess my identifications written on the yellow-paper slips with
the faunal material in the stapled bags will be largely self-explanatory.
As you can see, only an unidentified bone fragment, along with one
mouthpart each from two common reef-fish families (Triggerfishes and
Spiny Puffers), and an amphibian forelimb bone are present. In
regard to the last-named item, I have referred it to Bufo marinus,
the Giant Neotropical Toad historically introduced to so many islands
of the Pacific, as it matches that species very closely. Also, there
are no native toads or frogs in Samoa, and the Polynesians are not
known to have introduced any. Therefore, even in the very unlikely
case your bone belongs to a different amphibian species, it would
almost surely still represent a post-Contact introduction.

I hope these identifications and comments on the present faunal
remains may be of some interest and use to you. Many thanks for the
chance to see this material. Please be sure to let me know if there
are any questions on any of my procedures, identifications, or
comments. Also, my appreciation to you and Joe for your
thoughtfulness in sending me a copy of the most interesting Smallpox
paper. Continued best in everything!!
CATEGORIES USED FOR ARCH. CONSULS. OF HAWAII FAUNAL IDENTIFICATIONS

Alan C. Ziegler
Revised 25 June 1993

MISCELLANEOUS

Artifact..........................................any historically manufactured item as well
as any geological, vegetal, osteological, or other material obviously or possibly
intentionally "worked", including bones showing apparent butchering marks.

NON-VERTEBRATE

Basalt..............................................all non-disintegrated volcanically derived
material, including pumice, and volcanic glass fragments not included under "Artifact".

Inorganic..........................................usually, geological material not included
under either of the 2 foregoing categories.

Coal

Charcoal

Vegetable..........................................all uncharred or otherwise unmodified
vegetal material.

Coral Reef Rubble..............................including fragments of mollusk, echinoderm,
etc., that seem obviously to have weathered out of the reef or to be quite beach-worn, and
thus probably not human food midden.

Coral..............................................non-fossil material that seems to have
entered the deposit in a relatively fresh condition, although sometimes beach-worn.

Echinoderm.......................................usually, exoskeleton remains of sea urchin,
quite possibly being human food midden.

Mollusk............................................non-fossil material of marine, freshwater,
and/or terrestrial forms that seems to have entered the deposit in a relatively fresh
condition, most of the non-terrestrial material probably being human food midden.

Crustacean........................................usually, exoskeleton remains of crab or
lobster, with an occasional barnacle plate, much—but not all—probably being human food
midden.

Invertebrate.....................................remains of invertebrate groups either not
more specifically identifiable, or other than those listed above; for example, bryozoan
exoskeletons, calcareous polychaete worm tubes, etc.

VERTEBRATE

CLASS CHORDATA (Sharks and Rays) AND/OR OSTEICHTHYES (Bony Fishes) [Arrangement and
nomenclature follow Goeke, W.A., and V.E. Brock, 1965 (reprinted 1965), Handbook of
Hawaiian Fishes, University of Hawaii Press, Honolulu.]

Shark..............................................not identified to any lower taxonomic
level; in Hawai‘i there are 9 families comprising about 22 species.

Ray.................................................not identified to any lower taxonomic
level; in Hawai‘i there are 3 families comprising about 5 species.

Albulid............................................member(s) of the family Albulidae
(Bonefishes), of which there is a single species reported for Hawai‘i; usually found near
shore in open sand-bottomed areas, and reaching about 90 cm in length.

Muraenid..........................................member(s) of the family Muraenidae (Moray
Eels), of which there are over 35 species in Hawai‘i; some reaching a length of 150 cm.
Congrid. ........................................... member(s) of the family Congridae (Conger Eels), of which there are at least 7 species in Hawaii'i; some reaching a length of 150 cm.

Belonid. ......................................... member(s) of the family Belonidae (Needlefishes), of which there are 3 species in Hawaii'i; usually found somewhat offshore near the ocean surface, and reaching 100 cm in length.

Holocentrid. ...................................... member(s) of the family Holocentridae (Squirrelfishes), of which there are about 15 species in Hawaii'i; many of them found in deeper reef areas, with most of them fairly small and only 1 or 2 approaching 45 cm in length.

Mugilid. .......................................... member(s) of the family Mugilidae (Gray Mullets), of which there are only 2 species in Hawaii'i; both relatively common inshore forms, reaching a maximum length of about 45 cm.

Polynemid. ....................................... member(s) of the family Polynemidae (Threadfins), of which Polydactylus sexfilis (Hoi) of inshore sand-bottomed areas is apparently the only species thus far reported for Hawaii'i, reaching perhaps 45 or 50 cm in length.

Carangid. ........................................ member(s) of the family Carangidae (Jacks), of which there are over 20 species in Hawaii'i; most of them deeper-water and fairly large forms; the species Caranx ignobilis (Ulua--or Papio for the smaller young) sometimes ranging in close to shore, and reaching 100 cm or more in length.

Lutjanid. ........................................... member(s) of the family Lutjanidae (Snappers), of which there are 10 or 11 native species in Hawaii'i; most of them offshore deep-water--although not pelagic--forms, reaching maximum lengths of 30 to almost 100 cm.

Mullid. ........................................... member(s) of the family Mullidae (Goatfishes), of which there are 10 species in Hawaii'i; many of them living on the reef or frequently visiting it, usually about 20-25 cm long but a few reaching 40-60 cm.

Cirrhitid. ........................................ member(s) of the family Cirrhitidae (Hawkfishes), of which there are 5 or 6 species in Hawaii'i; all inshore forms, only 1 of which reaches as much as 30 cm in length.

Labrid. ........................................... member(s) of the family Labridae (Wrasses), which is the largest family of fishes in Hawaii'i with over 40 species; predominately inshore forms, most of them fairly small but with a few larger forms reaching about 50 cm in length.

Scarid. ........................................... member(s) of the family Scaridae (Parrotfishes), of which the genera Calotomus (2? species) and Scarus (4-5 species) are essentially the only 2 expected to occur in Hawaii'i; both being typically inshore groups, and including 1 or 2 species that may reach 70 cm in length.

Acanthurid. ....................................... member(s) of the family Acanthuridae (Surgeonfishes), of which there are over 20 species in Hawaii'i; most of them inshore forms, with the genus Naso (Unicornfish or mostly Kala) comprising the 5 generally largest of these, reaching 40 to 75 cm in length.

Scombrid. ........................................ member(s) of the family Scombridae (Tunas and Mackerels), of which there are perhaps a dozen species in Hawaiian waters; almost all open-ocean (pelagic) forms, many reaching a m or more in length.

Scorpaenid. ..................................... members of the family Scorpaenidae (Scorpionfishes), of which there are perhaps as many as 25 species in Hawaii'i; a majority of them inshore, and fairly small (8-15 cm), forms, although several species may reach between 25 and 50 cm in length.

Balistid. ......................................... member(s) of the family Balistidae (Triggerfishes), of which there are about 10 species in Hawaii'i; mostly inshore forms, with the largest reaching about 35 cm in length.
Monacanthid........................................member(s) of the family Monacanthidae (Filefishes), of which the small Pteragogus spicograms (Fantail Filefish), reaching only about 15 cm in length and sometimes washing up on beaches dead in great numbers, is by far the most abundant of the 8 species to be expected in near-shore Hawaiian waters; the genus Aluterus contains the largest species, reaching about 50 cm in length.

Tetraodontid........................................member(s) of the family Tetraodontidae (Smooth Puffers), of which there are about 5 species, ranging up to 50 cm in length, in Hawaii'i — or perhaps close to a dozen if the several, generally small, species of the genus Canthigaster (considered to constitute the family Canthigasteridae [Sharp-backed Puffers] by some authors) are included--; a few forms of both types of these puffers may found in shallower inshore areas, and all of the species may possess an intrinsic poison although the flesh is apparently sometimes eaten without ill effects.

Diodontid........................................member(s) of the family Diodontidae (Spiny Puffers), of which 2 species of the genus Diodon, ranging from 35 to 70 cm in maximum length, are by far the most abundant in Hawaiian inshore waters, the single remaining species reported for Hawaii'i (genus Chilomycterus, 50 cm in length) apparently being quite rare here; all of these species are suspected of possessing an intrinsic poison although the flesh is apparently sometimes eaten without ill effects.

Fish........................................material of indeterminate class and family.

CLASS AMPHIBIA

Order Anura
Family Bufonidae: (True Toads)

Bufo marinus (Giant Neotropical Toad).............introduced to the Hawaiian Islands in 1932.

CLASS REPTILIA

Order Testudinata (Order Chelonia of some authors)
Family Cheloniidae: (Typical Sea Turtles) and/or Dermochelyidae: (Leatherback Sea Turtles)

Sea Turtle........................................comprises fragmentary remains that could not be assigned to a particular one of the half-dozen species of marine turtle found in the Pacific; among the several chelonids, Chelonia mydas (Green Sea Turtle) is possibly the most abundant and, apparently, the one most often taken for food; Dermochelys imbricata (Hawksbill Sea Turtle) is usually found much less frequently and is apparently not eaten although the horny scutes of the carapace and plastron ("tortoise shell") are used artifically; while the sole dermochelyid, Dermochelys coriacea (Leatherback Sea Turtle—which lacks the large flat bony plates of the carapace found in all other sea turtles) is an important egg-producer for human food purposes in Indonesia, Malaysia, and probably other areas of the Southwest Pacific, although it does not lay eggs in Hawaii'i.

Order Squamata
Family Indeterminate

Small Lizard........................................lizard(s) with a head-and-body length of less than about 10 or 15 cm; usually not identified to any lower taxonomic level although, in Hawaii'i, most or all of the material probably represents the Polynesian-introduced(? families Gekkonidae (geckos) and/or Scincidae (skinks) rather than any of the smaller members of historically introduced families.

Order Procellariiformes
Family Diomedeidae: (Albatrosses)

Diomedea sp. (Albatross)

Family Procellariidae: (Shearwaters, Petrels, and Fulmars)

Puffinus pacificus (Wedge-tailed Shearwater)

Puffinus sp. (Shearwater).................................(see "Small Procellariid" and "Medium Procellariid" categories below for the various species of this genus most likely represented.)

Bulweria bulwerii (Bulwer's Petrel)

Pterodroma phaeopygia (Hawaiian Petrel)

Pterodroma sp. (Petrel).................................(see "Small Procellariid" and "Medium Procellariid" categories below for the various species of this genus most likely represented.)

Small Procellariid....................................smaller member(s) of the family Procellariidae, in the general size range of Puffinus nativitatis (Christmas Shearwater), Bulweria bulwerii (Bulwer's Petrel), Pterodroma hypoleucata (Bonin Petrel), as well as, apparently, Puffinus herminieri (Audubon's Shearwater) and the possibly undescribed "Pterodroma sp.", both noted as previously being found on Molokai and/or O'ahu by Olson and James 1982:32-33.

Medium Procellariid.................................medium-sized member(s) of the family Procellariidae, in the general size range of Puffinus pacificus (Wedge-tailed Shearwater), Puffinus nycteis (Nevill's Shearwater), and Pterodroma phaeopygia (Hawaiian Petrel).

Family Hydrobatidae (Family Oceanitidae of Olson and James 1982:33): (Storm-Petrels)

Oceanodroma castro (Banded-rumped Storm-Petrel)......material of a very small member of this family, presumably this species although I have not been able to obtain comparative skeletal material of it either locally or from the Smithsonian Institution, although I have satisfactory material of the larger Oceanodroma tristrami (Tristram's Storm-Petrel).

Order Pelecaniformes
Family Phaethontidae: (Tropicbirds)

Phaethon lepturus (White-tailed Tropicbird)......the smallest of the 3 tropicbird species occurring in the Pacific.

Order Ciconiiformes
Family Ardeidae: (Herons, Egrets, and Bitterns)

Nycticorax nycticorax (Black-crowned Night-Heron)

Order Anseriformes
Family Anatidae: (Swans, Geese, and Ducks)

Branta sp. (Goose)........................................presumably, either the historically known Branta sandvicensis (Hawaiian Goose) or one of the prehistorically extinct, apparently semiflightless--or possibly even flightless--medium-sized forms morphologically similar to, but evidently specifically distinct from, Branta sandvicensis; (see Olson and James 1991:42-47).

Thambetochen xanion (O'ahu Lowland Moa-nalo)

Thambetochen sp. (Moa-nalo, in part)....................prehistorically extinct, large, "toothed-jawed", flightless, goose-like member(s) of the family Anatidae; (see Olson and James 1991:28-32, 33-39).
Moa-nalo (Large Flightless Anatid)......................prehistorically extinct, large, obviously flightless, goose-like member(s) of the family Anatidae; (see Olson and James 1991:28-42 for the various genera and species potentially represented on the different Hawaiian Islands).

Small Anatid......................................................duck(s) in the size range of Anas wyvilliana (Hawaiian Duck), Anas laysonensis (Layson Duck), and some migrant or accidental continental teal; smaller than most other migrant ducks that often reach the Hawaiian Islands, which are often in the general "medium" size range of continental Anas platyrhynchos (Mallard).

Medium Anatid......................................................member(s) of the family Anatidae in the general size range of smaller geese and larger ducks, such as Branta sandvicensis (Hawaiian Goose) and continental races of Anas platyrhynchos (Mallard).

Order Galliformes

Family Phasianidae: (Turkeys, Peafowl, Guinea fowl, Chickens, Pheasants, Quail, etc.)

Gallus gallus (Red Junglefowl)......................in almost all cases, fragmentary material representing pre-Contact Polynesian junglefowl would not be distinguishable from that of historically introduced chicken breeds of this same species. Also, I am not sure that most such material of other phasianids such as various species of larger pheasants (Phasianus, Lophura, etc.) as well as guineafowl (Numida), all historically introduced--could usually be distinguished.

Small-to-Medium Galliform......................member(s) of an indeterminate family (--although, in Hawai'i, most likely family Phasianidae--) in the general size range of historically introduced Alectoris chukar (Chukar) and various Francolinus (francolins), all also historically introduced.

Medium Galliform......................member(s) of an indeterminate family (--although, in Hawai'i, most likely family Phasianidae--) in the general size range of Gallus gallus (Red Junglefowl (=Chicken)) and various larger species of pheasants (Phasianus, Lophura, etc.) as well as guineafowl (Numida), the latter two types all being historically introduced forms.

Large Galliform......................member(s) of an indeterminate family (--although, in Hawai'i, most likely all historically introduced members of the family Phasianidae--) in the general size range of Pavo cristatus (Common Peafowl; introduced to the Hawaiian Islands in 1850) and Meleagris gallopavo (Wild and Domestic) Turkey; introduced in 1786.

Order Gruiformes

Family Rallidae: (Rails, Moorhens or Gallinules, Coots, etc.)

Gallinula chloropus (Common Moorhen)

Porzana sp. (Hawaiian Flightless Rail)......................(formerly "Small Flightless Rallid"); sparrow- to plover-sized flightless member(s) of the family Rallidae; (see Olson and James 1991:49-62 for the various species potentially represented on the different Hawaiian Islands).

Medium Rallid......................................................member(s) of the family Rallidae in the general size range of Gallinula chloropus (Common Moorhen) and Fulica c. alai (Hawaiian Coot); most of the material probably consists of certain bones of 1 or both of these 2 species that I cannot satisfactorily distinguish, especially in the case of fragmentary material.

Order Charadriiformes

Family Charadriidae: (Plovers and Dotterels)

Pluvialis dominica (Lesser Golden-Plover).............this relatively common migratory species is most abundant--and thus most readily available for capture--in the Hawaiian Islands from August through April, although a few individuals may occasionally be found here all year.
Family Scolopacidae: (Curlews, Turnstones, Tattlers, Sandpipers, etc.)

Numenius tahitiensis (Bristle-thighed Curlew)

Medium Scolopacid........................member(s) of the family Scolopacidae, smaller than curlew, in the general size range of Arenaria interpres (Ruddy Turnstone), Heteroscelus incanus (Wandering Tattler) or a slightly larger species.

Family Laridae: (Gulls, Terns, and Jaegers)

Medium Larid..............................member(s) of the family Laridae in the general size range of jaegers and medium-sized gulls, none of which breed in the Hawaiian Islands but several species of which are relatively frequent vagrants or winter visitors here.

Order Columbiformes

Family Columbidae: (Pigeons and Doves)

Columba livia (Rock Dove)........................introduced to the Hawaiian Islands in 1796. (There are no native Hawaiian columbiforms, and of the 20 or so species of the order [all family Columbidae except for 1 sandgrouse of the family Pteroclididae] historically introduced to the State only 4 managed to establish widespread, long-surviving, populations: Columba livia [Rock Dove or "Domestic Pigeon"], Streptopelia chinensis [Spotted Dove], Geopelia striata [Zebra Dove], and Zenaida macroura [Horned Dove]—apparently only in the Pu‘uwa‘awa‘a area in the North Kona District of Hawai‘i Island. Thus, I presume most or all bones of columbids found will represent only these 4 forms although in a few cases osteologically similar species—introduced but now extirpated—could conceivably be represented.)

Streptopelia chinensis (Spotted Dove)..............introduced to the Hawaiian Islands sometime in the 1800’s; (see note under "Columba livia", above).

Geopelia striata (Zebra Dove)..................introduced to the Hawaiian Islands in 1922; (see note under "Columba livia", above).

Order Strigiformes

Family Strigidae: (Typical Owls)

Asio flammeus (Short-eared Owl)

Medium Strigid..................................comprises owl material that does not appear to be the sole Hawaiian representative of the family Tytonidae Tyto alba (Common Barn-Owl, introduced to the Hawaiian Islands in 1958), but very likely represents either or both the native Asio flammeus (Short-eared Owl) and the prehistorically extinct "Long-legged Oahu Owl" of Olson and James 1982:37-38 (both family Strigidae), many of whose bones I cannot yet satisfactorily distinguish, especially when fragmentary.

Order Passeriformes

Family Corvidae: (Ravens, Crows, Magpies, and Jays)

Corvus hawaiiensis (Hawaiian Crow)

Corvus (large species) (Crow)....................member(s) of the genus in the general size range of continental Corvus corax (Common Raven); presumably either or both the prehistorically extinct Hawaiian Corvus implusius and C. viriosus of James and Olson 1991:11-22 could be included.

Corvus sp. (Crow)..................................comprises material presumably representing this genus but that could not be certainly assigned to any of the 3 above-mentioned Hawaiian species.

Family Meliphagidae: (Honeyeaters)

Chaetoptila sp. (Kioea)...............................(historically extinct on Hawai‘i Island, and known only fossil elsewhere in the State.)
Family Indeterminate

Small Passeriform. .................... member(s) of 1 or more families of this order ("Perching Birds" or "Songbirds"), up to the general size of cardinals or smaller thrushes; most of the extinct and extant endemic Hawaiian passeriform species—as well as a number of the historically introduced ones—would be of this size.

Medium Passeriform. ..................... member(s) of this order in the general size range of myna and robin to larger jays; among endemic Hawaiian passeriform species, apparently only the extinct Chaetopitta sp. (family Meliphagidae) and, possibly, a very few of the larger prehistorically extinct species of Hawaiian Honeycreepers and Finches (subfamily Drepanidinae of the family Fringillidae; see James and Olson 1991)—as well as a few of the historically introduced species of various families—would be of this size.

Order and Family Indeterminate

Small Bird. ......................... member(s) of indeterminate order and family up through the general size of storm-petrel, quail, plover, sparrow, myna, and thrush; probably a large amount of the material represents passeriforms but smaller native or historically introduced species of 3 or 4 other orders could well be included, also.

Medium Bird. ........................ member(s) of indeterminate order and family in the general size range of shearwater and petrel, tropicbird, night-heron, duck, hawk, junglefowl (=chicken), moorhen and coot, curlew, gull, owl, crow, and so on; in Hawai‘i, probably no passeriforms other than Hawaiian species of the genus Corvus would be included, but a number of native or historically introduced species of up to a half-dozen other orders could potentially be.

Large Bird. ............................ member(s) of indeterminate order and family in the general size range of albatross, booby, frigatebird, goose, eagle, turkey, raven, and so on, in Hawai‘i, a number of native or historically introduced species of up to a half-dozen orders could potentially be included.

CLASS MAMMALIA (As far as possible, arrangement and nomenclature follow Toech, P.Q., 1986, Mammals in Hawai‘i, Second Edition, Bishop Museum Press, Honolulu; except that the more generally accepted name *Mus musculus* is used here instead of *Mus domesticus*.)

Order Chiroptera

Family Vespertilionidae: (Common Bats)

Lasiurus cinereus (Hoary Bat)

Order Primata

Family Hominidae: (Humans)

Homo sapiens (Modern Human)

Order Lagomorpha

Family Leporidae: (Hares and Rabbits)

Oryctolagus cuniculus (European Rabbit). introduced to the Hawaiian Islands sometime after 1778; known to have become established by 1823.

Order Rodentia

Family Muridae: (Old World Rats and Mice)

Rattus exulans (Polynesian Rat). comprises all material of this Polynesian-introduced species that, because of its relatively small size, could be distinguished with some degree of certainty from corresponding material of the 2 larger Rattus species (see following category) historically introduced to the Hawaiian Islands.

Rattus norvegicus and/or R. ratus (Norway and/or Roof Rat)... comprises all material that, because of its relatively large size, could be distinguished with some degree of certainty from that of the smaller Rattus exulans; although, except for essentially intact crania, I doubt that isolated skeletal elements of these 2 larger, post-Contact, species can safely be distinguished from each other.
Rattus sp. .................................................. comprises material presumably all representing this genus but that could not be assigned to any particular 1 of the 3 Rattus species named in the just-preceding 2 categories, usually because of either its fragmentary nature or its relative immaturity.

Mus musculus (House Mouse)..........................introduced to the Hawaiian Islands sometime after 1778.

Order Mysticeti
    Family Balaenopteridae: (Fin-back Whales) and/or Balaenidae: (Right Whales)

Mysticete........................................ member(s) of the order Mysticeti (Whalebone Whales), of which perhaps 6 species might be expected to occur in the Central Pacific, with adult lengths ranging from about 6 to 30 m.

Order Odontoceti
    Family Delphinidae: (Porpoises, Dolphins, etc.), Physeteridae: (Sperm Whales), and/or Ziphiidae: (Beaked Whales)

Physeter macrocephalus (Sperm Whale)...................a physeterid, with largest individuals (of) reaching a length of 19 m.

Small Odontocetes..........................members(s) of the order Odontoceti (Toothed Whales) up to about 3 m or so in length, thus including in the Pacific a half-dozen or more porpoise- and dolphin-like species of the family Delphinidae, as well as 2 unusual tiny physeterids of the genus Kogia (Pygmy and Dwarf Sperm Whales).

Medium Odontocetes..................member(s) of the order Odontoceti (Toothed Whales) from about 3 to 9 m in length, thus including here only the 4 largest species of Pacific Delphinidae, as well as both Pacific members of the family Ziphiidae.

Order Carnivora
    Family Canidae: (Wolves, Dogs, Foxes, etc.)

Canis familiaris (Domestic Dog)......................(I doubt that it is possible to distinguish remains of pre-Contact Polynesian dogs from morphologically similar forms of historically introduced ones, although individuals of very large or otherwise osteologically distinct introduced modern breeds of this same species might be successfully identified as such.)

    Family Viverridae: (Mongoose, Civets, etc.)

Herpestes auropunctatus (Small Indian Mongoose)......introduced to the Hawaiian Islands in 1883.

    Family Felidae: (Lions, Tigers, Cats, etc.)

Felis catus (House Cat)..........................introduced to the Hawaiian Islands sometime after 1778.

Order Perissodactyla
    Family Equidae: (Horses, Donkeys, Zebras, etc.)

Equus caballus (Domestic Horse)......................member(s) of the family Equidae in the horse size range; although I have referred all such material to this species (introduced to the Hawaiian Islands in 1863), in reality, the similar-sized Equus asinus x Equus caballus (Mule; introduced or produced locally by at least 1851) --and perhaps even the smaller Equus asinus (Donkey; introduced by at least 1825) --could not always be distinguished from it on the basis of most fragmentary material. (In addition, there are apparently no comparative skeletons of Mule, and only a few miscellaneous bones of Donkey, available in Hawai'i.)
Order Artiodactyla

Family Suinae: (Pigs, Babirusa, Warth Hogs, etc.)

Sus scrofa (Pig) ........................................... (just as in the case of the Domestic Dog, I doubt that it is possible to distinguish remains of pre-Contact Polynesian pigs from morphologically similar breeds of historically introduced ones, although individuals of extremely large or otherwise osteologically distinct introduced modern breeds of this same species might be successfully identified as such.)

Family Cervidae: (Muntjac, Deer, Elk, Pudu, Mosee, Caribou, etc.)

Medium Cervid .............................. member(s) of the family Cervidae in the size range of Axis axis (Axis Deer) and Odocoileus hemionus (Mule Deer), both of which have been introduced to various Hawaiian Islands, the former in 1867 and the latter, definitely, in 1861, if not as early as about 1816 (see pp. 133-134 in the Tomich 1986 reference cited on the preceding page of this list).

Family Bovidae: (Cattle, Buffalo, Goats, Sheep, etc.)

Bos taurus (Domestic Cattle) .................... member(s) of the family Bovidae in the cattle size range; although I have referred all such material to this species (introduced to the Hawaiian Islands in 1793), in reality, other such large bovids as Bubalus bubalis (Water Buffalo; introduced about 1881?) and Bison (North American Bison; introduced in 1968) could not be distinguished from it on the basis of most fragmentary material.

Capra hircus/Ovis sp. (Domestic Goat/Sheep) ....... comprises fragmentary material from 1 or more smaller historically introduced members of, presumably, the family Bovidae, with the osteologically very similar Capra hircus (Domestic Goat; introduced to the Hawaiian Islands in 1778) and Ovis aries (Domestic Sheep; introduced in 1791) being the species most likely represented, although Ovis musimon (Mouflon; introduced in 1984) is an additional possibility on some Hawaiian Islands. (Except for portions of the cranium, I doubt that isolated, often fragmentary, bone material of these 2 genera can safely be distinguished, considering both their general skeletal similarity and the osteological variation occasioned by possible interbreeding with and among the different breeds of domestic stock.)

Family Indeterminate

Medium Artiodactyl ................................. member(s) of indeterminate family, other than Suinae (=pig); although on most isolated Pacific islands the possibilities (all historically introduced) are probably limited to Cervidae (various deer) and smaller Bovidae (Capra hircus [Domestic Goat] and Ovis aries [Domestic Sheep]); however, in Hawaii, Antilocapra americana (Pronghorn) of the family Antilocapridae, as well as the bovid Ovis musimon (Mouflon)--introduced here in 1959 and 1954, respectively--must additionally be considered.

Order and Family Indeterminate

Small Mammal .................................... member(s) of indeterminate order and family up through the general size of Rattus sp. and mongoose; in Hawaii, Polynesian- or historically introduced species of at least 3 orders could potentially be included.

Small-to-Medium Mammal .......................... member(s) of indeterminate order and family in the general size range of wallaby, rabbit, dog, and cat; in Hawaii, Polynesian- or historically introduced species of at least 3 orders could potentially be included.

Medium Mammal ..................................... member(s) of indeterminate order and family in the general size range of man, porpoise, seal, pig, deer, and goat/sheep; in Hawaii, native or introduced species of at least 4 orders could potentially be included.

Large Mammal ...................................... member(s) of indeterminate order and family in the size range of medium and large whales, horse, mule, donkey, and cattle; native or historically introduced species of up to 4 orders could potentially be included.
CLASS INDETERMINATE

Order and Family Indeterminate

Small Vertebrate.......................... comprises highly fragmented bone material representing member(s) of indeterminate class, order, and family, but with an estimated head-and-body length less than about 0.3 m.

Medium Vertebrate.......................... comprises highly fragmented bone material representing member(s) of indeterminate class, order, and family but with an estimated head-and-body length of from about 0.3 m to, roughly, 2.0 m.

Large Vertebrate........................... comprises highly fragmented bone material representing member(s) of indeterminate class, order, and family, but with an estimated head-and-body length of more than about 2.0 m.
APPENDIX D

Plates
Plate IV: Site AS-21-100; Feature A-4
Plate VIII: Site AS-21-100, Feature A-9, Facing East
30 November, 1994

Joe Kennedy
Archeological Consultants
59-624 Pupukea Road
Haleiwa, Hawaii 96712

Dear Joe,

At long last we have completed the major element analyses of the Samoan samples you left with us. I am enclosing a brief report on these samples. You will notice that they are rather similar to some other East Tutuila quarry samples reported by Best et al in Neoromining the Stone: Archeologists and adzes in Samoa. J. Polynesian Society, v.101, p. 45-85, 1992, particularly the sample from the Laeno Quarry. I don't know where these various quarries are so I'm afraid you will have to figure out whether or not this is the same place where your sample comes from. I can tell you that the chemistry is similar enough to consider your samples as a match to the Laeno Quarry sample although the difference in K,O values is slightly outside of what is normal analytical error. Everything else agrees very well.

I hope you will find these data to be useful to your report. Give me a call if you have any questions. We will not bill you until we have run the trace elements which probably will take a month or so.

Sincerely yours,

John Sinton