

Successful settlement on Polynesian islands required the alteration of environments, and such alteration produced extensive cultural landscapes. While some of the characteristics of these landscapes are well-established, what drives the spatial and temporal structure of these settlements is not clear across the entire region. Here, we present data on the nature and structure of settlement along one geological substrate in the interior of Ta'ū Island, Manu'a Group, American Samoa. Our results suggest that variability in slope and soil fertility were key drivers of archaeological patterns. Early use of the area seems to meet expectations of an ideal free distribution wherein the community was dispersed and located in relatively optimal locations for settlement. Characteristics of the settlement in the 15th century AD and later are consistent with landscape packing and community integration, signaling a shift to an ideal despotic distribution.

Communities distribute themselves across space in response to a number of drivers, both culturally and environmentally defined. Cultural meaning is constructed and social relations manifested through activities undertaken across landscapes (Knapp and Ashmore 1999). At times, normative cultural perceptions of social space affect the orientation of communities and notions of social centrality (Ashmore and Sabloff 2002). These processes of community formation occur across variable environmental conditions, and patterning of landscape alteration, especially at a regional scale, is often driven by environmental variability (Winterhalder et al. 2010). The environment offers a set of opportunities and constraints (Ladefoged et al. 2009) that contribute to patterns of architectural construction in so far as these opportunities and constraints are associated with costs and benefits of using those locations for different activities.

The intersecting impact of cultural and environmental drivers of settlement are visible across Polynesia (e.g., DiNapoli et al. 2019; Kahn and Kirch 2013; Ladefoged et al. 2009, 2020; Lepofsky and Kahn 2011; Weisler and Kirch 1985), and the Sāmoan archipelago exemplifies this situation (Morrison and O'Connor 2018). Sāmoa offered a diverse set of environments for human settlement, which drove variation in the structure of settlement across the island group (Green 2002). Villages were largely coastal in the historic period, but extensive interior settlement was the norm during the 2nd millennium AD (Davidson 1969, 1974; Glover et al. 2020; Green 2002; Holmer 1980; Jackmond et al. 2018; Jennings et al. 1982; Martinsson-Wallin 2007). Extensive built landscapes are well documented across the archipelago (Davidson 1974; Glover et al. 2020; Jennings et al. 1982; Morrison and O'Connor 2018), including in the interior uplands of the small eastern islands that collectively constitute the Manu'a Group (Quintus 2020; Quintus et al. 2017). The small size of these latter islands and the bounded nature of their interior landscapes make them ideal case studies for examining the nature and development of built landscapes in the region. While past research has highlighted recurrent archaeological patterns (Quintus and Clark 2016), little research has investigated the spatial drivers and temporal development of these settlements.

We build on this research by describing, analyzing, and interpreting synchronic and diachronic patterns of a built landscape on Ta'ū Island in the Manu'a Group of American Sāmoa (Fig. 1). First, archaeological, soil fertility, and land morphology investigations provide a dataset from which to examine the spatial structure of settlement and the effects of environmental variability at the scale of an individual dispersed village. Second, an extensive set of radiocarbon dates (Quintus et al. 2020) allows an examination of how settlement structure changed through time. Finally, the combination of these datasets presents an opportunity to test expectations of ideal free and ideal despotic distribution models in this small island environment to assess the roles of soil fertility, slope, and social status in the development of a village-scale settlement.

Samoan Settlement Units, Patterns, and Processes

Sāmoan societies were historically organized as “house societies”. The household, defined by a social title, included an extended family with land, a set of domestic architecture, and other property (see Mead 1969). Multiple interacting households constituted *pitonu'u* (subvillages) and multiple *pitonu'u* were grouped to form *nu'u* (roughly, villages). These are relational social units (Shore 1982), defined on the basis of interaction, but each had a spatial component (Jennings et al. 1982). Titles, land, and resources were held by descent groups (Mead 1969, 18, 71-73) and

rights to cultivate land or build a house were based on participation in familial activities and with the permission of the title holder. Titled individuals from each decent group were ranked, reflecting the social position of the descent group to which the family title belonged, and these different ranks reflected the social level of authority of each individual (e.g., household, *pitonu 'u*, *nu 'u*). Ranking was dynamic and dependent on actions. In particular, acts of generosity and fertility were closely tied to status, ideologically linked to the concept of *mana* (Shore 1989). Both in Samoa and elsewhere, the failure of chiefs to provide materially for themselves and the rest of the population was interpreted as a loss of divine power and met with political instability (Allen 2010; Howard 1985; Shore 1989). Thus, access to fertile land to produce materials for exchange and redistribution was of high importance.

House societies are proposed to have a long history in the Sāmoan archipelago, extending back to the 1st millennium AD (Green 2002), and are thought to be identifiable archaeologically. Holmer (1976, 1980; see also Jennings et al. 1982) has argued that material records of these social relations are visible in some areas of the western islands of the archipelago through a nested set of archaeological remains termed household units, wards, and villages (see also Morrison and O'Connor 2018). Household units were the basic level of organization, represented by a set of domestic architecture and associated land, bounded by walls (Holmer 1976, 1980). The size of house foundations was sensitive to variable status, documented both archaeologically and historically (Holmer 1976:48; see also Jennings et al. 1982), with those of high status possessing higher and/or larger house foundations or house lots. Importantly, the houses of elites, built of perishable material with a limited archaeological signature, were no larger than commoner houses (see Davidson 1974, 214); it was the size – height and area – of the house foundation (e.g., platform, terrace of stone and earth) that was the important marker of difference. Distinct clusters of large residential structures have been further interpreted as elite architecture and argued to represent areas of chiefly authority (Holmer 1980; Jennings et al. 1982). Each cluster, around which is scattered architecture of those of lower status, was argued to represent authority over a group of extended families, or wards. These are interpreted as equivalent to ethnographic *pitonu 'u* (Jennings et al. 1982; Martinsson-Wallin 2007), but the term ward has been preferred because *pitonu 'u* are relationally rather than spatially defined. Groups of wards are interpreted to reflect villages roughly equivalent to *nu 'u* (Jennings et al. 1982). These nested settlement units were integrated by a diverse set of stone and earthen walkways and paths that connected household units and wards. Primary walkways, defined by their large size, were situated especially close to clusters of high-status architecture (Holmer 1980; Jennings et al. 1982) and Green (2002, 129) opined that the configuration of these paths may have helped define or reaffirm political networks.

While broadly similar to settlement zones documented in the western islands, archaeological communities in the interiors of Ofu and Olosega in the Manu'a group are also defined by a set of patterns that reflect the topography of the islands. Terraces are the dominant element of these cultural landscapes and many of these terraces exhibit evidence of residential use (e.g., pavings and curbing alignments). This is consistent with ethnohistoric and ethnographic reference to former villages in these locations (La Perouse 1798; Mead 1969), and the distribution of terraces suggest the presence of distinct communities (Quintus 2020). These settlements are best characterized as low-density agro-residential villages within which was located a large set of households and, at times, sub-village groups. Individual or small groups of terraces are inferred

to represent centers of domestic activity equivalent to household units (Quintus 2020; Quintus and Clark 2016). Mean terrace size generally decreases with increasing slope and clusters of large terraces interpreted as elite residences are positioned in central or seaward locations (Quintus and Clark 2016). These clusters of large terraces are thought to represent sub-village- and village-level authority (Quintus 2015; Quintus and Clark 2016). Agricultural infrastructure (i.e., drainage ditches) has been found interspersed among residential terracing (Quintus 2012; Quintus et al. 2016), and at least some of the terraces, especially those that are too narrow to support structures, may have functioned solely as garden spaces. The distribution of vegetation types across the interiors of these islands hint that agroforestry was practiced at lower elevations, amongst residential features, while forms of extensive shifting cultivation were practiced at higher elevations (Quintus 2015). These archaeological patterns are consistent with observations of French explorer La Perouse (1798, 55-56) who observed from his vessel an interior settlement on Ta'ū wherein houses were situated about midway up the mountain with cultivated plots situated around them.

Ethnographic sources document the symbolic significance of the seaward and center sections of villages in Sāmoa (Mead 1969; Shore 2014). Chiefly residences and associated features located in these central areas were focal points of villages (Lehman and Herdrich 2002; Mead 1969; Shore 2014), around which commoner households and other village activities were oriented. These spatial relations served to produce and reproduce social relations. As Shore (2014, 386) noted in the context of chiefs serving as focal points of communities in West Polynesia:

“This, then, is not simply a cultural model of space. It is a cognitively grounded form of political socialization affording those who use it an intrinsically hierarchical perception of the world. This model literally forces the self, in a range of ordinary orientational tasks, to view the world from the perspective of a social superior.”

This spatial configuration of villages was historically a mechanism of political legitimization in this cultural context. The construction of architecture in the geographical core of a larger system also had practical implications in that such a location would make management or oversight of the larger area easier (Weisler and Kirch 1985).

These ethnographic patterns seem to extend at least into the last few hundred years prior to European contact, as the symbolic significance of the center of villages helps explain some archaeological patterns (Quintus and Clark 2016). What drove the selection of specific areas for focal points or as centers in the past is unclear, but previous research has called attention to the role of slope in generating some residential patterns in these interior settlements (Quintus and Clark 2016). Slope is a key technological constraint to terracing in these environments in that labor costs increased drastically with increasing slope as more fill material was needed to produce each unit of terrace width. This manifested in a reduction in terrace width and variation with increasing slope as the construction of wide terraces became too costly.

Still, these focal points could be established anywhere in these interior landscapes where slope is suitable for the construction of terracing, which covers a broad area. Given the well documented relationship between the fertility of land and Polynesian chieftainship (Howard 1985; Shore 1989), we hypothesize that these focal points were established in agriculturally productive

spaces. Indeed, variation in agricultural production is a well-documented driver of patterning in archaeological landscapes across multiple spatial scales in Polynesia. Variation in agricultural potential frequently constrained the distribution of cultivation (Vitousek et al. 2014). Even within cultivated zones, however, differences in agricultural potential had substantial effects on the distribution and nature of the archaeological record, as various factions attempted to gain access to productive locations, legitimize authority, or move away from the demands of elites. In the ‘Opunohu Valley of Mo‘orea, Kahn and colleagues (Kahn and Kirch 2013; Lepofsky and Kahn 2011) have found that elite residences were positioned in agriculturally productive locations with lower status individuals occupying more marginal spaces. Kahn and Kirch (2013) relate these archaeological patterns to competition between social houses as different corporate groups attempted to invest in landed house estates in order to maintain or accumulate status through time. Similar trends are visible in Hawai‘i. In both Kaupo and Kahikinui on Maui, the spatial distribution of temple sites tied to those in power is correlated with the boundaries of productive locations, serving both to mark territory and signal authority over these locations (Baer 2016; Kirch et al. 2004). The location of temples in the Leeward Kohala Field System (LKFS) has similarly been tied to managerial oversight and the formation of authority (McCoy et al. 2011; Phillips et al. 2015), while there is a lower density of agricultural infrastructure and habitation as well as little evidence of elite presence in less optimal areas of the LKFS relative to its core (Ladefoged et al. 2020).

Documentation of the impact of environmental variability on synchronic patterns of settlement elsewhere hint that such variation may have been important on Ta‘ū in producing both spatial and temporal patterns of the built landscape. Pacific archaeological landscapes are palimpsests, and the growth of these landscapes is structured by previous land use as well as environmental conditions (Ladefoged et al. 2011). Past land use, often in the form of constructed environments, intersects with environmental variation to influence where factions of a population can live, how they can exploit an environment, and how they should interact with other groups in that same environment. While previous temporal data is limited (but see Quintus 2018), ideal free and ideal despotic distribution models provide testable expectations of these phenomena. These models assume that individuals will attempt to maximize their evolutionary fitness, often by improving their economic well-being and maximizing their net-energetic returns (Weitzel and Codding 2020). The ideal free distribution (IFD) predicts that when access to land is unconstrained, individuals will settle first the most suitable locations until the density of settlement increases to such an extent that those most suitable areas are no longer an option or are less suitable (Kennett et al. 2006; see also Fretwell and Lucas 1969). After, individuals will choose to occupy previously more marginal zones. Suitability is defined by accessibility, the availability of livable space, and appropriate resources (Winterhalder et al. 2010), which, in agricultural societies, is often based on soil fertility. However, access to land is often not unconstrained, especially in ranked societies, where some individuals are better able to compete for optimal land when resources are defensible (Mattison et al. 2016). In these cases, which form an ideal despotic distribution (IDD), territoriality may develop that interferes with the ability of individuals to settle optimal zones, pushing individuals to settle lower ranked habitats before it would be expected in an IFD (Bell and Winterhalder 2014; Prufer et al. 2017). Because highly suitable areas are defended by those of higher rank, less suitable areas are settled by those with limited social authority and opportunities. Thus, spatial sorting by rank and markers of resource control should be visible across resource heterogeneous landscapes. These patterns may be emergent in

archaeological sequences. As both Kennett et al. (2009) and Prufer et al. (2017) demonstrate, initial unconstrained access to suitable land, as in an IFD settlement model, can give rise over time to control of land associated with an IDD settlement model as social power is differentially accumulated, landscape suitability changes, and knowledge of landscape variability increases.

Based on these models, we expect that individuals in the interior uplands of the Manu'a group initially occupied areas of gentle slope and high soil fertility relative to the surrounding areas. As settlement density increased, we expect settlement occurred in more marginal areas, here defined as areas of steeper slope and lower soil fertility. Landscape packing may also have increased competition, especially as internal social ranking became more marked, which could necessitate investment in boundary walls that more clearly marked land ownership or elaboration of status symbols.

Intensive survey and excavation across a terraced landscape on the Luatele substrate of the island of Ta'ū provide an opportunity to evaluate these patterns and expectations. In particular, we aim to compare Luatele to settlement zones on Ofu and Olosega to evaluate whether recurrent patterns documented on those islands extend to Ta'ū. We then assess the role of slope and soil fertility in driving those patterns before testing expectations of IFD and IDD models against the development of this interior settlement.

Environmental Setting and Methods of Investigation

All the islands of Manu'a are small, with Ta'ū the largest at 36 km². Settlement of the group occurred around 2650-2750 calBP (Clark et al. 2016; Petchey and Kirch 2019), though sites dating to this period are not yet documented on Ta'ū. Occupation throughout the group was largely coastal through the first millennium BC and much of the first millennium AD (Quintus 2015), with only limited evidence of the use of the interior uplands at this time (Quintus et al. 2020). Intensive use of island interiors occurred by the end of the first millennium AD and continued through the second millennium AD (Quintus 2015, Quintus et al. 2020).

The Luatele site (AS-11-123) was identified in the northeastern quadrant of the Ta'ū interior using lidar imagery and first investigated in 2015. The name of the site derives from the geological substrate on which the site primarily sits, though some archaeological remains are found on the adjacent Lata substrate as well (Fig. 2). The area is heavily vegetated with a mix of secondary (e.g., *Rhus taitensis*, *Myristica* spp.), economic (e.g., *Cocos nucifera*, *Artocarpus altilis*; *Hibiscus tiliaceus*), and invasive (e.g., *Adenanthera pavonina*) forest species. The ages of most surface substrates on the island are unknown, but all are younger than 100,000 years (McDougall 2010) and, on stratigraphic grounds, the Luatele substrate is younger than the adjacent and more spatially extensive Lata substrate. It is generally hot, humid, and rainy across the island. Lower elevations of the island's interior receive roughly 4,000 mm annually while the higher elevations receive some 7,500 mm. Slope values generally range from 10° up to 30° in the project area, though slopes under 10° and over 30° are locally present.

Fieldwork was undertaken across three field seasons (Motu 2018; Quintus et al. 2017). These efforts focused on four transects and an intensive recording of features near the center of the Luatele substrate (Fig. 2). Additional spot checks were undertaken between these transects to

confirm the continuous distribution of features and to further map key linear features that extended outside of transects. Field-recorded features were supplemented by a dataset of terraces documented between transects previously identified through analysis of a lidar dataset. Methods of digital feature identification and a discussion of characteristics of those features can be found in Quintus et al. (2017). The lidar dataset also allows confirmation of the continuation of linear features that were partially mapped in the field.

We focus here on two major categories of documented features: terraces and linear mounds. Terraces are defined as artificially flattened surfaces with at least three free standing sides. The length and width of each feature was measured and the presence of secondary features was noted for each terrace. The area of field-recorded terraces was calculated using a simple length x width equation. We use this simple measure because the exact boundaries of individual terraces were often ambiguous given the density of the vegetation, the way that the features graded into surrounding slopes, and post-construction processes of erosion and deposition that have impacted the form of each feature. While there is some uncertainty, these measurements are useful for relative comparison across the site. Linear mounds are mounded features built of cobbles, boulders, and soil that are longer than they are wide. The configuration of these features falls into three broad types: a single linear mound (single wall), two mounds running parallel to each other (double wall), and mounds that are continuous but change in morphology from single to double walls across their extent (mixed form). The single walls are morphologically similar to low walls across the western islands of Sāmoa that form boundaries around sets of features and open spaces (Davidson 1974; Holmer 1980), while the double walls are morphologically equivalent to walled walkways (Holmer 1980). As such, they are interpreted in these terms here. The height and width of each feature were measured, though these measures vary along the length of each feature. All features were plotted using the internal GPS of Apple iPads and the ESRI Collector App with 5-10 m accuracy, with the shape of these features later modified to reflect field recorded dimensions if errors were identified. Each archaeological feature was then described and photographed.

A small percentage of field-identified features were chosen for excavation. Two methods of excavation were used: small test pits to acquire datable material under constructed features and larger test units to examine the internal structure of features. Twenty-six test pits and 10 controlled units were dug through 20 terraces (~6% of total terraces) and 13 linear mound segments (~14% of total linear mound segments). Two units were dug into a single terrace and three test pits were dug into a single linear mound segment. Additional methods of excavation, charcoal analysis, and radiocarbon dating can be found in Quintus et al. (2020).

Slope and elevation data were extracted for each terrace identified in the field and digitally using ArcDesktop 10.7. A 10 m DEM produced by the USGS was downloaded (catalog.data.gov) from which elevation in meters and slope in degrees was derived. Soil fertility across the project area was measured through soil chemistry. Our analysis focused on three measures that correlate with boundaries of intensive agriculture in Hawai'i and Rapa Nui (Vitousek et al. 2014): pH, % base saturation, and exchangeable Ca. pH is an important variable that, among other things, impacts nutrients available to plants and Al toxicity, with values between 6 and 7 considered optimal. Percent base saturation is linked to pH and is a good predictor of plant available nutrients. Exchangeable Ca is not a soil fertility indicator, per se, but it is an important base cation and one

factor that impacts the availability of Ca to plants. We include it here because it was considered the best predictor of field boundaries in Hawai‘i (Vitousek et al. 2014). We principally sampled soils along three transects across the Luatele substrate (Fig. 3) as defined by previous geological mapping (Stice and McCoy 1968): one vertical transect ($n = 13$) and two lateral transects (upper $n = 17$; lower $n = 22$). Four samples at the center of the lateral transects were included as part of the vertical transect. Six additional samples were taken from below and between these two lateral transects nearer the eastern and western boundaries of the Luatele substrate. Soil pH was measured for 54 samples while exchangeable Ca and % base saturation were measured for 53. At each location, we composited three integrated samples collected from unmodified slopes to 30 cm depth, following methods in Vitousek et al. (2004). All samples were air dried and passed through a 2 mm sieve. Measurement of pH was accomplished with air-dried soils mixed with deionized water in a 1:2 ratio at the Indigenous Cropping Laboratory at the University of Hawai‘i at Mānoa. Exchangeable cations and base saturation were analyzed following procedures in Soil Survey Laboratory Staff (1992) using the ammonium acetate (NH_4OAc) method buffered at pH 7 at the University of Hawai‘i at Hilo Analytical Laboratory.

The segmented package (Muggeo 2008) was used in R (R Core Team 2021) to carry out a small set of segmented or piecewise regressions. Soil characteristics, slope, and terrace size were each evaluated against elevation. While patterning of soil fertility on the island is likely to be driven by variable precipitation (see Vitousek et al. 2014), we explore the relationship between our soil fertility indicators and elevation to maintain consistency with other datasets and because fine-grained precipitation datasets are lacking. We also assume that elevation is a good proxy for rainfall in this high island environment. Segmented regression assesses whether the relationship between two variables is better explained with more than a single line and highlights at what elevation the nature of the relationship begins to differ. Breakpoints are defined as the position where the relationship between variables begins to differ. The Davies’ test (Davies 1987), which tests for a change in the slope of a regression parameter, was used to test the statistical significance of breakpoints using a 0.05 alpha level. Moran’s I (Spatial Autocorrelation tool) and Anselin Local Moran’s I (Optimized Cluster and Outlier tool) tests were performed in ArcDesktop 10.7 to examine point patterns in a combined field and digital dataset of terraces in order to identify clusters of terraces of different sizes at difference scales. Chi-squared tests and confidence intervals were calculated in Minitab. Analyzed data are provided in supplementary spreadsheets.

The Spatial Structure of the Luatele Settlement

Three-hundred twelve terraces and 93 linear mound segments were recorded across a ~130 ha area during pedestrian survey. Terracing and linear mounds occur between these transects and have been recorded in digital surveys (Motu 2018; Quintus et al. 2017). The vast majority of terraces we recorded are located on the Luatele substrate, with a small number located on the Lata substrate at the far eastern end of the project area that were documented digitally and field confirmed. Given some uncertainty of substrate boundaries, it is possible that the Luatele substrate does extend further east to an intermittent stream that defined the southeastern side of our project area. The area of contiguous terracing is roughly bounded on the northwest side of the project area by an intermittent stream and by steep cliffs to the north. The inland boundary is more difficult to define as archaeological remains continue slightly past the crater (Klenck 2016).

However, a series of large cross-slope walls does mark an elevation at which the nature of the archaeological record changes from a dense concentration of terracing to more specialized features and more sporadic linear mounds.

The size of field-recorded terraces varies considerably across Luatele, ranging from 8 m² to 714 m² (Fig. 2, Supplemental Table 1). Features in the southeastern transect (Transect III [95% confidence interval for mean, 46-65 m²]) are smaller than those in the center (Transect II [121-165 m²] and IV [103-163 m²]) and northwest (Transect I [100-140 m²]). Terrace size also varied by elevation, though the relationship is not linear. Mean terrace size increases with increasing elevation in the lower half of the site and then decreases with increasing elevation moving further inland (Fig. 4A). While the relationship is weak, the point at which the relationship between elevation and terrace size changes, the breakpoint, is estimated by segmented regression at 198 m ($r^2 = 0.08$; Davies' $p < 0.001$; see Supplemental Information). These spatial patterns are even more apparent when terraces are broken into four size classes (Supplementary Table 2); in particular, very large terraces (over 300 m²) are distributed unevenly. Seventy-seven percent of these features recorded in the field are in a roughly 8-ha area near the center of the Luatele substrate (seaward of the absolute center), including the two largest in the dataset located next to each other.

These field data can be supplemented with 457 digitally recorded terraces (the analytical dataset from Quintus et al. 2017) to create a combined field and digital dataset (Fig. 5, 6). Identified patterns are largely consistent with those documented in the field dataset with larger terraces situated in the middle elevations of the site (Fig. 4A, Fig. 6; Supplemental Table 2, 3). Thirty-one terraces over 300 m² in size are included in the combined dataset, with 61 percent located in the roughly 8-ha area in the center of the Luatele substrate. The breakpoint between terrace size and elevation in this dataset is also at 198 m ($r^2 = 0.05$; Davies' $p < 0.001$; see Supplemental Information). The same as that identified in the field dataset. More generally, terraces are spatially autocorrelated (Moran's I; z -score = 14.56; $p < 0.001$; see Supplemental Information). An Optimized Cluster and Outlier Analysis (Anselin Local Moran's I; see Supplemental Information and Supplemental .shp) using terrace area as the value parameter identifies the grouping of large terracing near the center of the project area as a significant high-value cluster (False Discovery Rate [FDR] correction, 95% confidence, $p < 0.026$) and terracing at the upper elevations and near the southeastern field transect as clusters of low-values. In addition to these clusters that are consistent with patterns in the field data, a significant high value cluster was highlighted at the southeastern end of the project area (see also Fig. 6). This area was not intensively surveyed in the field, but spot checks did confirm the presence of a few large features in the area. Several individual outliers were identified in all of these clusters while some terraces at the northwestern edge of the substrate were classified as a low-value cluster. The presence of outliers indicates that terrace sizes are poorly sorted across the site; small and large terraces are intermixed even though there are areas where large or small terraces are clustered.

The majority of linear mounds (boundary walls) are oriented parallel to the slope, with segments running from near the bluff to near Luatele crater. The distance between adjacent boundaries within surveyed transects is reasonably consistent, ranging from ~30 m to ~80 m with no clear spatial patterning in the field data available vertically or laterally across the project area. The longest linear mound in the site, which is of mixed form but is a double wall for much of its

extent, is interpreted as a path that stretches 1.6 km across the settlement (Wall 2). This feature was only partially mapped in the field, with connecting segments visible using the lidar dataset. This feature is interpreted to have served a function comparable to primary walkways in the western islands of the archipelago as it effectively integrates the site from one side to the other. It does so at an elevation around 200 masl for most of its extent, though it does extend to an elevation of 240 masl toward the southeastern boundary of the site. Sixty-four percent of very large terraces in the field dataset are located within 50 m of this path, compared to 19% of terraces smaller than 300 m² ($n = 307$; excludes terraces beyond extent of feature; $\chi^2 = 24.28$; $p < .001$). Other cross-slope walls are interspersed amongst the terraces, some of which form retaining walls for the terraces. However, a series of these walls, which are far larger than others, occur at and seem to mark the upper elevation boundary of the settlement. These wall segments do not connect across the entire breadth of the site but they do define a boundary at a relatively consistent elevation: at ~310 masl in the eastern transect (Wall 78), at ~315-330 masl in the center, and ~340 m in the center-west transect. It is above this point that there seems to be a shift in the nature of the archaeological record wherein terracing is more sporadic, linear mounds parallel to the slope are rare, and ritual sites are present (see Klenck 2016).

Features are generally distributed in slopes less than 20° (Fig. 4B), with some exceptions along the seaward boundary of the site. Extensive gentle sloping land is one of the characteristics that seems to delineate the Luatele substrate in the eastern half of the island. The size of terracing is generally more variable in gentler or moderate slopes, where mean terrace size is higher, though this pattern is not as apparent in the combined dataset. These differences relate to variation in the width of terraces rather than length. Long terraces were still constructed in steeper slopes but wide terraces were not, as the labor requirements of wider terraces outweighed benefits of their construction. There is a breakpoint in the relationship between slope values associated with terraces and elevation at 183 m in the field dataset ($r^2 = 0.23$; Davies' $p < 0.001$; see Supplemental Information) and 218 m in the combined dataset ($r^2 = 0.14$; Davies' $p < 0.001$; see Supplemental Information). From the cliff to this breakpoint, slope values associated with terraces decrease substantially with increasing elevation while mean terrace size increases (Fig. 4C). The decrease in mean terrace size above the 200 m contour, however, is not related to changes in slope as slope values associated with terraces generally stabilize below 20° above the 200 m contour.

Soil fertility varies by elevation with lower elevations being more fertile than higher elevations (Fig. 7, Supplemental Table 4; Autufuga 2021). This suggests that precipitation is a key driver of soil fertility across the Luatele substrate, as demonstrated elsewhere (Vitousek et al. 2014), with areas of higher rainfall on Luatele being less fertile. The location of cross-slope boundary walls between 310-340 masl coincides with low values of soil parameters. It is above this elevation that some soils begin to fall below 30% base saturation and the majority of soils exhibit pH values of less than 5.7, both values of soil fertility that seem to constrain agriculture elsewhere in Polynesia (Vitousek et al. 2014). Measured exchangeable Ca values are low throughout the project area, at least relative to agricultural landscapes in Hawai'i and Rapa Nui, and these values also decline with increased elevation. There is some evidence that soil fertility is higher in the northwestern half of the project area than in the southeastern half in the lower elevations (Table 1), which correlates with increased mean terrace size in the northwest relative to the

southeast, but two of these differences are not statistically significant and all of the differences are relatively small.

Segmented regression provides further insights into the relationship between elevation and soil characteristics (see Supplemental Information). The vertical soil transect was used to assess breakpoint patterns as it is not affected by the lateral variation in soil fertility measures across the project area. No statistically significant breakpoint was present in the relationship between pH and elevation as the relationship is relatively linear. The breakpoint in exchangeable Ca occurs between the second and third sample point (Breakpoint Est. = 84 m; Supplemental Information), after which exchangeable Ca declines with increased elevation in a relatively linear fashion. In contrast, a breakpoint is present between elevation and base saturation at 204 masl ($r^2 = 0.80$; Davies' $p = 0.03$). This is similar to the breakpoint between terrace size and elevation, wherein terrace size began to decrease above ~200 m, and between slope and elevation, wherein slope values stabilize above ~185-215 m.

Subsurface Investigations

The excavation of terraces allowed an opportunity to evaluate their function and internal structure. This is important since no excavation has been conducted through the surfaces of terraces on Ofu or Olosega. All but one terrace through which controlled excavation was undertaken on Ta'ū ($n = 8$) displayed a similar stratigraphic sequence. These terraces were largely built on sloping ground onto which a fill was transferred to flatten the surface. In those units dug from the terrace front to back, this layer of fill increased in thickness the closer one was to front of the terrace (Fig. 8A). The lone exception to this general pattern was a feature built near the edge of the bluff leading down to the coastal plain (Terrace 98, Fig. 8B). Here, the individuals that constructed the terrace used large angular boulders to help create a flat surface onto which sediment was dumped to complete the terrace. A rough cobble pavement was then constructed, which seems to have provided a base to the living floor. This style of construction is a unique solution in a steep location where construction of a terrace with earthen fill alone would be difficult.

All terraces excavated with controlled methods exhibited evidence of residential use. In three cases, surface curbing alignments evince such a function. These outlines are all relatively small, being between 20-30 m², but fall within the range of house sizes documented elsewhere in the archipelago (Davidson 1974). Subsurface layers of loosely placed sub-angular to sub-rounded boulders and cobbles create floor pavement in three units (Figs. 8C, 8D). These pavements, even though they are quite rough, are interpreted to mark locations of previous superstructures. Postholes, which also document the presence of superstructures, were identified in two units and basin-shaped features interpreted as trash pits were recorded in two units. Small basalt flakes indicative of tool maintenance and use were recovered in all but one controlled excavation, while waterworn basalt gravel and small cobbles (*ili'ili*) of former pavings were identified in all controlled units. Locally available angular cobbles were found on the surface of most terraces in the project area, similar to those found scattered on residential platforms in the Mt. Olo tract on 'Upolu. Holmer (1976) argued that these cobbles were an important addition to foundation surfaces as they increased drainage and limited rot of superstructures. It is plausible that scatters of angular stone and subsurface foundations would have effectively served this function in

Luatele. Coral gravel, a common house paving material on the adjacent island of Ofu and Olosega, was noticeably rare in Luatele. It was found during excavation in only one unit, while a small coral boulder was found in the retaining wall of another feature.

The construction ages of 15 terraces in Luatele have been modelled previously (Quintus et al. 2020). Each terrace can be placed into an early ($n = 6$; pre-AD 1400) or late ($n = 9$; post-AD 1400) temporal group (Table 2). We include in the early group all terraces for which a pre-1400 age is plausible, which includes two terraces with *terminus post quem* (TPQ) but no *terminus ante quem* (TAQ) dates. With no upper constraint, these terraces have modelled construction ages that range into the historic period even though their associated TPQ are in the 12th and 13th century respectively. Thus, we use an assumption in this analysis that there is little temporal lag between these TPQ dates and the event of terrace construction when a terrace is lacking a TAQ.

The spatial distribution of dated terraces can be found in Figure 9. All terraces dating to the early period are larger than 100 m² and smaller than 300 m², with both smaller and larger terraces present in the later period. Terraces dated to the early period are all located below 221 masl and all but one is within a 30 m elevation envelope that corresponds well with various breakpoints between slope, soil measures, and elevation. The four dated terraces in the highest associated elevations date to the late period. There is little difference between slope values associated with terraces of different time periods, and both early and late terraces are located across the lateral extent of the Luatele substrate. The two dated terraces that may fall on the older Lata substrate were both built in the later temporal period.

One controlled unit was dug through a linear mound to better understand the internal morphology of these features. The internal structure of the feature is similar to that documented for some linear mounds in Hawai‘i (Quintus and Lincoln 2020), with a mounded profile and construction fill of earth, cobbles, and small boulders. There appears to have been little deposition around the basal stones of these features, implying that they were relatively late additions to the site. Radiocarbon dating supports this conclusion. Modelled construction ages are available for 10 linear mound segments (Quintus et al. 2020). Almost all linear mound segments are dated to the 17th century AD and later (Table 3). Of the two examples that potentially date before this time, one is found in the center and one at the southeastern end of the project area. These two features have the lowest associated elevations of the dated features, but there may be substantial lag between the TPQ date and the construction of each feature. Both the large pathway that stretches across nearly the length of the site (Wall 2) and the only dated large cross-slope feature (Wall 78) that forms part of the upper boundary of the settlement were constructed in or after the 17th century AD.

Discussion

Large size is a characteristic of high-status architecture in Sāmoa (Davidson 1974; Holmer 1976, 1980; Jennings et al. 1982), and clusters of large architecture are interpreted as centers of authority (Jennings et al. 1982, 89). These clusters in the Manu‘a group have spatial characteristics of community focal points documented in ethnohistoric and ethnographic literature (Quintus and Clark 2016). In Luatele, this architecture is largely, but not solely, concentrated in a roughly 8-ha area near the center of the Luatele substrate and near the center of

the distribution of terraces across this landscape, a pattern confirmed by spatial autocorrelation analyses. We interpret this cluster of large terraces to be the focal point of the settlement comparable to those found in communities on the adjacent islands of Ofu and Olosega. Outside this focal zone, mean terrace size is smaller in the southeast than in the center and northwest. Mean terrace size also decreases above the 200 m contour.

Slope played a role as an important technological constraint to terrace size in Luatele. That slope was a technological constraint is demonstrated by the fact that construction of a terrace in steep slopes necessitated the use of a different construction method relative to terraces in gentler slopes. The presence of terraces, some large, in steep slopes below the 200 m contour highlights a tradeoff between slope and soil fertility. Given that soil fertility declined with increasing elevation, it seems that at least some individuals or groups were willing to invest additional labor to construct terraces in steeper slopes to gain access to more fertile land. Slope partially contributes to the location of the focal point within Luatele, but other areas of gentle slope would also be suitable for the construction of large terraces. In fact, a larger area of contiguous slope values below 10° is located to the southwest of the recorded focal point, but comparable terraces are not found in the area. Instead, the focal point is situated at an intersection of stabilizing slope and declining soil fertility. The position of the focal point takes advantage of gentler slopes relative to areas downslope and higher soil fertility relative to areas upslope.

Construction in this location, without the limitation of slope and with still relatively high soil fertility, is important in a social context where fertility was often taken as a sign of the efficacy of leadership and proximity to the divine (Howard 1985; Shore 1989). Access to productive land that made one's group more capable of meeting social obligations was a key component of status maintenance and accumulation. Furthermore, based on Sāmoan cultural models of space in the ethnographic and ethnohistoric data (Shore 2014), the position of this focal point at the center of the archaeological distribution served to legitimize the inhabitants of these terraces. The position also affords more efficient access across the settlement to those living in the focal point, perhaps increasing some level of community oversight. The orientation of the settlement across Luatele and the position of the focal point at the center of the substrate may speak to attempts to control the Luatele landscape, specifically. The youthful age of the substrate and expansive gentle slopes, relative to adjacent areas, may have made the area especially attractive. In general, smaller residential structures in Luatele seem to be situated in less suitable locations based on slope and soil fertility. While those in the center of the settlement had access to both gentle slope and relatively high soil fertility, individuals elsewhere had to choose between the two. The other cluster of large terraces at the southeast edge of the project area may represent more local authority, at the sub-village level, akin to those documented on 'Upolu and Savai'i (Jennings et al. 1982). This pattern, wherein architecture associated with those in power was built in agriculturally productive landscapes, is well documented broadly across the region (Glover et al. 2020; Kahn and Kirch 2013; Kirch et al. 2004; Lepofsky and Kahn 2013; McCoy et al. 2011).

This is not to say that no small terraces are located in the focal point as several are and there is no evidence of concentric circles of decreasing status with increased distance from the settlement center, as would be expected from the ethnographic model proposed by Shore (2014). Rather, there is a general centering pattern to the status architecture (see Hutson 2016, 160-165) with a few large terraces found outside the center and a number of smaller terraces intermixed among

the larger features in the focal point. This is consistent with what might be expected if decent groups lived near each other and if these decent groups were ordered hierarchically. Thus, the distribution of terrace sizes may represent ordering at two scales, the community as a whole and within each descent group.

The most notable difference between Luatele and settlements zones on Ofu and Olosega is the presence of linear mounds in the former. This is partially a result of raw material availability; there is more stone available across and around Luatele than on either Ofu or Olosega because of the youthful age of Ta'ū. However, the presence of these linear mounds also indicates the perceived need to bound and control land at multiple spatial scales. At the site-scale, the large cross-slope walls (e.g., Wall 78) that form the upslope boundary of the site demarcate a point on the landscape wherein soil fertility thresholds that correlate with boundaries of intensive agriculture elsewhere in Polynesia occur (Vitousek et al. 2014). The long boundaries parallel to the slope highlight localized efforts to partition the land around smaller social groups. The mixed form pathway (Wall 2) stretching across the settlement is more integrative. Proximity to the long pathway may have been an important marker of status, as traffic along this pathway would have exposed inhabitants in Luatele to the large complexes located along the 200 m contour. This is consistent with the relationship between primary walkways and elite structures documented in the western islands of the archipelago (Davidson 1974; Green 2002; Holmer 1980; Jennings et al. 1982).

The available modelled construction ages of terraces and linear mounds allow for a preliminary examination of the formation of these patterns. Apart from one exception, the early terraces were built in a relatively narrow elevation and slope band dispersed laterally across the Luatele substrate. This slope and elevation band is similar to that of the focal point. The one exception is the uniquely constructed terrace on the side of the bluff (Terrace 98). Terrace construction in and after the 15th century occurred around previously built terraces and began to extend into higher elevations, though the average slope values targeted seem to have stayed consistent. The construction of linear mounds was largely late, indicating that settlement density did not reach a threshold where physical demarcation of land was necessary until late in the cultural sequence. It further suggests that these features were not merely the result of the piling of excavated rocks from garden activities, but, rather, were intentional boundaries. The construction of these features, especially the pathway across the settlement, evince increased settlement integration in the 17th century or later.

These data are largely consistent with expectations derived from an IFD settlement model (Weitzel and Coddling 2020). Early occupation across Luatele occurred in relatively optimal locations in terms of soil fertility (elevations around 200 m) and, generally, within a narrow band of slope values. It is surprising that earlier terraces were not built on gentler slopes relative to later terraces, but this may relate to sampling. Alternatively, it may imply that differences in slope below a certain threshold were not practically important for inhabitants. Later construction marks population growth and movement into more marginal locations, as defined by soil fertility. Three of the later terraces are below 100 m² in size and are relatively narrow with widths between 4 m and 5 m. It is possible that these functioned as garden spaces, but their size could still support small residential structures. The two dated terraces that may lie on the Lata substrate also date to the 16th century or later. Older substrates tend to be less fertile (Vitousek et

al. 2014) and our results may document later movement into less optimal areas, though the Lata substrate is still relatively young (less than 100 ky) and soil fertility on the substrate is poorly understood (Autufuga 2021).

The current configuration of the landscape, specifically the correlation between terrace size, slope, and soil fertility in addition to the presence of boundary walls, meets expectations of an IDD settlement model (see Bell and Winterhalder 2014). However, the formation of this pattern is difficult to unravel with our current data. The construction of most linear mounds late in the cultural sequence following increased landscape packing highlights an increased concern with land boundaries. These features might mark a late transition to an IDD. If the two relatively early radiocarbon determinations under linear mounds accurately date the construction of those linear mounds, it would indicate that boundaries were constructed first at the more fertile lower elevations, as expected by an IDD model. That the three largest terraces from the early period were in the central and northwestern sections of the Luatele substrate, areas of slightly higher soil fertility relative to the southeast, could imply early control of more suitable areas by higher ranked individuals. However, size differences were more muted at this time, lateral soil fertility differences across Luatele are limited, and there is little other evidence of competition or attempts at control. Certainly, the equivocal evidence of status distinctions during this early period contrasts with indications of differential rank visible in the early 'Opunohu Valley sequence in the Society Islands (Kahn and Kirch 2013).

At present, we favor a model of gradual focal point emergence. We hypothesize that initial use of the area established the boundaries of the settlement. The creation of settlement boundaries defined a central point after which time materializations of rank developed as a mechanism of political legitimization and as a product of access to high suitability land. Additional dating of the large terraces in the focal point of the settlement would test this interpretation, and we would expect those large terraces to date in later time periods if our favored model is correct.

Conclusions

Terraced landscapes are an important component of the archaeological record across the Pacific and, indeed, the world (Treacy and Denevan 1994). In the Manu'a group, these cultural landscapes share a set of recurrent patterns, indicating a shared settlement structure and, likely, the impacts of shared environmental characteristics. In Luatele, consideration of slope and soil fertility contributed to the production of these patterns. Social status was a key variable that intersected with slope and soil fertility to produce the archaeological patterns that we documented. It does seem that soil fertility was more influential than slope as the architectural focal point was located in a position that privileged soil fertility over low slope and because it appears that slope was only a constraint when it reached values above roughly 15°.

Material inequality seems to have been a product of these environmental conditions and was emergent across Luatele, which then was maintained by these same environmental conditions. The architectural materialization of rank distinctions appears to have been relatively muted when terracing began to be constructed in Luatele, at least in comparison to later times. This is consistent with the general lack of boundary walls in this early time period, which suggests a lower level of competition for land relative to later periods. Terraces were constructed in more

marginal locations over time and between already established features. While smaller features were built in more marginal locations, more elaborated terraces were constructed in previously occupied spaces. This landscape packing and eventual territorial behavior appear to have been late phenomena in Luatele. Evidence of paths and boundaries that cross-cut the settlement suggest the presence of larger social units at this time as well. The late emergence of larger social units and small-scale institutionalized inequality in Luatele is consistent with evidence of the development of suprahousehold authority after the 15th century AD elsewhere in the Manu'a group (Quintus et al. 2016). Within a social structure where extended families were land-holding entities and rank was perceived through abundance and fertility, access to and control of productive land was an important mechanism of status maintenance and accumulation.

Our analysis of Luatele adds to a growing body of data examining the growth of interior settlements across Polynesia. Communities across the region targeted optimal locations for initial settlement that reflected a concern with agricultural production. Later settlement occurred in more marginal locations, with settlement in optimal locations becoming more elaborated to reflect power and status accumulation. The latter is especially well documented in the Society Islands and was likely a key driver of increased institutionalized social inequality (Kahn and Kirch 2013). While social inequality is far more muted in Manu'a than in the Society Islands, the position of the settlement focal point in Luatele speaks to a concern of elites with access to and control over fertile land. As noted globally, the transgenerational transmission of fertile lands through corporate descent groups is an important mechanism that gives rise to social inequality (Prufer et al. 2017; Shennan 2011). This is notably true in Polynesia where political practice was concerned with demonstrations of *mana*. In this context, access to and transgenerational transmission of fertile landscapes provided foundations for stable hierarchical political organizations in environmentally predictable locations.

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Figure Captions

Fig. 1. The Manu‘a Group and Ta‘ū island. The shaded areas with the inset image of Ta‘ū are areas where contiguous terracing is visible in the lidar dataset.

Fig. 2. A) The distribution of field recorded archaeological features (terraces, and linear mounds) in relation to geological substrates. Field transects are labeled with Roman numerals. B) The distribution of terrace sizes within the four intensive transects from northwest (top) to southeast (bottom). Geological map and shapefiles were produced by the National Park Service (NPS) Geologic Resources Inventory (GRI) program.

Fig. 3. The location of soil samples across slopes of the Luatele substrate.

Fig. 4. Relationship between key variables across Luatele with the field dataset on the left and the combined dataset on the right. A) The relationship between terrace size and elevation. Each dot is a terrace and dotted lines track changes in mean size. B) The relationship between terrace size and slope. Lines track changes in mean size and asterisks identify outliers. Small boxes represent the IQR, whiskers are the range without outliers, and large boxes mark the range within each group. C) The relationship between slope and elevation associated with each terrace. Each dot represents a terrace and the dotted lines are LOESS smoothers with 0.5 degrees of smoothing and two steps.

Fig. 5. The distribution of terraces in the combined dataset compared to geological substrate.

Fig. 6. Mean terrace size in 10,000 m² cells across Luatele. Terraces with centroid points within each cell were included in the calculation of that cell’s mean terrace size. Note cells with higher mean terrace size in the center and southeast.

Fig. 7. The relationship between three soil fertility indicators and elevation: A. pH, B. exchangeable Ca, and C. % Base Saturation. The figures in the right-hand column include all soil samples. The figures in the left-hand column include samples from the vertical transect. Reference lines represent the breakpoint in the relationship between terrace size and elevation (200 m), the elevation of the cross slope walls on the southeastern side of the project area (310 m), and the elevation of the cross slope walls on the northwestern side of the project area (340 m). The LOESS curves were calculated using one degree of smoothing and two steps.

Fig. 8. Characteristics of terraces documented in excavation. A) The east wall of Terrace 117 showing the wedge-shaped Layer II interpreted as fill to level the terrace. B) The south wall of Terrace 98 illustrating the bolder fill (Layer IIb) and basalt cobble pavement (Layer Ib) of the terrace. The boulder fill was excavated down two courses without an identifiable base. C) The top of a rough pavement/foundation in a 1x1 m unit excavated into Terrace 282 (Transect I). D) The base of a rough pavement/foundation in a 1x1 m unit excavated into Terrace 120 (Transect III).

Fig. 9. The distribution of early (squares) and late (triangles) terraces.

Table 1. Mean and standard error of soil measurements in the northwest and southeast halves of the project area using samples from the lower lateral transect combined with a small number of samples from the vertical transect in proximity. Bottom row shows the results of Mann-Whitney U Tests.

	pH (SE)	Exchangeable Ca (SE)	% Base Saturation (SE)
Southeast (n=13)	5.97 (0.06)	7.74 (0.55)	63.4 (3.83)
Northwest (n=17)	6.21 (0.07)	8.15 (0.59)	67.7 (3.24)
	<i>U=53; z=2.39; p=0.02</i>	<i>U=91.5; z=0.77; p=0.44</i>	<i>U=83; z=1.13; p=0.26</i>

Table 2. Modelled ages and characteristic of 15 dated terraces in Luatele (from Quintus et al. 2020). TPQ = *Terminus Post Quem*, TAQ = *Terminus Ante Quem*

Name	Modelled Age (95.4% HPD)	Associated Constraint(s)	Temporal Period	Area (m²)	Slope (in degrees)	Elevation (m)	Location in Luatele
Terrace 117	AD 86-1052	TPQ and TAQ	Early	108	15.1	213	Southeast
Terrace 120	AD 725-1329	TPQ and TAQ	Early	112	17.6	202	Southeast
Terrace 238	AD 1182-1896	TPQ	Early	286	14.9	192	Center
Terrace 282	AD 901-1336	TPQ and TAQ	Early	231	12.9	221	Northwest
Terrace 320	AD 1272-1801	TPQ	Early	140	13.9	215	Southeast
Terrace 98	AD 1310-1411	Construction	Early	270	26.5	104	Center
Terrace 110	AD 1458-1864	TPQ	Late	360	11.2	178	Center
Terrace 163	AD 1708-1905	TPQ	Late	48	20.9	186	Southeast
Terrace 210	AD 1708-1904	TPQ	Late	119	17.6	190	Southeast
Terrace 252	AD 1670-1810	TPQ and TAQ	Late	171	13.0	230	Center
Terrace 311	AD 1490-1895	TPQ	Late	42	8.5	299	Southeast
Terrace 321	AD 1544-1903	TPQ	Late	128	18.9	188	Southeast
Terrace 48	AD 1470-1895	TPQ	Late	390	14.0	281	Northwest
Terrace 68	AD 1707-1904	TPQ	Late	56	12.3	260	Center
Terrace 8	AD 1415-1586	TPQ and TAQ	Late	319	16.4	210	Northwest

Table 3. Modelled ages and characteristics of 10 linear mound segments (from Quintus et al. 2020). Two segments of Wall 2, the mixed form feature that runs across much of the project area, were dated. Wall 78 is one of several cross-slope linear mounds at the upper elevation boundary of the site.

Name	Modelled Age (95.4% HPD)	Elevation	Location	Type
Wall 89	AD 1050-1897	186	Southeast	Single Parallel to Slope
Wall 36	AD 1490-1895	180	Center	Single Parallel to Slope
Wall 78	AD 1674-1902	311	Southeast	Cross-Slope Boundary
Wall 92	AD 1685-1903	232	Center	Double Parallel to Slope
Wall 48	AD 1698-1904	228	West-Center	Single Parallel to Slope
Wall 2 Double Segment	AD 1707-1904	213	Northwest	Cross-Slope Double (Part of Larger Mixed Form Feature)
Wall 86	AD 1708-1903	214	East-Center	Single Parallel to Slope
Wall 93	AD 1708-1905	270	West-Center	Cross-Slope Single
Wall 2 Single Segment	AD 1709-1905	200	West-Center	Cross-Slope Single (Part of Larger Mixed Form Feature)
Wall 46	AD 1711-1905	261	Center	Single Parallel to Slope