Section 6 Summary and Interpretation

6.1 Pedestrian Inspection

The proposed transit route traverses through the actively cultivated agricultural fields of Aloun Farms at the western end of the route, extending east into the highly urbanized towns of Waipahu and Pearl City. Pedestrian inspection confirmed that that the entire project area has been previously disturbed by either agriculture or urban development. Thus the agricultural activities and urban development within the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. As a result no surface cultural resources were observed within the project area.

6.2 GPR Survey

Prior to test excavation, all test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits.

In general, the results of the GPR survey were inconclusive. The maximum “visibility” within the study area was restricted to approximately 75 to 100 cm below the existing ground surface. Furthermore, the results of the GPR within this zone of visibility were inconsistent as buried objects (i.e. metal pipes, large basalt boulders, concrete slabs, etc.) were not always identified and stratigraphic layers with varying consistencies were not always isolated. There appears to be 3 factors causing the inconsistent results within the project area. The first is soil chemistry. Approximately one-third of the project area is situated within actively cultivated agricultural fields that are most likely fertilized with potassium and/or nitrogen, which would increase the conductivity of the soils causing limited depth “visibility” and inaccurate data collection. Adding to this is the red color of the soils observed throughout a majority of the project area. The red coloring is likely a sign of high iron content, which would further increase the conductivity of the soil. Also observed was the presence of thick clay deposits throughout the project area. Clay soils (especially those that are inundated) are noted as being very conductive, resulting in radio wave attenuation at shallow depths causing limited depth “visibility” and inaccurate GPR data collection (Conyers 2004).

The second factor for inaccurate GPR data collection is that a majority of the project area lacked uniform stratigraphy. A majority of the project area is situated within a highly developed urban area, defined by extensive filling associated with road construction, utility installation, and land reclamation. These filling events have caused the artificial deposition of stratigraphic layers with vastly different compositions (i.e. varying parent material and soil chemistry) resulting in layers with very different dielectric constants. GPR is able to effectively locate subsurface anomalies (i.e. buried objects, voids, areas of disturbance, etc.) when the surveyed area has a consistent dielectric constant (i.e. the frequency setting for radio waves to travel through). Subsurface anomalies are able to be located by the GPR because they have a different dielectric constant from the material in which it is situated, resulting in radio waves to be reflected back and recorded by the GPR unit. If the material being surveyed does not have a consistent

dielectric constant, radio wave propagation can be attenuated (i.e. limited depth “visibility”) and GPR data can become inaccurate.

The third factor is related to surface topography. Uneven surface topography (both at ground level and buried) can cause a phenomenon known as radar scatter. Radar reflections off of surfaces “that contain ridges or troughs, or any other irregular features, can either focus or scatter radar energy, depending on the surface’s orientation and the location of the antenna on the ground surface” (Conyers 2004: 73). Irregular surfaces within the project area were observed at recently tilled agricultural fields (construction sheets RW001 through RW006), within a basalt boulder concentration in Ho`opili Station Test Trench 1 (see Figure 83), and within landfill deposits observed at the proposed Pearl Highlands Station and P&R (see Section.6.14 above). It is believed that these irregular surfaces functioned as reflective planes diverting the emitted radar energy away from the GPR antenna, resulting in inaccurate GPR data collection. Of the three limiting factors, this one probably hindered the GPR survey the least

Thus it has been concluded that a number of factors severly limit accurate GPR survey within the project area. The environmental conditions (i.e. soil chemistry) present within project area caused the sediments to be too conductive causing the radar waves to attenuate, resulting in limited depth “visibility” and inaccurate data output. Additionally, a majority of the project area is situated within a highly developed urban area, defined by extensive filling associated with road construction, utility installation, and land reclamation. This filling has caused the stratigraphy of the area to be non-uniform, a factor which limits the GPRs ability to effectively isolate buried objects. This conclusion is consistent with the National Resources Conservation Service (NRCS), which also indicated that GPR suitability in this area is moderate to low (see Figure 9).

6.3 Subsurface Testing

A total of 92 test excavations (57 backhoe trenches and 35 column location test pits) were excavated within the project area. Trenches were excavated at proposed transit stations with a focus on testing areas that are planned for subsurface disturbance (i.e. elevator shafts, subsurface utilities, etc.). Test excavations were also located at selected support column foundations along the proposed elevated rail line. Test excavations were distributed throughout the project area to provide representative coverage and assess the stratigraphy and potential for subsurface cultural resources within the project area. The testing program also focused on characterizing the remnants of the project area’s buried land surface that predated historic and modern fill and/or pavement layers, as these remnants of the older land surface are more likely to be associated with significant cultural deposits.

Following a review of the observed and documented stratigraphy, 5 stratigraphic zones were delineated within the project area (Figure 357). Stratigraphic Zone 1 includes construction sheets RW001 through RW006. In general, the observed and documented stratigraphy of Stratigraphic Zone 1 consisted of a single stratum of naturally deposited alluvial sediment utilized for agriculture. Signs of previous disturbance via agriculture (i.e. tilling of soil and installation of water lines) were observed from the surface to an approximate depth of 100 cm. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). No subsurface cultural resources were observed within this stratigraphic zone.

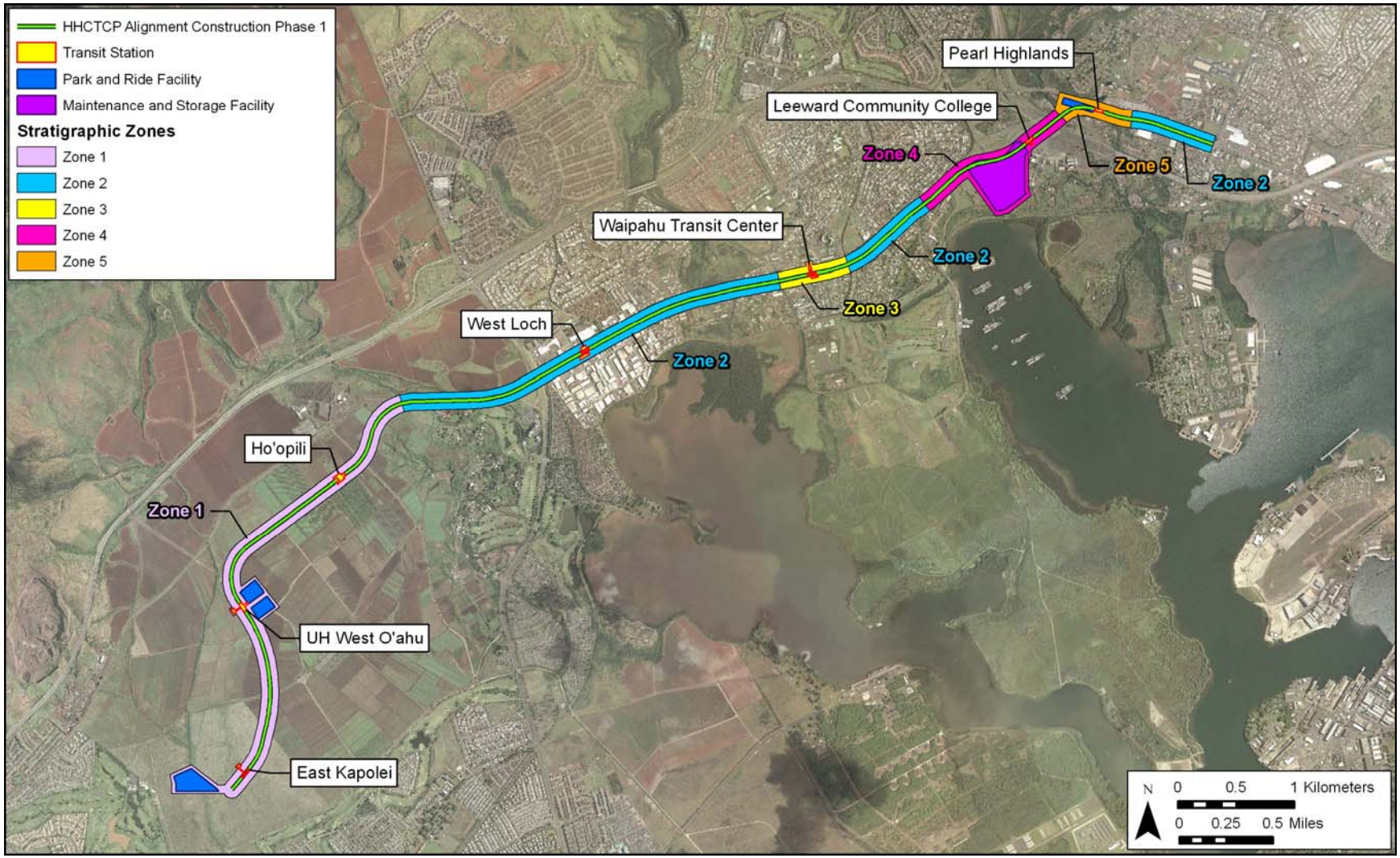

Figure 357. Stratigraphic Zones within the project area

Stratigraphic Zone 2 includes construction sheets RW007 through RW010, as well as RW012 and RW016. In general, the observed and documented stratigraphy of Stratigraphic Zone 2 consisted of varying fill layers associated with urban development (i.e. asphalting paving and utility installation), overlying naturally deposited alluvial sediments. Of particular interest were the testing results at West Loch Station (see Section 6.8 Construction Sheet RW008 above). At this location, layers and pockets of water rounded basalt cobbles were observed within the alluvial sediments, suggesting that the immediate area once had running water prior to modern urban development. A review of historic maps indicates a stream and a concentration of LCAs in the immediate area (Figure 358), providing further evidence of running water in the area prior to development. No subsurface cultural resources were observed within this stratigraphic zone.

Stratigraphic Zone 3 includes construction sheet RW011. In general, the observed and documented stratigraphy of Stratigraphic Zone 3 consisted of varying imported fill layers overlying naturally deposited alluvial sediment inundated with water and containing roots and decomposing organic matter, suggesting the area was once a marsh prior to urban development. The fill layers appear to be associated with two distinct events: 1) mass grading and filling associated with land reclamation, and 2) asphalt parking lot construction. Of note was the presence of reddish orange mottling and charcoal flecking within the dark clay sediments (Stratum II) observed at the *makai* (southern) portion of the proposed Waipahu Station (see Figure 183 and Figure 204 to Figure 221). These inclusions are suggestive that agriculture, specifically taro cultivation, had occurred in this area prior to urban development. A review of LCA documentation for the area confirmed that *lo‘i* (wetland taro) was present within the area that was tested. Accordingly, the buried agricultural sediments were determined to be a cultural resource, and assigned as SIHP 50-80-9-7751.

Stratigraphic Zone 4 includes construction sheet RW013 and RW014. In general, the observed and documented stratigraphy of Stratigraphic Zone 4 consisted of varying layers of naturally deposited silt. The silt in this area was extremely compacted and may be associated with historic leveling and grading activities which took place in the area during the construction of the Navy ‘Ewa Drum Filling and Storage Area. Additionally, substantial cuts into the existing slope were observed throughout the area, which could have removed a majority of the existing topsoil. Thus leaving an extremely compacted sediment that has not had enough time to be broken down by root activity and organic decomposition. No subsurface cultural resources were observed within this stratigraphic zone.

Stratigraphic Zone 5 includes construction sheet RW015. In general, the observed and documented stratigraphy of Stratigraphic Zone 5 consisted of varying layers of fill. Fill events were determined to be associated with residential and agricultural development, as well as extensive garbage dumping. Large amounts of modern garbage (concrete, automobiles, home appliances, plastic, etc.) were observed concentrated beneath the ground surface, suggesting that the area was once utilized as a dump and landfill. No subsurface cultural resources were observed within this stratigraphic zone.

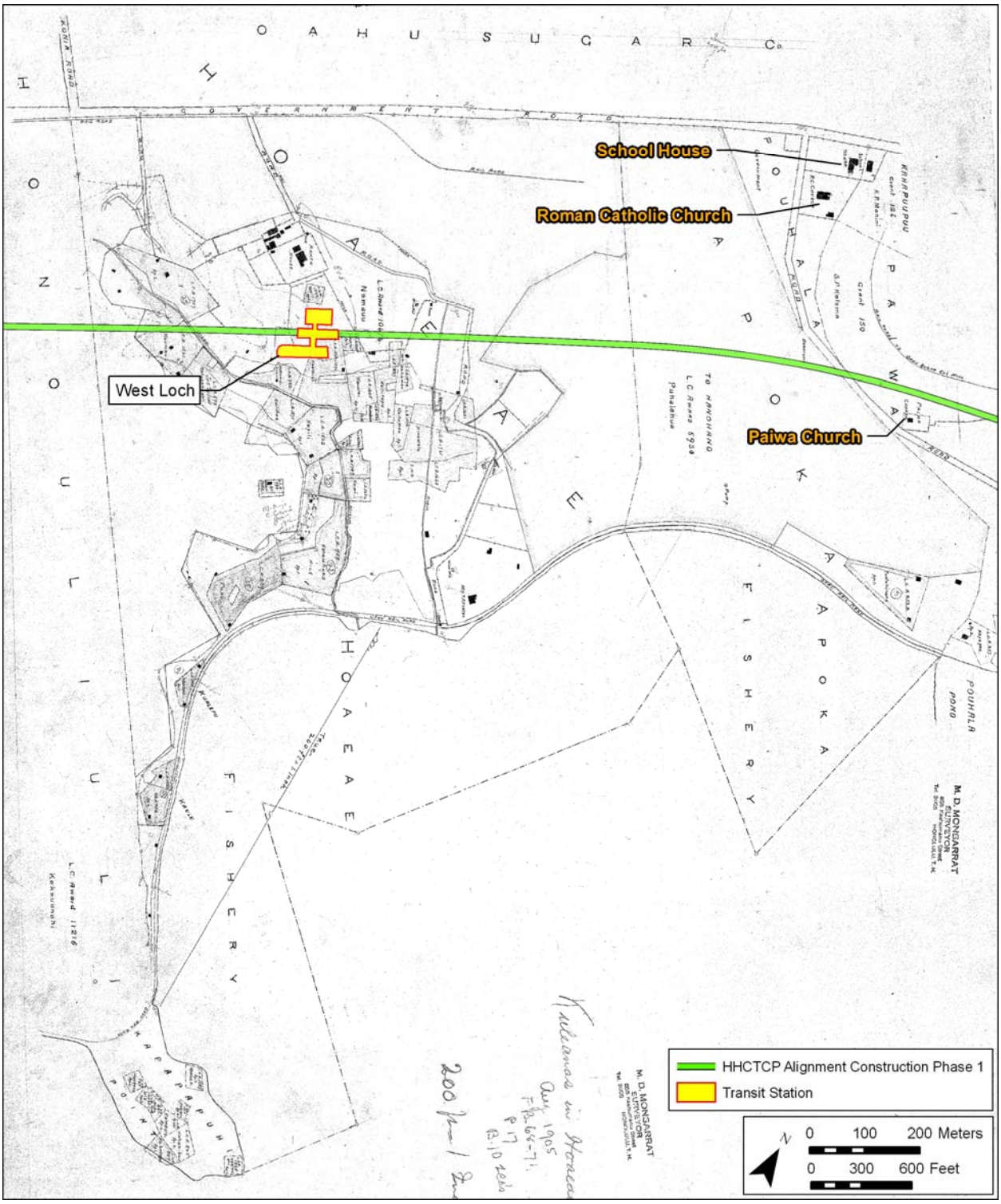

Figure 358. 1905 Map of Hoaeae by M.D. Monsarrat showing a stream and LCA concentration in the vicinity of the proposed HHCTCP West Lock Station