Volume III

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Oahu Community Correctional Center

October 27, 2017

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Appendix M: Cultural Impact Assessment

Oahu Community Correctional Center

October 27, 2017

Prepared for:

State of Hawaii
Department of Accounting and General Services
Department of Public Safety

Prepared by:

ASM affiliates

A Cultural Impact Assessment for the O'ahu Community Correctional Center Replacement Project

TMKs: (1) 1-2-013:002; (1) 4-2-003:004, 024, 025, 026;
(1) 9-5-046:041 and 042; (1) 9-9-010:006, 030 por., 046 por.,
054, 055, 057, and 058

Hālawa, Kalihi, Waikele, and Kailua *ahupua'a*
'Ewa, Kona, and Ko'olaupoko Districts
Island of O'ahu

DRAFT VERSION

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1. INTRODUCTION

At the request of Louis Berger, on behalf of the State of Hawaiʻi Department of Public Safety (PSD), ASM Affiliates (ASM) has prepared this Cultural Impact Assessment (CIA) to accompany a Hawaiʻi Revised Statues (HRS) Chapter 343 Environmental Impact Statement (EIS) in support of the Oahu Community Correctional Center (OCCC) replacement project. PSD plans to develop a new facility to replace the current OCCC facility at one of four possible locations on Oʻahu, including its current location (TMK: (1) 1-2-013:002) in Kalihi Ahupuaʻa, Kona District (Figures 1 and 2). The three alternative development sites, all located within ʻEwa District, are 1) Lot 17 of the Mililani Technology Park (TMKs: (1) 9-5-046:041 and 042) in Waikele Ahupuaʻa; 2) the Animal Quarantine Station (TMKs: (1) 9-9-010:006, 046 por., 054, 055, 057, and 058), and 3) the Hālawa Correctional Facility (HCF) (TMK: (1) 9-9-010:030 por.), both located in Hālawa Ahupuaʻa (see Figures 1 and 2). In addition, the proposed project includes upgrades and expansion of the housing and infrastructure of the Women's Community Correctional Center (WCCC) to accommodate the relocation of female inmates currently housed at the existing OCCC facility. The WCCC is located in Kailua Ahupuaʻa, Koʻolaupoko District (TMKs: (1) 4-2-003:004; 024, 025, and 026) (Figure 3). Additionally, if the Animal Quarantine Station location is selected, the new OCCC facility will be placed where the current Animal Quarantine Station facilities are located and a new Animal Quarantine Station will be developed on Parcel 054 (see Figure 2).

This document has been prepared in compliance with the Office of Environmental Quality Control (OEQC) *Guidelines for Assessing Cultural Impact*, adopted by the Environmental Council, State of Hawaiʻi, on November 19, 1997. As stated in Act 50, which was proposed and passed as Hawaiʻi State House of Representatives Bill No. 2895 and signed into law by the Governor on April 26, 2000, "environmental assessments . . . should identify and address effects on Hawaii's culture, and traditional and customary rights . . . native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the 'aloha spirit' in Hawaiʻi. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on governmental agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups."

Below are descriptions of all five subject areas and a contextual discussion of the proposed OCCC replacement project. This is followed by a presentation of both general and area specific culture-historical background information and an examination of prior relevant studies; all of which combine to provide the physical and cultural contexts for the respective subject areas. The consultation effort is then presented, followed by a discussion of the results and analysis.

SUBJECT AREA DESCRIPTIONS

The subject of the current study is comprised of four discrete locations on Oʻahu that are each being considered as the site for the proposed OCCC replacement project: the current OCCC, the HCF, the Animal Quarantine Station, and Mililani Tech Park (See Figures 1 and 2). A fifth location, the WCCC in Kailua, is also included in this study because female inmates currently housed at OCCC will be relocated there as part of the OCCC replacement project (see Figure 3). Four of the five locations are developed parcels with extant buildings and associated infrastructure (Figures 4-7); the fifth location, Lot 17 of Mililani Tech Park in Waikele Ahupuaʻa, is an undeveloped wooded area (Figure 8).

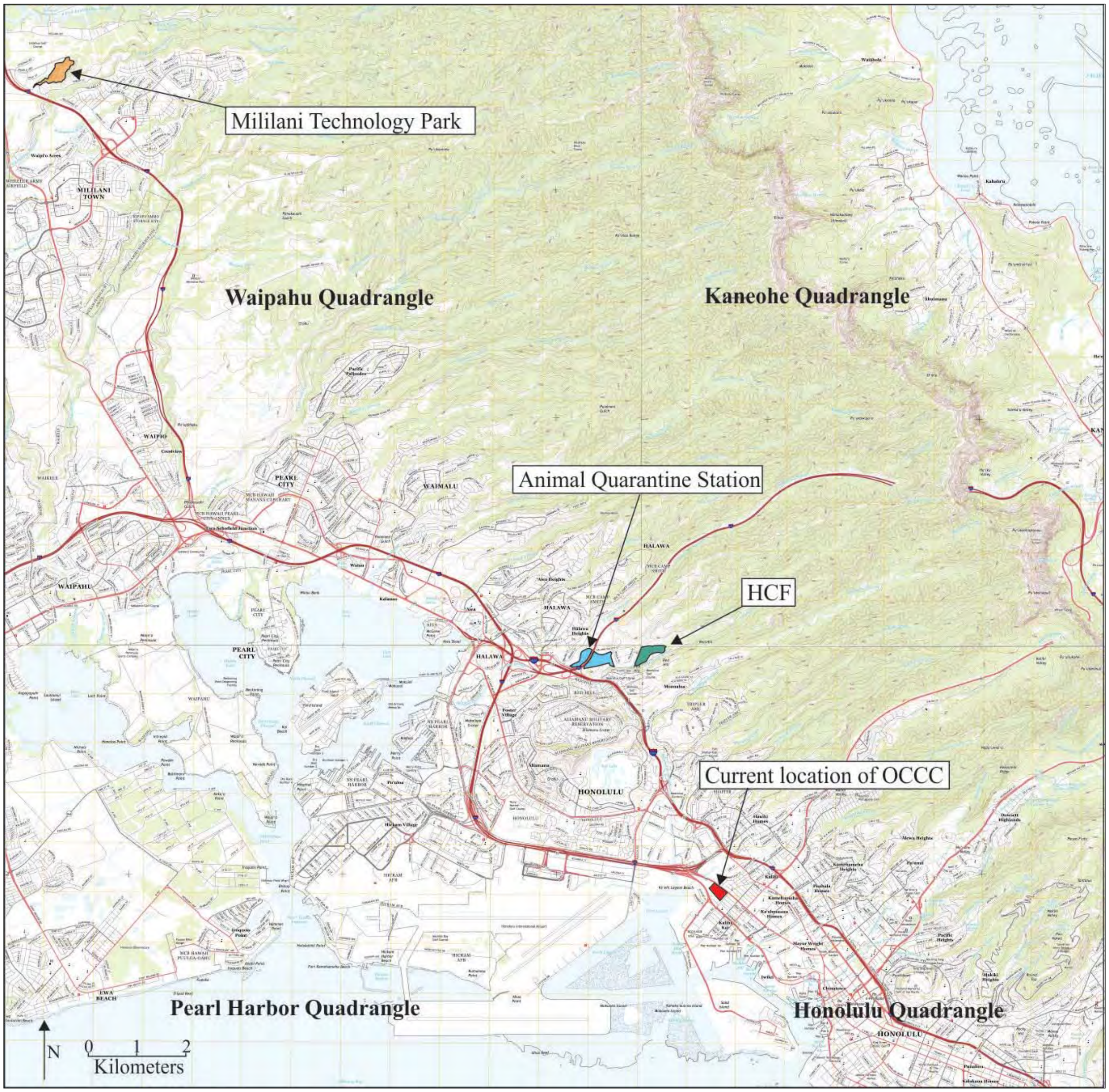


Figure 1. Possible OCCC locations plotted on composite of portions of four USGS 2013 7.5-Minute series Quadrangles.

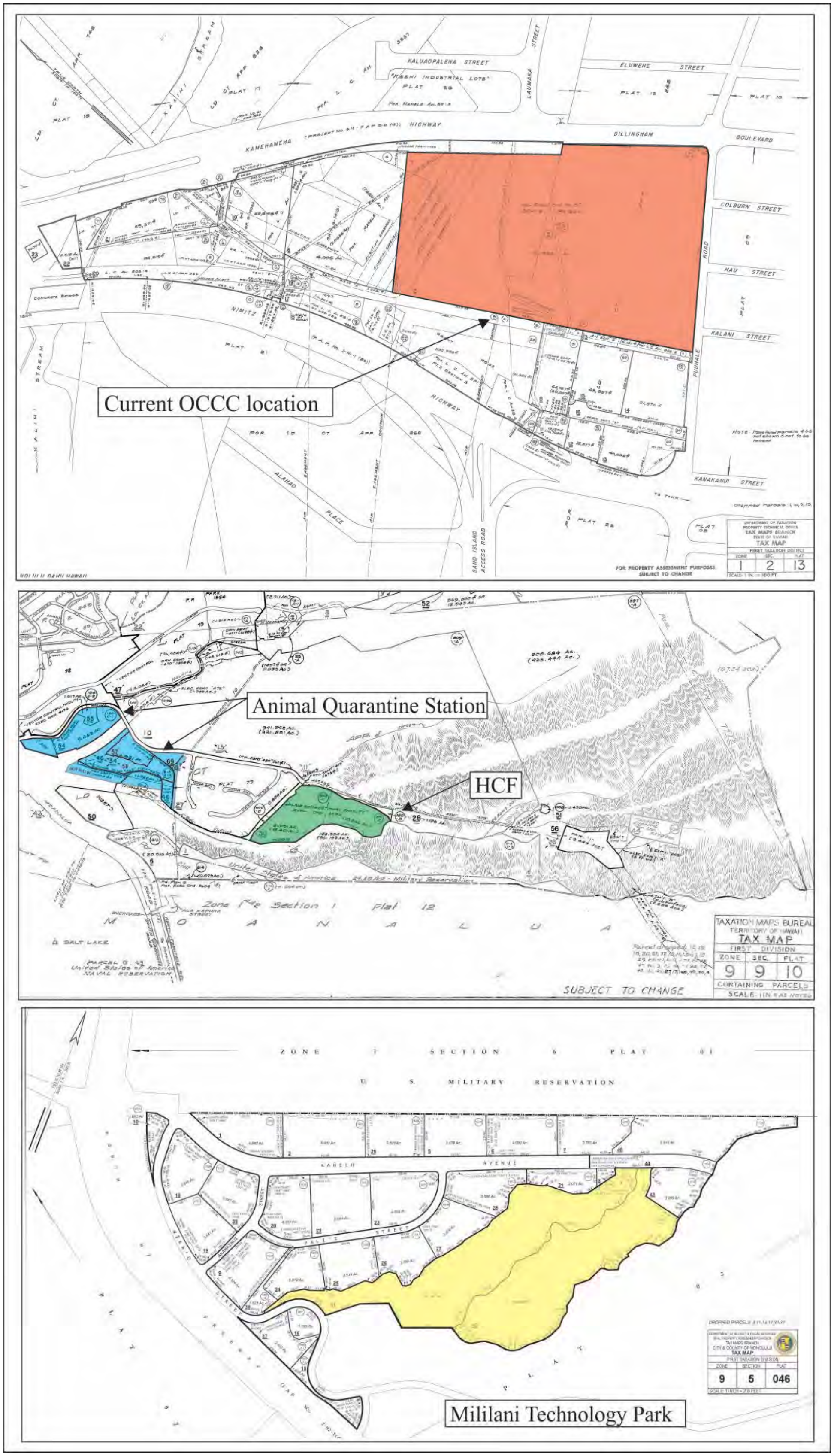


Figure 2. Tax Map Key (TMK) maps showing possible OCCC locations.

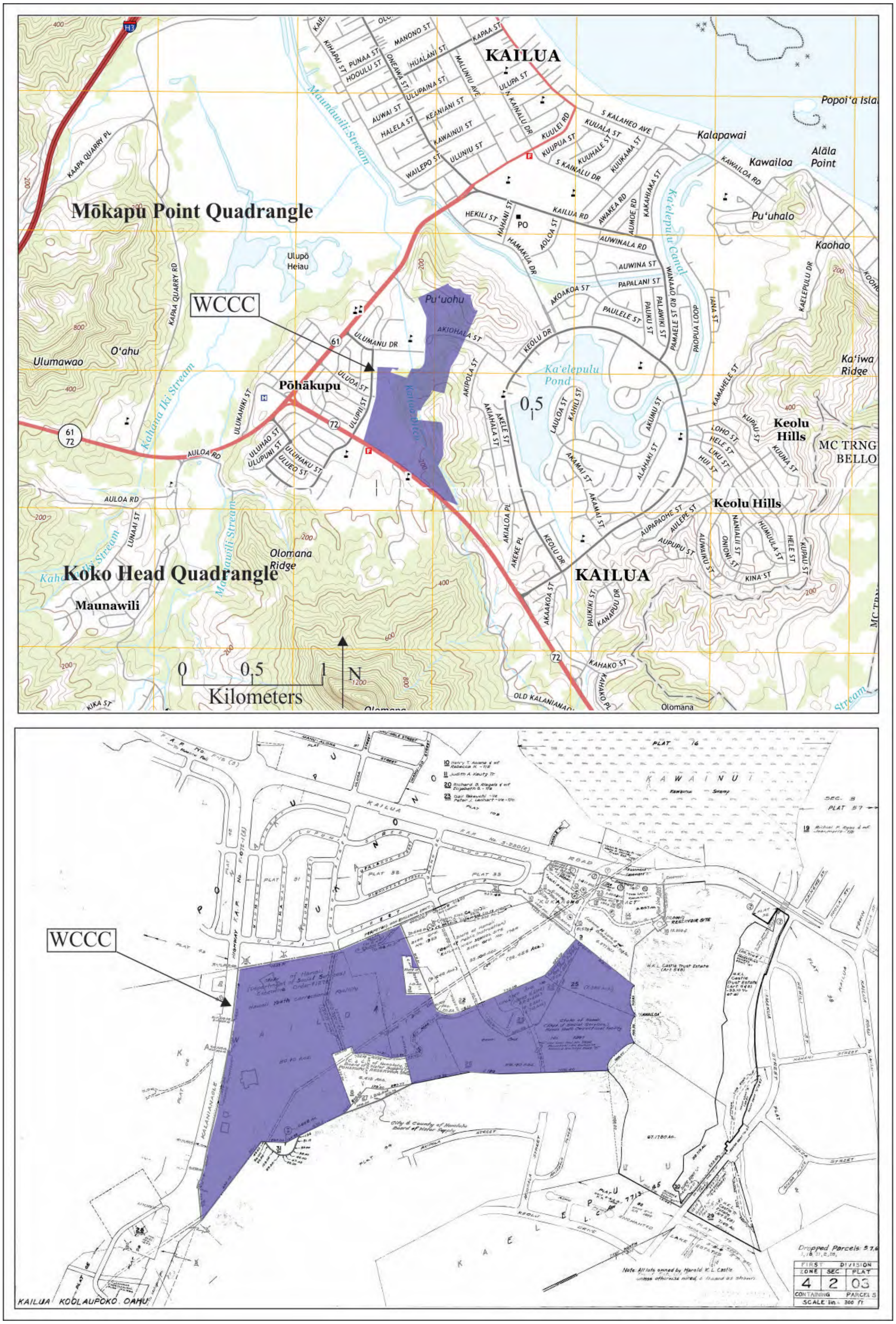


Figure 3. WCCC location plotted on composite of portions of two USGS 2013 7.5-Minute series Quadrangles (top) and on TMK map 4-2-003 (bottom).

Figure 4. Existing parking lot at current OCCC where proposed OCCC facility would be located.

Figure 5. Animal Quarantine Station.

Figure 6. Halawa Correctional Facility recreation field and proposed location for new OCCC.

Figure 7. Open field at WCCC where new housing is proposed for female OCCC inmates.

Figure 8. Buildable portion of Mililani Tech Park Lot 17.

Both the current 40-acre Animal Quarantine Station and the 35-acre Halawa Correctional Facility (HCF) are located in the *ahupua'a* of Hālawa, a valley within the 'Ewa District. Both properties are situated between the North Hālawa Stream branch and the intermittent South Hālawa Stream branch. The mean annual rainfall in this area is approximately 104.62 centimeters with most rainfall occurring between the months of October through March (Giambelluca et al. 2013). Although the south portion immediately behind both facilities remain largely undeveloped, the northern portion of both parcels is home to the Hawaiian Cement Company. The Animal Quarantine Station is bisected by the H-3 freeway. The western portion of the Animal Quarantine Station is bordered by North Hālawa Stream, while the eastern portion is adjacent to the Hālawa Industrial Park. The Hālawa Industrial Park also serves as the western boundary for HCF. Soils within the Animal Quarantine Station have been heavily disturbed as more than half of the property (western portion) contains mixed filled land (FL), and quarry (QU) series soil types, while the eastern portion of the property contains Kawaihapai stony clay loam (KlaA) (USDA 2017). Elevation within the Animal Quarantine Station ranges between 24 and 43 meters above mean sea level. Soils within the HCF are also of a mixed type with more than half of the parcel consisting of Kokokahi clay (KtC), while the northern portion of the parcel contains Rock land (rRK) and Kaena stony clay (KaeB). The southern portion of the parcel that borders the South Hālawa Stream branch consist of Kawaihapai stony clay (KlaA) (USDA 2017). Elevation within the HCF ranges between 55 and 95 meters above mean sea level (Figure 9).

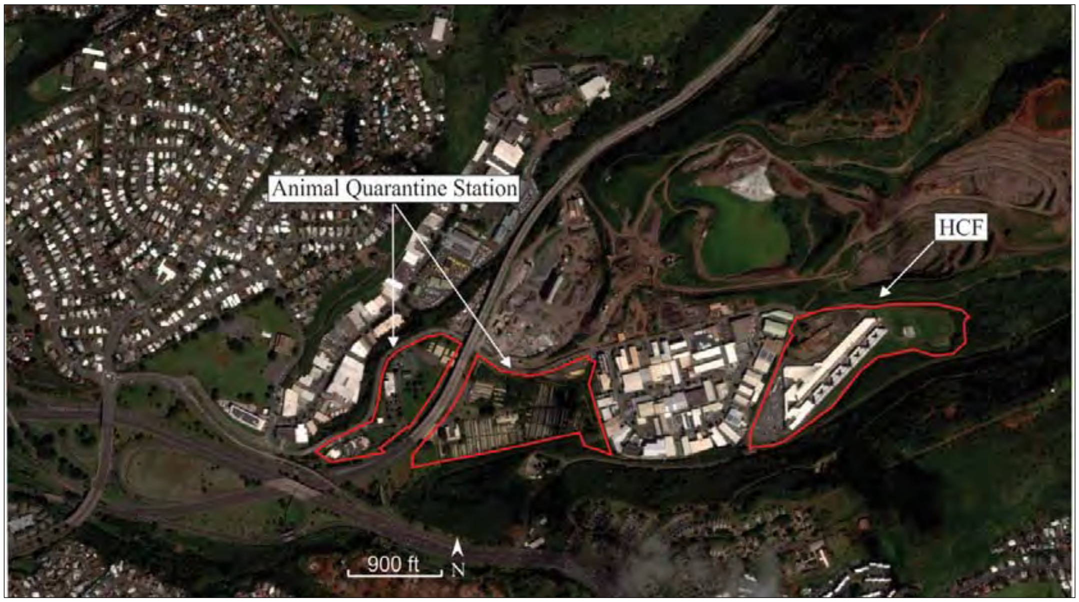


Figure 9. January 16, 2013 satellite image showing HCF and Hālawa Animal Quarantine locations.

The current OCCC location is a roughly 16-acre property located within an urbanized coastal section of Kalihi Valley (also known as Kalihi-Kai), situated in the *ahupua*ʻa of Kalihi, Kona District. Elevation within the OCCC facility ranges between 2 and 7 meters above mean sea level. The mean annual rainfall is 78 centimeters in this area, with most rainfall occurring between the months of October through March (Giambelluca et al. 2013). The northeast end of OCCC is situated approximately 340 meters southeast of Kalihi Stream, which empties into Keʻehi Lagoon. The property contains predominantly ʻEwa soils (EmA), described as moderately shallow silty clay loam while the northern portion of the parcel is comprised of mixed filled land (FL) (USDA 2017). Historically, coastal Kalihi contained multiple fishponds, however due to the expanding harbor and industrial area, the original Kalihi coastline has been drastically altered and nearly all the fishponds have been in-filled. OCCC is situated between two major thoroughfares: Dillingham Boulevard/Kamehameha Highway to the northeast, and Nimitz Highway to the southwest (Figure 10).

Figure 10. January 29, 2013 satellite image showing current OCCC location (outlined in red).

The Mililani Technology Park Lot 17 is a 40-acre (19-acre buildable area) currently undeveloped property located within Waikele Ahupuaʻa, ʻEwa District. This property is bordered by Waikakalaua and Kipapa gulch. Elevation within the property ranges between 200 and 260 meters above mean sea level. The annual mean rainfall in this area is 113 centimeters, with most rainfall occurring between the months of October through March (Giambelluca et al. 2013). The soils within the study area is of a mixed type with majority of the parcel characterized by Helemano silty clay (HLMG), and Leilehua silty clay (LeB). The northwest and southwest corner of the parcel consist of Wahiawa silty clay (WaA and WaB) (USDA 2017). The Mililani Technology Park consists of developed and undeveloped industrially zoned lots that houses religious centers, a preschool, as well as several commercial businesses (Figure 11).

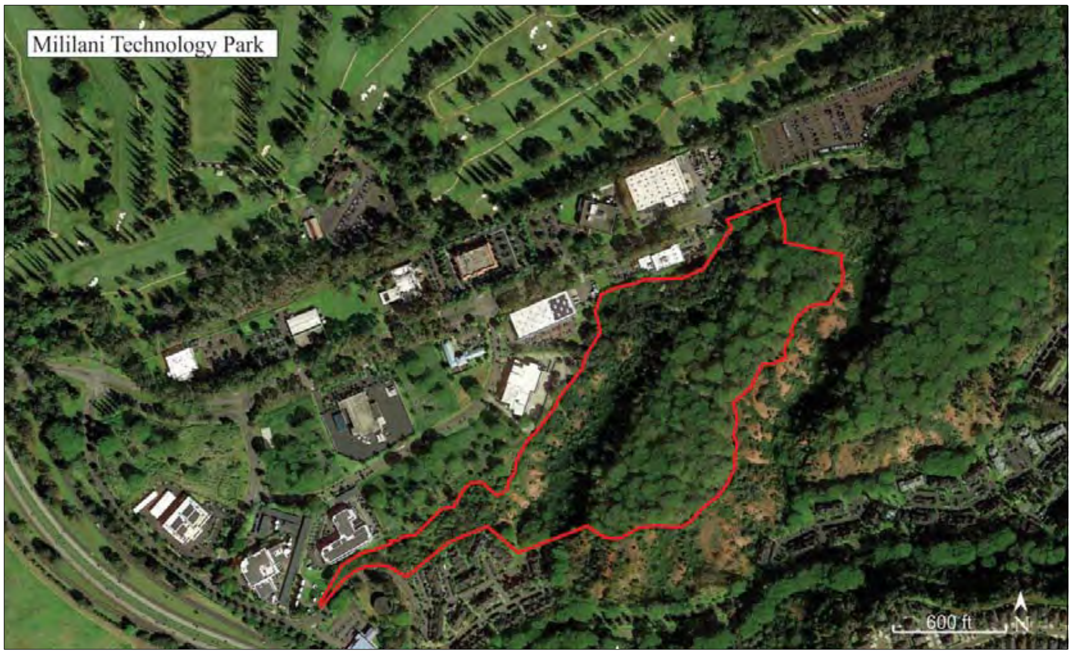


Figure 11. January 16, 2013 satellite image showing Mililani Technology Park Lot 17 location (outlined in red).

The current WCCC location is a 122-acre property located in the *ʻili* of Kawailoa, Kailua Ahupuaʻa, Koʻolaupoko District. Elevation within the study area ranges between 30 and 110 meters above mean sea level. The annual mean rainfall is 107 centimeters in this area, with most rainfall occurring between the months of October through March (Giambelluca et al. 2013). Bisecting the parcel is a branch of Maunawili Stream. Soils within the study area are mixed with the north portion of the property containing Pohakupu silty clay loam (PkB), and two types of Papaa clay (PYE and PYF). The central portion of the property contains of two types of Papaa clay (PYF and PYD), with the addition of two type of Alaeloa silty clay (AeE an older substrate and ALF). The southern portion of the property has two types of Pohakupu silty clay loam (PkB and PkC), in addition to Hanalei silty clay (HnA) and two types of Alaeloa silty clay (AeE and ALF) (USDA 2017). The area to the southwest of the WCCC facility has been developed with housing, while Kailua High School is location to the northwest (Figure 12). The area immediately to the east of WCCC contains a City and County-owned water tank, however the general area remains relatively undeveloped. Farther to the east is Kaʻelepulu Pond, whose margins have been extensively developed with urban housing and parks. There are four large monkeypod trees within the property that have been designated as Exceptional Trees by the Arborist Advisory Committee of the City and County of Honolulu (City and County of Honolulu Department of Parks and Recreation 2017).

Figure 12. January 15, 2013 satellite image showing WCCC location.

THE OCCC REPLACEMENT PROJECT

This section of the report provides a brief historical context for Hawai‘i’s carceral system as a basis for understanding the systems current disproportionate effect on Native Hawaiian populations, and by extension on Native Hawaiian culture.

Hawai‘i’s Criminal Justice System (1840-1918)

The history of Hawai‘i’s Euro-American criminal justice system can be traced back to the first constitution of the Kingdom of Hawai‘i promulgated on October 8, 1840, by Kauikeaouli (Kamehameha III) at the advice of foreign political advisors. This constitution was the first of its kind and marked an important shift in Hawai‘i’s longstanding sociopolitical system by establishing a legal framework that governed the monarchy (Keahiolalo-Karasuda 2010). The influence of Christian missionaries is apparent in these early laws as it provided them with a legal basis to enforce Christian beliefs and values onto all sectors of the population. Although the 1840 Constitution did not specify forms of punishments, sections seven through thirteen of the Constitution recognized certain acts as being punishable by law, such as causing injury or committing a crime against another citizen or the Kingdom. Additionally, the Constitution declared that a person accused of a crime had the right to a trial conducted according to the law (Achiu 2002). The 1840 Constitution became the instrument that allowed an individual with the legal knowhow to bring about charges against any citizen of the Kingdom regardless of their social status. Section four of the 1840 Constitution reads:

> The above sentiments are hereby published for the purpose of protecting alike, both the people and the chiefs of all these islands, while they maintain a correct deportment; that no chief may be able to oppress any subject, but that chiefs and people may enjoy the same protection, under one and the same law (Achiu 2002:33).

This legal framework for dealing with lawbreakers was a new concept that was fundamentally different from the traditional system. This new framework emphasized Christian beliefs and values all while punishing individuals who held to certain traditional practices and beliefs (OHA et al. 2010). Crimes committed under the traditional laws of the islands did not go unpunished. The *kapu* system implemented during the reign of the chief Wākea established a set of religious laws that governed nearly all aspects of traditional life (Malo 1951). Crimes committed under the *kapu* system were also punishable as these crimes were viewed as an offense to the gods and the chiefs alike, and therefore, threatened the very foundation upon which Hawaiian society was organized (King 1993). Lawbreakers that were found guilty often faced severe corporal punishment, seizure of property, and even banishment (King 1993, Ellis 1917). However, a lawbreaker could be absolved of his or her crime by entering a designated *pu'uhonua* (place of peace and safety) or seeking the mercy of a chief or chiefess, as they were also known as *pu'uhonua*. Such chiefs and chiefesses had the authority to exonerate a person from their crime, thus allowing for their reintegration into society (Kamakau 1964). The 1840 Constitution not only undermined the foundation of the *pu'uhonua* but it effectively disempowered the chiefs from exercising their power to free an individual from the death penalty. While the legal groundwork for the criminal justice system was laid starting in 1840, the emergence of Hawai'i's jail facilities occurred much earlier.

Hawai'i's first western-style jail facility has its origins with Russian colonists who sought to establish Hawai'i as the main provisioning port for Russian ships engaged in the Pacific fur trade. The Russian-American Company set out from Sitka, Alaska to expand their resource depleted territory and seek new kinds of investments (Mills 2002). Although their initial attempts to colonize the islands were thwarted when one of their ships wrecked off of Kaua'i, the Russians eventually found refuge on that very island under the ruling chief Kaumuali'i. While the Russians were engaged in establishing a fort on Kaua'i, the rest of the archipelago was recovering from the aftermath left from Kamehameha's conquest. In 1810, Kamehameha turned his attention to unifying the islands with the exception of Kaua'i under his rule. Although Kamehameha did not seize Kaua'i by force, the chief Kaumuali'i recognized Kamehameha as an independent sovereign. Through their peaceful negotiation, Kamehameha offered military protection over Kaumuali'i's island kingdom. In 1816, Kamehameha left O'ahu for Hawai'i Island to settle his affairs and in his absence, the Russian brig *Ilmen* captained by Doctor George Anton Schäffer arrived in Honolulu for repairs and was soon joined by the *Kodiak*, another Russian ship under the command of Captain Young. Although they had permission from Kamehameha to build a block house, the crew of about eighty Russians proceeded to build a fort made from mined coral blocks, mounted their guns, and raised the Russian flag. Their actions caused great alarm for both native and foreign residents of Honolulu as this was viewed as an attempt to seize the islands. A messenger was sent to inform Kamehameha of the situation, where he then dispatched his generals and warriors to investigate and settle the matter. The arrival of Kamehameha's militia in Honolulu made a profound impression, causing the Russians to wisely pack up and sail back to Kaua'i (Emerson 1900). Left with a half-completed building, John Young and Kalaimoku (William Pitt) advised Kamehameha to construct a fort that would protect the port and the nearby royal compound from future invaders. Kamehameha proclaimed a draft and ordered all men and women to help with erecting the fort known as Kekuanohu (Figure 13). By 1817, the fort was completed and from that time until its demolition in 1857 it housed several administrative functions such as police headquarters, courthouse and served as the first jail for unruly foreign sailors (ibid.).

Shortly after it became law, it was realized the 1840 Constitution could be used to control anyone, including the Hawaiian chiefs (King 1993). On October 20, 1840, just several days after the constitution was enacted, the Honolulu Fort was the site of Hawai'i's first public execution (Clark 1874, Emerson 1900). The chief Kamanawa, (grandfather of King Kalākaua and Lili'uokalani) and Lonopuakau were both sentenced to death after being accused of murder; both received the notice of the execution, which was sent by King Kamehameha III and Prime Minister Kekāuluohi. An American sailor named Joseph Clark provides insight into that tragic day:

> The sentence of death was published on the 5th, for the murder of a female on the 28th of Sept. The following is the sentence… (Clark 1847:179)
>
> On the 20th, the day previously appointed for the execution, at 11 o'clock the chief Kamanawa and the native Lonopuakau, were both hanged by the neck upon the ramparts of the fort, before an immense crowd of spectators. The Rev. Messrs. Armstrong and Smith addressed the throne of grace in their behalf. About eight hundred natives, under arms, were assembled, and passed behind them, two and two, with arms reversed, until the whole was concluded. As they dropped, the colors were half-mastered, the bell tolled, and there was a general yell and weeping throughout the village. The chief died a very hard death. (ibid.:180)

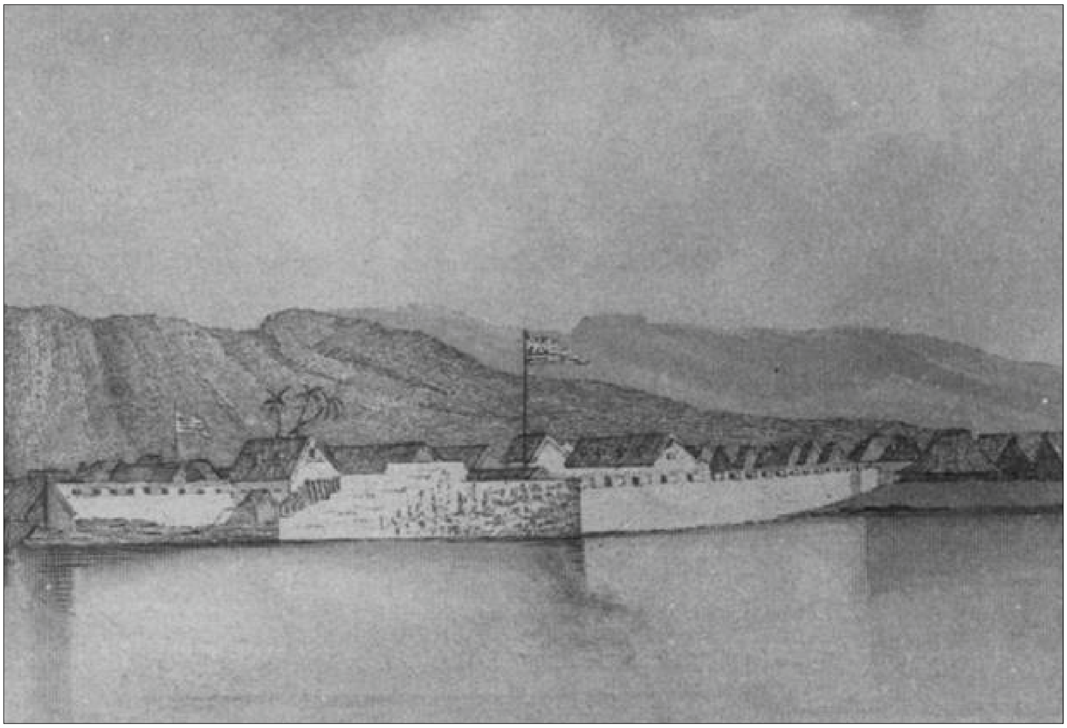


Figure 13. Rendition of Honolulu Fort 1837, Hawaiʻi State Archives, Henry Colburn collection, PP-36-5-001.

The Honolulu Fort continued serving as a jail but by 1822, Queen Kaʻahumanu, a staunch Christian convert proclaimed more criminal laws that were to be observed and supported by the chiefs (King 1993; Kamakau 1992). According to Kamakau, Kaʻahumanu verbally enforced various forms of capital punishment and established the island of Kahoʻolawe as a place of exile for convicts (Kamakau 1992). As early as 1826, the first male exiles were sent to the island of Kahoʻolawe, while females were sent to Lānaʻi. The area of Kaulana Bay located on the northwest end of Kahoʻolawe served as the penal colony headquarters until 1847 when the last convict, George Morgan, a Caucasian man served out his sentence on the island (MacDonald 1972).

In 1855, under the administration of Alexander Liholiho (Kamehameha IV), the legislature appropriated $10,000 for the construction of a new prison. The area of Iwilei was chosen as the site for the new prison, which was completed in 1857 (Figures 14 and 15), at which time the old Honolulu Fort was demolished (Kuykendall 1953). The prison was constructed from coral and was built on a pile of coral rubble between the fishponds of Kawa and Kūwili (Figure 16). Although this prison was formally known as Oahu Prison, it was sometimes referred to as Kawa Prison or simply “The Reef” (Ruby and Stephenson 2012).

Figure 14. Former Oahu Jail in Iwilei with fishponds in foreground, Hawai‘i State Archives, Oahu Prison Collection, PP-61-5-020-00001.

Figure 15. Exterior of former Oahu Prison, Hawai‘i State Archives, Oahu Prison Collection, PP-61-5-005-00001.

Figure 16. Portion of Registered map 1609 by W.A. Wall, 1893 showing site of Oahu Prison.

In 1886, while visiting Honolulu, Mark Twain stumbled upon the prison and described it as such:

> … we presently arrived at a massive coral edifice which I took for a fortress at first, but found out directly that it was the Government prison. A soldier at the great gate admitted us without further authority than my countenance, and I suppose he thought he was paying me a handsome compliment when he did so; and so did I until I reflected that the place was a penitentiary. However, as far as appearances went, it might have been the King's palace, so neat, and clean, and white, and so full of the fragrance of flowers was the establishment, and I was satisfied.
>
> We passed through a commodious office whose walls were ornamented with linked strands of polished handcuffs and fetters, through a hall, and among the cells above and below. The cells for the men were eight or ten feet high, and roomy enough to accommodate the two prisoners and their hammocks, usually put in each, and have space left for several more. The floors were scrubbed clean, and were guiltless of spot or stain of any kind… (Twain 1972:57)

At the time of his visit, Twain noted that the prison contained four wards, housed both male and female inmates, and could accommodate one hundred thirty-two prisoners (ibid.). Twain also visited the prison yard (Figure 17) and noted the differences in this facility compared to those he observed back on the continent:

> The prison-yard—that sad inclosure which, in the prisons of my native America, is a cheerless barren and yieldeth no vegetation save the gallows-tree, with its sorrowful human fruit—is a very garden! The beds, bordered by rows of inverted bottles (the usual style here), were filled with all manner of dainty flowers and shrubs…(ibid.:58)

Although Twain had a generally positive outlook on the conditions of the prison and the yard, a 1906 report from the Governor noted that the prison yard was also the site of several executions. The report stated, "it became the duty of the high sheriff to carry out the sentence of death imposed, upon conviction of the crime of murder in the first degree, upon [which] six men confined in the prison, these being duly executed in the yard of the Oahu Prison in Honolulu in accordance with the law." (Governor 1906:117)

Figure 17. Former Oahu Prison yard, Hawai‘i State Archives, Oahu Prison Collection, PP-61-5-011-00001.

In the 1902 Report of the Governor of the Territory of Hawai‘i, under the monarchy, provisional government, and the Republic of Hawai‘i, the Oahu Prison in Honolulu “was the general place of confinement of all persons convicted of criminal offenses within the Territory” (Governor 1902:114). During this same year, the legislature sought to formally segregate convicted felons from the misdemeanor population by establishing the Honolulu Jail, which was located adjacent to the Oahu Prison (ibid.).

In 1914 under the Territory of Hawai‘i, a 9.8-acre site in Kalihi-Kai was identified as the new location for Oahu Prison. Construction for the new prison was underway the following year (Governor 1915), and by 1918, the prison was completed and renamed the Territorial Penitentiary. The Territorial Penitentiary served as the main detainment center for convicted felons, misdemeanants, and inmates awaiting trial (Governor 1918). By the mid-1970s, the former Territorial Penitentiary came under the control of the City and County of Honolulu and subsequently renamed to the present Oahu Community Correctional Center (OCCC) (see discussion in the *Establishment of OCCC* section below).

Impact of the Criminal Justice System on the Native Hawaiian Population

Although the bulk of this study has focused on identifying site-specific cultural impacts, the authors of this report also seek to identify any potential impacts that may adversely affect the Native Hawaiian population at large. The following section explores the most recent data regarding Native Hawaiian representation in Hawai’i’s criminal justice system and explores the impacts this project may have on the said population.

In 2010, the Office of Hawaiian Affairs (OHA et al.) in a collaborative research effort published the most comprehensive study that focused on the disparate treatment of Native Hawaiians in the criminal justice system. Since the adoption of a Western system of governance and laws with the 1840 Constitution, Native Hawaiians have and continue to be adversely affected at every stage of the criminal justice system, starting with arrest and continuing through parole (OHA et al. 2010). The reasons Native Hawaiians are adversly affected by the criminal justice system is varied, however, the OHA et al. 2010 study identified a variety of social factors that are unique to indigenous people. In the context of Hawai‘i, having an understanding of the historical trauma associated with the loss of land, language, and spirituality that occurred as a result of Western contact are fundamental components that must be understood.

One of the key findings from the OHA et al. 2010 study revealed that Native Hawaiians are not only disproportionately represented at every stage of Hawai‘i’s criminal justice system but this disproportionality increases exponentially as individuals move through the system. Figure 18 shows the rate at which Native Hawaiian representation increases at every stage of the criminal justice system (OHA et al. 2010). As the United States' overall rate of incarceration has increased by some 450 percent, Hawai'i's incarceration rate has been even more rapid with a growth of 709 percent between 1980 and 2008 with 41 individuals incarcerated per 100,000 in 1980 to 332 individuals per 100,000 in 2008 (Figure 19).

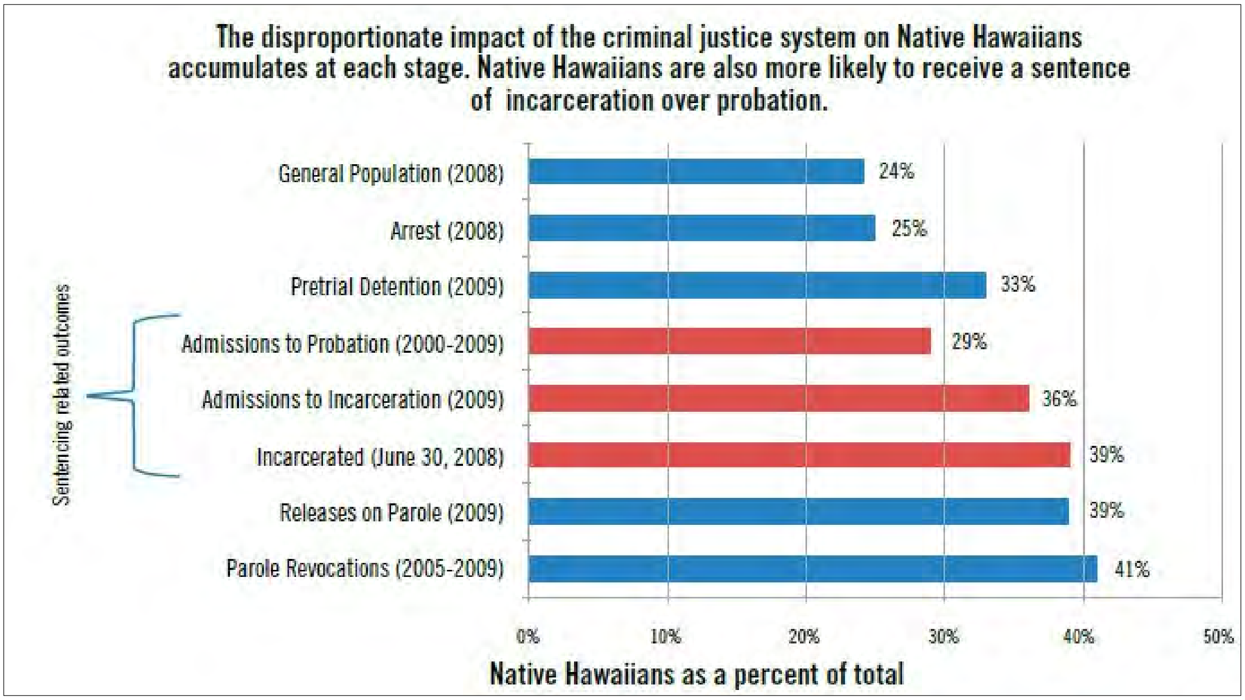


Figure 18. Native Hawaiian representation at each stage of the criminal justice system. (OHA et al. 2010:27)

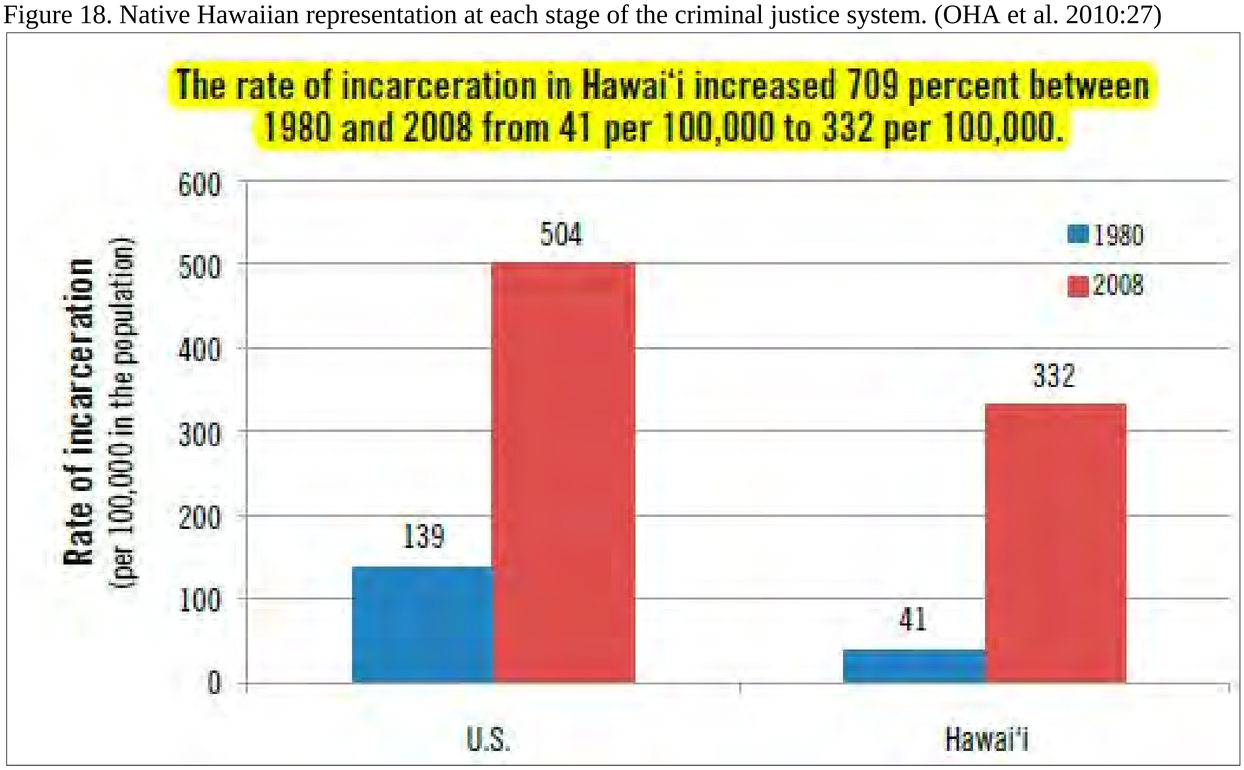


Figure 19. Rate of incarceration for the U.S. and Hawai'i. (OHA et al. 2010:17)

Population estimates collected in 2008 by the Hawaiʻi Department of Business, Economic Development, and Tourism reported that 1,257,607 people lived in Hawaiʻi with Native Hawaiians making up 24 percent of the total population (OHA et al. 2010:21). Arrest rates seem to mirror the population percentage figures with Native Hawaiians accounting for 25 percent of the total number of arrests made annually. However, as arrested populations move through the system, these figure increase disproportionately for Native Hawaiians within the incarerated population (ibid.:27). And, when the data is segregated by gender the results are even more alarming as Native Hawaiian women make up approximately 44 percent of the incarcerated women's population and Native Hawaiian men comprise 37 percent of the incarcerated men's population (ibid.:39). Keahiolalo-Karasuda (2010) has suggested that these figures may be underestimation of the actual percentages. Data collected in 2009 by the Hawaiʻi Criminal Justice Data Center revealed that even though Native Hawaiians do not use drugs at dissimilar rates to other ethnicities, they make up the largest portion (32 percent) of the people admitted to prison for a drug offense (OHA et al. 2010:45). Methamphetamine accounts for the greatest number (54 percent) of drug charges in Hawaiʻi, with Native Hawaiians receiving the largest percentage of those charges at 38 percent Additionally, Hawaiʻi has a mandatory sentence of ten years for methamphetamine-related charges resulting in more Native Hawaiians being incarcerated for longer periods of time (ibid.:47).

The rates at which Native Hawaiians are impacted by the criminal justice system is known to have devastating effects on the individual and collateral consequences that extend into their families and communities. OHA's 2010 study found that individuals coming out of incarceration are faced with many challenges that hinder them from successfully reintegrating and contributing to society such as 1) diminished educational opportunities. 2) difficulty in obtaining a driver's license. 3) exclusion from civic and political participation and 4) difficulty finding employment and vocational opportunities. Cumulatively these factors often result in the breaking up of the family unit as incarcerated parents who lose custody of their children may never get them back (ibid.). Also "if a person convicted of a crime is able to reunite with his or her family after incarceration, the family may find itself homeless" as their absence contributes to economic disparity within the household (ibid.:61). As formerly incarcerated individuals struggle to regain their economic independence and social footing, their families and communities are also adversely affected by their experience. The impacts that result from the imprisonment of a parent can have long-lasting negative consequences that contribute to a cycle of continued contact with the criminal justice system.

Children are most vulnerable to the emotional, physical, and psychological impacts that result from having a parent incarcerated. These children are more likely to develop anti-social behaviors, join gangs, display delinquent behavior, develop mental health problems, and use drugs than children whose parents are not incarcerated. These impacts on children are even greater when a mother is incarcerated as she is often the primary caregiver. For Native Hawaiian families, the impacts of incarceration are often experienced across multiple generations. OHA et al. (2010:67) reported that a study conducted in 2000 found that in 33.9 percent of Native Hawaiian households grandparents played a part in the care of their grandchildren. The data collected from this study did not include statistics on the extent which extended family members contribute to caring for the children of incarcerated parents. Since Native Hawaiians make up the largest percent of Hawaiʻi's imprisoned population, this has resulted in inter-generational impacts that have long-lasting consequences.

Just as families are impacted by the imprisonment of a family member, so too are the communities and cultures in which they are associated. This is especially true for Native Hawaiian communities where the strength and resiliency are drawn from individuals and families that are able to make contributions that promote healthy communities and a flourishing culture (OHA et al. 2010). When an individual is removed from their community, their ability to contribute to their communities and cultures is curtailed. As a culture that has endured the tangible impacts of colonization fueled by Euro-American interest, Native Hawaiian communities are more vulnerable than ever to the loss of land, culture, and community. A consideration of the historical and on-going disproportionate effects that the criminal justice system has had and continues to have on Native Hawaiian populations is vital in assessing potential cultural impacts steming from the creation of new incarceration facilities and policies.

2. BACKGROUND

The chronological summary presented below begins with a synthesis of Precontact settlement patterns and Historic land use for the Hawaiian Islands. This is followed by legendary and historical references to the greater ‘Ewa, Kona, and Ko‘olaupoko Districts and the subject *ahupua‘a* of Waikele, Hālawa, Kalihi, and Kailua. This summary includes oral traditions and first-hand Historic accounts recorded by visitors and missionaries related to the *ahupua‘a* listed above as well as a discussion of land use practices. The discussion concludes with a review of the findings from prior investigations conducted in the subject area vicinities.

GENERAL CULTURE-HISTORICAL CONTEXT

Early Hawaiian Settlement Patterns

While the question of the timing of the first settlement of Hawai‘i by Polynesians remains unanswered, several theories have been offered that derive from various sources of information (i.e., archaeological, genealogical, mythological, oral-historical, radiometric). However, none of these theories is today universally accepted because there is no archaeological evidence to support the proposed timing for the initial settlement, or colonization stage, of island occupation. More recently, with advances in palynology and radiocarbon dating techniques, Kirch (2011) and others (Athens et al. 2014; Wilmshurst et al. 2011) have convincingly argued that Polynesians arrived in the Hawaiian Islands, sometime between A.D. 1000 and A.D. 1200 and expanded rapidly thereafter (c.f., Kirch 2011).

The initial settlement of Hawai‘i is believed to have originated from the southern Marquesas Islands (Emory in Tatar 1982). In these early times, Hawai‘i’s inhabitants were primarily engaged in subsistence level agriculture and fishing (Handy et al. 1991). This was a period of great exploitation and environmental modification, when early Hawaiian farmers developed new subsistence strategies by adapting their familiar patterns and traditional tools to their new environment (Kirch 1985; Pogue 1978). Their ancient and ingrained philosophy of life tied them to their environment and kept order; which was further assured by the conical clan principle of genealogical seniority (Kirch 1984). According to Fornander (1969), the Hawaiians brought from their homeland certain Polynesian customs and beliefs: the major gods Kāne, Kū, and Lono; the *kapu* system of law and order; cities of refuge; the *‘aumakua* concept; and the concept of *mana*.

Initial permanent settlements in the islands were established at sheltered bays with access to fresh water and deep sea fisheries. The near shore fisheries and coastal fishponds, which were enriched by nutrients carried in the fresh water, also offered opportunities for resource extraction and stewardship. Communities shared extended familial relations and there was an occupational focus on the collection of marine resources. Clusters of houses were found in these coastal areas where, over time, agricultural production first became established. Over a period of several centuries the areas with the richest natural resources became populated and perhaps even crowded, and inland elevations began to be used for agriculture and some habitation. Meanwhile, an increasing separation of the chiefly class from the common people began to emerge. As the environment reached its maximum carrying capacity, the result was social stress, hostility, and war between neighboring groups (Kirch 1985). Soon, large areas of Hawai‘i were controlled by a few powerful chiefs.

As time passed, a uniquely Hawaiian culture developed. The portable artifacts found in archaeological sites of this period reflect not only an evolution of the traditional tools but some distinctly Hawaiian inventions. The adze (*ko‘i*) evolved from the typical Polynesian variations of plano-convex, trapezoidal, and reverse-triangular cross-section to a very standard Hawaiian rectangular quadrangular tanged adze. A few areas in Hawai‘i produced quality basalt for adze production. Mauna Kea, on the island of Hawai‘i, possessed a well-known adze quarry. The two-piece fishhook and the octopus-lure breadloaf sinker are Hawaiian inventions of this period, as are *‘ulu maika* stones and *lei niho palaoa*. The latter was a status item worn by those of high rank, indicating a trend toward greater status differentiation (Kirch 1985).

As the population continued to expand so did social stratification. The Expansion Period is characterized by major socioeconomic changes, and intensive land modification. By this time, most of the ecologically favorable zones of the windward and coastal regions of all major islands were settled and the more marginal leeward areas were being developed. The greatest population growth occurred during the Expansion Period. It was during the Expansion Period that a second major migration settled in Hawai‘i, this time from Tahiti in the Society Islands. Rosendahl (1972) has proposed that settlement at this time was related to seasonal, recurrent occupation in which coastal sites were occupied in the summer to exploit marine resources, and upland sites were occupied during the winter months, with a focus on agriculture. An increasing reliance on agricultural products may have caused a shift in social networks as well; as Hommon (1976) argues, kinship links between coastal settlements disintegrated as those links within the *mauka-makai* settlements expanded to accommodate exchange of agricultural products for marine resources. This shift is believed to have resulted in the establishment of the *ahupuaʻa* system sometime during the A.D. 1400s (Kirch 1985), adding another component to an already well-stratified society. The implications of this model include a shift in residential patterns from seasonal, temporary occupation, to permanent dispersed occupation of both coastal and upland areas.

According to Cordy (2002), during the 14th century the ʻEwa, Kona, and Koʻolaupoko districts emerged as the main political centers on Oʻahu, however by the 18th century, these political centers shifted to the Kona District. By this time, the island of Oʻahu was divided into six traditional districts or *moku*: ʻEwa, Waiʻanae, Waialua, Koʻolauloa, Koʻolaupoko and Kona (Figure 20). *Moku* were further divided into distinct land units known as *ahupuaʻa*, which were usually wedge or pie-shaped, incorporating all of the eco-zones from the mountains to the sea and for several hundred yards beyond the shore, assuring a diverse subsistence resource base (Hommon 1986). The *ahupuaʻa* became the equivalent of a local community, with its own social, economic, and political significance. *Ahupuaʻa* were ruled by *aliʻi ʻai ahupuaʻa* (*ahupuaʻa* chief); who, for the most part, had complete autonomy over this generally economically self-supporting piece of land, which was managed by an appointed *konohiki* (lesser chief-landlord). The *konohiki*, thereby reported to the *aliʻi ʻai ahupuaʻa*, who in turn answered to an *aliʻi ʻai moku*, a higher chief who ruled over the *moku* and claimed the abundance of the entire district. Thus, *ahupuaʻa* resources supported not only the *makaʻāinana* (commoners) and *ʻohana* (extended families) who lived on the land, but also provided support to the ruling class of higher chiefs and ultimately the crown. The *aliʻi* and the *makaʻāinana* were not confined to the boundaries of an *ahupuaʻa*; when there was a perceived need, they also shared with their neighbor *ahupuaʻa ʻohana* (Hono-ko-hau 1974). As previously mentioned, three of the possible locations for the new OCCC facility in Hālawa and Waikele *ahupuaʻa* lie within the traditional *moku* (district) of ʻEwa, and the fourth potential location in Kalihi Ahupuaʻa lies within the *moku* of Kona/Honolulu (see Figure 20). The WCCC in Kailua Ahupuaʻa is situated within the *moku* of Koʻolaupoko.

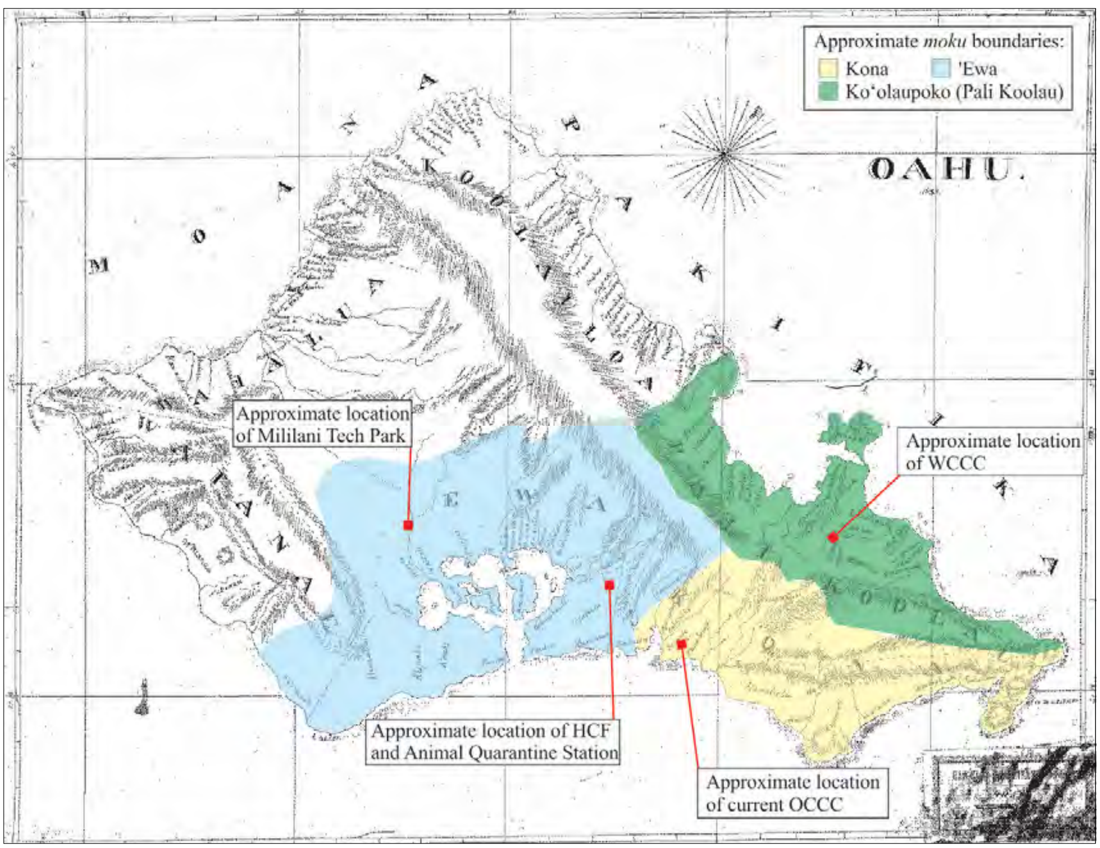


Figure 20. Hawaii Registered Map 455, showing WCCC and possible OCCC locations within traditional *moku* of Oʻahu, ca. 1883.

Ahupuaʻa were further divided into smaller sections such as *ʻili, moʻoʻāina, paukūʻāina, kīhāpai, kōʻele, hakuone,* and *kuakua* (Hommon 1986, Malo 1951, Pogue 1978). The chiefs of these land units gave their allegiance to a territorial chief or *mōʻī* (king). *Heiau* building flourished as religion became more complex and embedded in a sociopolitical climate of territorial competition. Monumental architecture, such as *heiau*, "played a key role as visual markers of chiefly dominance" (Kirch 1990:206). This form of district subdividing was integral to Hawaiian life and was the product of strictly adhered to resources management planning, in which the land provided fruits and vegetables and some meat for the diet, and the ocean provided a wealth of protein resources (Rechtman and Maly 2003). In communities with long-term royal residents there was a strict division of labor, with specialists in various occupations on land and in procurement of marine resources.

Hawaiʻi After European Contact

The arrival of Western explorers in Hawaiʻi ca. 1778, marked the end of the Precontact Period and the beginning of the Historic Period. With the arrival of foreigners such as British explorer Captain James Cook, in command of the ships *H.M.S. Resolution* and *H.M.S. Discovery*, Hawaiʻi's culture and economy underwent drastic changes. Demographic trends during the late Precontact early Contact Periods indicate population reduction in some areas, due to war and disease, yet increase in others, with relatively little change in material culture. At first there was a continued trend toward craft and status specialization, intensification of agriculture, *aliʻi* controlled aquaculture, the establishment of upland residential sites, and the enhancement of traditional oral history (Kirch 1985; Kent 1983). The Kū cult, *luakini heiau*, and the *kapu* system were at their peaks, although western influence was already altering the cultural fabric of the Islands (ibid). Foreigners very quickly introduced the concept of trade for profit, and by the time Kamehameha I had conquered Oʻahu, Maui and Molokaʻi, in 1795, Hawaiʻi had seen the beginnings of a market system economy (Kent 1983). Some of the work of the commoners shifted from subsistence agriculture to the production of foods and goods that they could trade with early visitors. Introduced foods often grown for trade with Westerners included yams, coffee, melons, Irish potatoes, Indian corn, beans, figs, oranges, guavas, and grapes (Wilkes 1845). Later, as the Historic Period progressed, Kamehameha I died, the *kapu* system was abolished, Christianity established a firm foothold in the islands, and introduced diseases and global economic forces began to have a devastating impact on traditional life-ways. This marked the end of an era of uniquely Hawaiian culture.

Written accounts left by early visitors to the Island of Oʻahu, such as those reproduced below, offer valuable insight into what life may have been like for the earliest residents of Kona, ʻEwa, and Koʻolaupoko. By the 1830s-1850s, fifty or so years after first European contact, the native population of the islands had already suffered a significant decline; meanwhile, the Western population kept increasing. Maly summarizes the reasons for the rapid decline of native populations:

> Overall, historic records document the significant effect that western settlement practices had on Hawaiians throughout the islands. Drawing people from isolated native communities into selected village parishes and Hawaiian ports-of-call, had a dramatic, and perhaps unforeseen impact on native residency patterns, health, and social and political affairs. In single epidemics hundreds, and even thousands of Hawaiians died in short periods of time. (1998:36)

The *Māhele Āina* of 1848

Western settlement practices spurred profound religious, socioeconomic, and demographic changes that took place in the early 1800s resulted in the establishment of a Euro-American style of land tenure, and the *Māhele ʻĀina* of 1848 was the vehicle used to divide the land between the crown, government, *konohiki*, and native tenants. Prior to this land reformation, all the land and natural resources of Hawaiʻi were held in trust by the *aliʻi* who, in concert with *konohiki* land agents, meted out use rights to the native tenants at will. During the *Māhele* all lands were placed in one of three categories: Crown Lands (for the occupant of the throne), Government Lands, and *Konohiki* Lands; all three types of land were subject to the rights of the native tenants therein. As such, these lands were claimed mainly as entire *ahupuaʻa* or *ʻili kūpono* (a subdivision of an *ahupuaʻa* that operated nearly independently of the *ahupuaʻa* in which it was located) and recorded in the *Buke Māhele*.

The *aliʻi* and *konohiki* were required to present their claims to the Board of Commissioners to Quiet Land Titles (commonly referred to as the Land Commission) to receive a Land Commission Award (LCAw.) for lands provided to them by Kamehameha III. They were also required to provide commutations to the government to receive Royal Patents on their land claim awards. The lands claimed during the *Māhele* were identified by name only, with the understanding that the ancient boundaries would prevail until the land could be formally surveyed. Awarding lands by name is one way the Land Commission expedited their work until formal government surveys could be completed (Chinen 1961).

As the King and chiefs made claims to large tracts of land via the *Māhele*, questions arose with regard to the protection of rights for the native tenants. To address this matter, on August 6, 1850, the *Kuleana* Act or Enabling Act was passed that allowed native tenants to acquire an allodial title to *kuleana* parcels that they actively lived on or farmed. As such, all lands identified and claimed during the *Māhele* were subject to the rights of the native tenants therein. The Board of Commissioners oversaw the program and administered the *kuleana* as Land Commission Awards (Chinen 1958). Native tenants wishing to make a claim to their lands were required to submit a Native Register with the Land Commission, followed by Native Testimony given by at least two individuals to confirm their claim to the land. Testimony was typically given by neighbors. Upon successful submittal of the required documents, the Land Commission rendered their decision, and if successful, the tenant was awarded a *kuleana* parcel. Unlike the *Māhele* between the chiefs, tenants claiming land through the *Kuleana* Act were required to pay for a Government surveyor to survey and map the boundaries of their awarded parcels.

Following the *Māhele*, the Hawaiian kingdom initiated a grant program in an effort to encourage more native tenants to engage in fee-simple ownership of parcels of land. These parcels consisted primarily of Government lands-those lands given outright by the King, or commuted to the Government by *aliʻi* in lieu of paying the commutation fees on the parcels awarded them during the *Māhele*. These land grants ranged in size from roughly ten acres to many hundreds of acres. When the sales were agreed upon, Royal Patents were issued and recorded following a numerical system that remains in use today. In 1862, the Commission of Boundaries (Boundary Commission) was established to legally set the boundaries of all the *ahupuaʻa* that had been awarded as a part of the *Māhele*. However, boundary descriptions were not collected for all *ahupuaʻa*. The primary informants for the boundary descriptions were old native residents of the lands, many of which had also been claimants for *kuleana* during the *Māhele*. This information was collected primarily between 1873 and 1885, and was usually given in Hawaiian and transcribed in English as they occurred.

LEGENDARY AND HISTORICAL ACCOUNTS OF THE SUBJECT DISTRICTS AND AHUPUAʻA

The forthcoming section presents various traditional and historical accounts that specifically mention the vicinity of the four potential OCCC locations as well as the WCCC location. Traditional accounts or *moʻolelo* were passed down orally from one generation to the next, and many such tales featured descriptions of *wahi pana* or legendary places. While historical accounts composed and recorded by visitors, missionaries, and local Hawaiian historians provide valuable insight into traditional lifeways practiced prior to the arrival of European and North American explorers. This discussion is organized into sections by district and *ahupuaʻa*; and the data is presented chronologically, beginning with traditional *moʻolelo*. These are followed by historical accounts of land use through the years, from the arrival of early visitors, through the *Māhele*, and ends with recent land use history of the subject areas.

The first traditional account presented is an excerpt from a *mele* that contains references to all four subject *ahupuaʻa*: Kailua, Waikele, Hālawa, and Kalihi; it is part of "History of Kualii" published in a *Collection of Hawaiian Antiquities and Folk-lore Volume IV* by Fornander (1916-1917:364-433). Kūaliʻi was a celebrated chief of Oʻahu and is believed to possess supernatural powers. This *mele* was composed by two brothers Kapaahulani and Kamkaaulani, "men in search of a new master or lord" (ibid.:364). These brothers devised a plan in which Kamakaaulani would give the *mele's* name to Kūaliʻi while Kapaahulani would urge his rival "to make war upon Kualii" and upon reaching the battlefield, Kapaahulani would chant their prayer, thus ending the battle before it began. Everything went according to plan and Kapaahulani chanted the *mele* of Kūaliʻi on the plains of Keahumoa in Honouliuli, ʻEwa on the eve of Kāne (moon phase). After he finished, "the two armies came together and the battle was declared off" (ibid. 400). As a result, "the king of Koolauloa then gave over, or ceded, the districts of Koolauloa, Koolaupoko, Waialua and Waianae" (ibid.). The following excerpts are from the *mele* for Kūaliʻi (emphasis added):

The rain that supplies Kekuapololi,
Coming near to the hill of Kalalau
Koolau trembles.
<u>O Ku, O Kalamahaaiakea</u>,
<u>To Kalama indeed the land belongs</u>,
<u>A permanent resident in Kailua</u>. . . (ibid.:396)
. . . O Kawelo! Say, Kawelo!

The arched house at Kauamoa—Waipio;
Let us cast the net in the awa-pond—of Waiawa;
Do not stretch yourself at—Manana.
Many are the ravines,
Numerous the sharks at Waimano;
We are drawn by the current of Waiau;
In the kukui grove we are sheltered—in Waimalu;

Kaweloiki, the sharp-pointed hill,
Hill of Kapolei.
Blue is the poi which appeases
[the hunger] of Honouliuli;
Fine the salt of Kahuaike—Hoaeae;
Slippery is the fish of Waikele—Waikele;
Let us arise, is it daylight—at Kalauao;
Let us enter and dine—at Aiea;
Do not pass by —Halawa;
Let us abide in the hollow—of Moanalua;
We will bend the hau—at Kahauiki;
And go zigzagging down the edge—of Kalihi.
(ibid.:400)

ʻEwa District (HCF; Animal Quarantine Station; Mililani Tech Park-Lot17)

As previously mentioned, three of the possible locations for the new OCCC facility, Mililani Technology Park in Waikele Ahupuaʻa, and the Animal Quarantine Station and HCF in Hālawa Ahupuaʻa, are located within ʻEwa District. ʻEwa, occupying the south-central coast of Oʻahu, extends from Honouliuli Ahupuaʻa in the west to Hālawa Ahupuaʻa in the east. ʻEwa encompasses the estuary of Pearl Harbor, known to the ancient Hawaiians as "Ke-awa-lua- o-Puʻuloa, The- many (*lau*)-harbors (*awa*)-of Puʻuloa. Puʻuloa was the rounded area projecting into the sea at the long narrow entrance of the harbor" (Handy et al. 1972:469). ʻEwa translates literally as "crooked" (Pukui et al. 1974:28). Much of ʻEwa is watered by streams that flow from the Koʻolau Range, although the western plains are arid. Many legends arise from the waters of Puʻuloa, some of which specifically mention Waikele Ahupuaʻa and are discussed in detail below.

Handy et al. described the ancient ʻEwa *moku* as:

> … This wide area anciently consisted of both seaward and high interior plains (including Wahiawa and Waiʻanae-uka, now a part of the district of Waialua), the deep leeward valleys of the Koʻolau mountain range, and the coastal region of the Waiʻanae range to the northwest. Now, although its area has been diminished by the political redivisioning of 1886 and 1909, it is still of great importance, although for different reasons. . .
>
> The salient feature of ʻEwa, and perhaps its most notable point of differennce, is its spacious coastal plain, surrounding the deep bays ("lochs") of Pearl harbor, which are actually the drowned seaward valleys of ʻewa's main streams, Waikele and Waipiʻo. . .
>
> These bays offered the most favorable locality in all the Hawaiian Islands for the building of fishponds and fish traps into which deep-sea fish came on the inflow of tidal waters.
>
> The lowlands, bisected by ample streams, were ideal terrain for the cultivation of irrigated taro. The hinterland consisted of deep valleys running far back into the Koʻolau range. Between the valleys were ridges, with steep sides, but a very gradual increase of altitude. The lower parts of the valley sides were excellent for the culture of yams and bananas. Farther inland grew the *ʻawa* for which the area was famous. The length or depth of the valleys abd the gradual slope of the ridges made the inhabited lowlands much more distant from the *wao*, or upland jungle, than was the case on the windward coast. Yet the wao here was more extensive, giving greater opportunity to forage for wild foods in famine time.
>
> The people needed this resource because ʻEwa, particularly its western part, got very little rain in the summer months when the trade winds dropped their moisture in the interior. Stream water for irrigation, however, was always abundant. In the summer, compared with the windward coast, ʻEwa was consideraby hotter in the daytime, and warmer at night, often rather windless. (1972:469)

The abundance of streams is evident in the names of the subject *ahupuaʻa* located in ʻEwa. Hālawa translates literally as "curve" (Pukui et al. 1974:36), which is likely a reference to the curving north and south forks of its namesake Hālawa stream (Figure 21). Waikele translates literally as "muddy water" (ibid.:223), which may be a reference to the various freshwater streams located therein, such as Kaukonahua and Waikakalua streams located to the north and south of the Mililani Tech Park location, respectively.

Waikele along with neighboring Waipiʻo and Hōʻaeʻae *ahupuaʻa* to the east and west, respectively, comprise the region of Waipahu (see Figure 21). Waipahu extends from modern day Pearl City to Honouliuli Ahupuaʻa. Waipahu translates as "bursting water" (Pukui et al. 1974:227), yet another reference to the many freshwater springs in the area. In addition to hosting the productive cultivation of crops such as *wauke*, *māmaki*, *ʻawa*, *olonā*, bananas, and yams, ʻEwa was also home to *aliʻi* and royalty during the Precontact Period, in Lepau located on the Waipiʻo Peninsula (Handy et al. 1972).

Legendary Accounts of ʻEwa District

There are many myths and legends of ʻEwa, most of which are associated with the waters of Puʻuloa. For instance, it is believed that the first breadfruit planted in the Hawaiian Islands was brought from Upolo Samoa and planted at Puʻuloa in ʻEwa by Kahaʻi (Fornander 1916-1917:392), the grandson of the great navigator and *alliʻi nui* Moikeha (Emerson 1893).

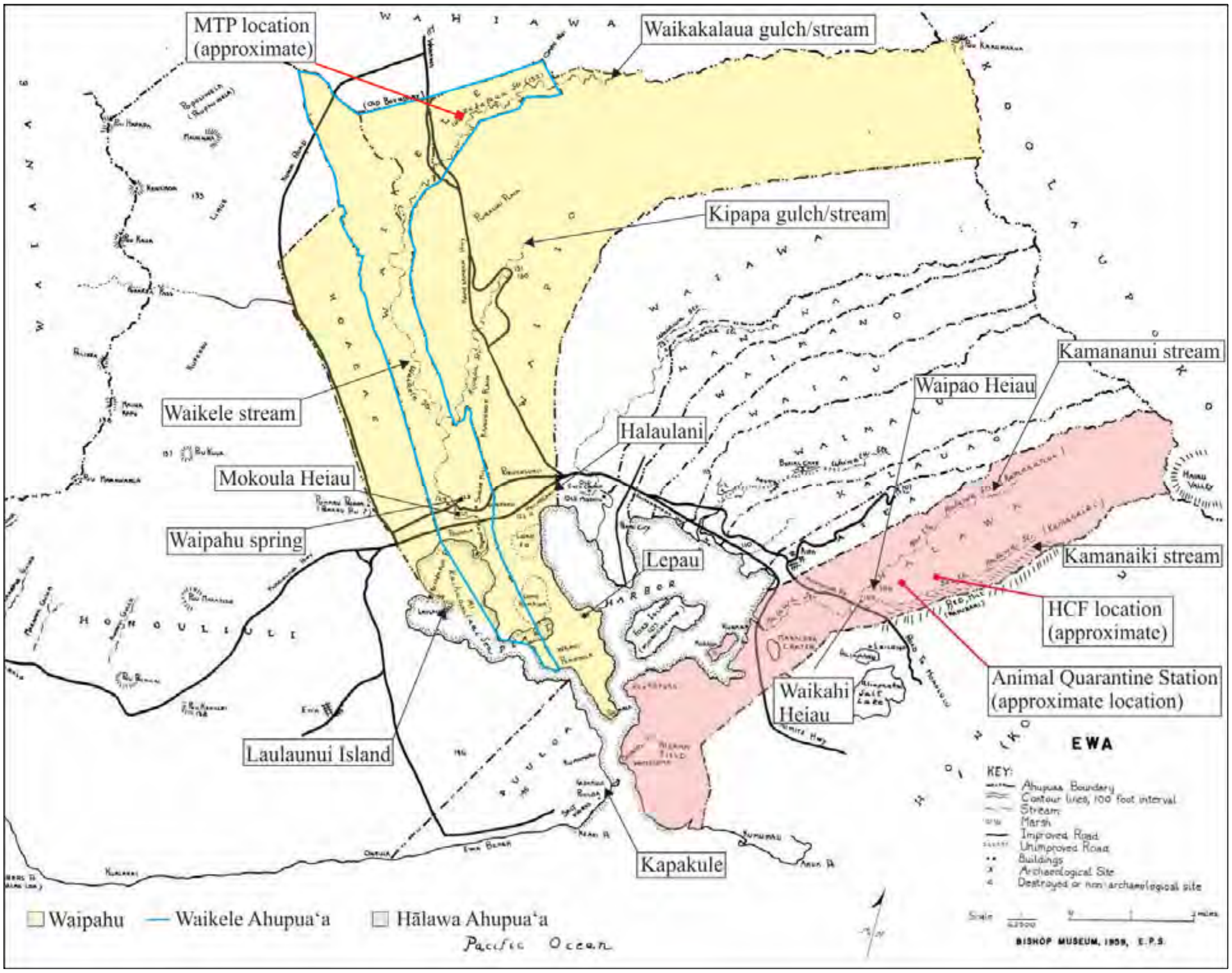


Figure 21. Annotated map from Sterling and Summers (1978:57) showing some of the *wahi pana* of ʻEwa referenced in the text.

ʻEwa was also the site of a place known as Kukaniloko that carried great significance for the *aliʻi* of Hawaiʻi, "where it was the desire of future chiefs that their sons be born" (ibid.:70). This sacred place was instituted by Nanakaoko, one of the sons of Nanamaoa who is reported to have come to the Hawaiian Islands from Tahiti around A.D. 1025 according to Kalakaua (ibid.). Even Kamehameha I hoped for Liholiho to be born there, but the queen's health did not allow the journey. Later in the same volume, Kalakaua mentions "the hallowed enclosure of Kukaniloko," of which he states that "chiefs born there were endowed with especial prerogatives and distinctions, and the beating of a sacred drum called *hawea* gave notice without of the birth of a *tabu* chief" (ibid.:200). A few legendary accounts of ʻEwa make specific references to *wahi pana* in Waikele and Hālawa *ahupuaʻa* and are presented below. In addition, the locations of some of these *wahi pana* are depicted in Figure 21 above.

Legendary Accounts of Hālawa and Waikele ahupuaʻa

Hawaiian Historian Samuel Kamakau recounts the legend of a *moʻo* (a shape-shifting water lizard) called Kanekuaʻana who came from Kahiki and brought bounties of fish with her to the people of ʻEwa. Among the blessings bestowed upon ʻEwa, were the *pipi* or pearl oysters from which Pearl Harbor got its name, as told in the following excerpt, which mentions Hālawa by name:

> Kanekuaʻana was the *kiaʻi* [guardian]of ʻEwa, and the *kamaʻaina* from Halawa to Honouliuli relied upon her. Not all of the people of ʻEwa were her descendants, but the blessings that came to her descendants were shared by all. . . (Kamakau 1964:83)

Hālawa is also mentioned in “Legend of Kalelealuaka and Keinohoomanawanui” published in *Collection of Hawaiian Antiquities and Folk-lore Volume IV* by Fornander (1916-1917:464-470). The legend is set during a time of war between Kakuhihewa, the king of ʻEwa, and Pueonui, the king of Kona (from Moanalua to Makapuʻu) in which “Pueonui was acquiring the Ewa lands” (ibid.:464). Kalelealuaka and Keinohoomanawanui lived in a house in Lihue that faced ʻEwa and at night they often made wishes. The legend opens with the following wish Keinohoomanawanui would recite nightly that reveals a glimpse into traditional Hawaiian life:

> My wish is this: that we sleep until the first crowing of the cock, then we proceed down to the plain, pull up some ahuhu, gather them together, continue on down to the beach, pound until soft, put the stuff into the cracks, catch an eel, return home, put the eel in banana leaves, cook it in the oven underground; then at the second crowing of the cock uncover the oven and place the cooked eel to one side to cool; after it is cooled we will then proceed eating until we have had our fill; when we will retire to our mats, place our heads on our pillows, face up to the roof and watch the rats race along the battens. (ibid.)

Meanwhile, Kalelealuaka had a much loftier wish in which he enjoyed all the riches of the *mōʻī* Kākuihewa, including his daughters as wives, and the king reduced to servitude. Word reached the king who consulted his priest as to whether Kalelealuaka’s wish was proper or not. His priest advised Kākuhihewa to carry out the wish for Kalelealuaka “he will be the man to gain the conquest for you, so that you will own the whole island” (ibid.:466). Thus, Kākuhihewa prepared everything Kalelealuaka had wished for and even took the men on as sons-in-law, to gain Pueounui’s lands. The fighting between the high chiefs resumed and Kalelealuaka and Keinohoomanawanui fought bravely on behalf of their king. However, Kalelealuaka appeared lazy for he slept during the day but rose very early in the morning to fight when no one was watching; Kalelealuaka, “would run from Ewa to Kapukaki, the heights looking down at Halawa, where he would meet the officers of the opposing army and fight them single handed. . .” (468). Kalelealuaka took feather capes and helmets as trophies from the warriors he had slain, and one night a farmer from Hālawa saw him returning with the spoils. The next night, the farmer ambushed Kalelealuaka, hitting him in the arm with a hooked spear, which he was helpless to remove. Kākuhihewa was able to take over Pueonui’s lands and attributed his defeat to Keinohoomanawanui. However, the Hālawa farmer knew better and told the king he had wounded another man in the middle of the night, to whom credit for the victory was rightly owed. The spear that remained in victory was rightly owed. The spear that remained in his arm acted as proof that “it was Kalelealuaka’s arm acted as proof that “it was Kalelealuaka that caused the overthrow and final defeat of Pueonui” (ibid.:470). Thus, Kalelealuaka became chief ruler and Kākuhihewa served beneath him. Also, a footnote to this legend explains that the dagger in the ground left in front of their home indicated that the king had heard their scheme. The same footnote presents a similar instance that also mentions Hālawa, “the case of Kamehameha’s night visit to the camp of plotting chiefs at Halawa, Oahu, when he stuck his spear in the ground in front of their house of conference” (ibid.:466).

Hālawa Valley is mentioned in two similar legends that tell of the daughter of the leading high-priest or kahuna of Kauaʻi and her struggle to survive after escaping the battlefield where Kalanikupule (also spelled Kalanikapule) reigned victorious. According to Kamakau (1992), Kahulunuikaʻaumoku, daughter of Kuʻohu, fell alongside warriors during the war known as Kukiʻahu. During this nearly month-long war (November 16-December 12, 1794) fought at Kalauao in ʻEwa, Kalanikupule of Oʻahu ultimately defeated the forces of Kaʻeokulani, chief of Maui, Molokaʻi, and Lanaʻi, with the support of two foreign ships. On the final day of battle, “the dead were gathered together, carried to Paʻaiau, and piled in a heap” and among them was Kahulunuikaʻaumoku (ibid.:169). The story continues thusly:

> Her body had been picked up for dead, carried with the others to Paʻaiau, and left in the heap of corpses. It was about one o’clock in the afternoon when she fell. At about ten o’clock that night she was aroused by an owl that flew over her and beat its wings on her head. She opened her eyes as from a deep sleep and found herself lying with the dead in a great heap. A guard was walking to and fro. The owl flew seaward and she followed, crawling, until she reached the sea. Then she swam to the opposite shore in spite of her many wounds and landed at ʻAiea, where the owl led her up Halawa valley into the mountains. There she found a cave and fell as if dead. While she lay unconscious, the owl flew to a former *kahu* of hers who knew the country well around Halawa, and this person brought her food and anointed her wounds. Two days later Ka-lani-ku-pule proclaimed an amnesty giving life to the captives, on pain of death if anyone, commoner or chief, kept up the slaughter. Ka-

> hulu died in 1834. I have seen with my own eyes the scars of the many wounds with which her body was covered. Thus God showed mercy to this woman until she heard the word of God and the Holy Trinity. (169-170)

Another version appears in a story titled “The City of Refuge: A Tale of Oahu” published in *Hawaiian Idylls of Love and Death* by Reverend Herbert Gowen (1908:59-66). This version begins the night after a battle and describes the scene thusly:

> . . . and there was silence on the battlefield. As the moon rose, its long shafts of light quivered across the lagoons which stretched between Moanalua and Waianae, and silvered the coral beach of Ewa, so that the dark heaps of corpses stood out with weird distinctness. (ibid.:59)

Gowen goes on to recount how women followed the men into battle, “at first to supply the warriors with food and drink from their calabashes, stood at last, side by side, with their husbands to aid them, and fell across their corpses” (ibid.:60). In this version, the protagonist is still described as the daughter of the high-priest of Kaua‘i, who remains nameless; but, in contrast she is called Liliha and is the wife of a warrior named Kahulu. As in Kamakau’s version, Liliha escaped and “struck out for the Aiea shore” she swam there for “she hoped to find refuge among her kin until the wrath of Kalanikapule should be overpast” (ibid.:61). Although wounded and bleeding, Liliha managed to reach the shore without drawing the attention of any sharks. Gowen described her arrival onshore as follows:

> At the entrance of the Halawa valley was a thicket almost concealing the mouth of the pass. A tangle of *ieie* had overgrown the shrubs and trees, so that to right or left of the white boulders, over which in freshet-times the torrents passed from the mountains to the sea, there was just the place where a hunted fugitive might hide or a wounded animal might die.
>
> . . . But the valley of Halawa was not to be Liliha’s coffin. Her swoon of the battlefield was but repeated, and when she awoke there was near her the sound of many men all talking together around a fire whose glow penetrated her hiding place . . (ibid.)

These men had Kahulu captive and Liliha was able to free him as the men succumbed to their *‘awa* stupor. The couple fled across the ‘Ewa plain towards the *pu‘uhonua* (city of refuge) but were unable to reach it before their captors caught up with them and killed them where they stood “vanquished upon the sand” (ibid.:64). Gowen concludes the tale with the following response from the king to the captors upon hearing the news that the couple had been killed before reaching the *pu‘uhonua*: “Set Kahulu free! Verily, he reached the *puuhonua*, for there is no city of refuge like that of a woman’s love” (ibid.:66).

Hālawa is mentioned in “How They found Fire,” which is found in a chapter titled “The Oahu Legends of Maui” published in *Legends of Maui* by Westervelt (1910:119-127). In this short legend, Maui sought fire to cook with and saw a Hawaiian mud hen named Alae tending a fire. Alae tried to keep it from Maui, which angered the demi-god and he threatened to kill it,

> The bird replied, “If you kill me you cannot find fire.” Maui said, “Where is fire?” The Alae said, “Go up on the high land where beautiful plants with large leaves are standing; rub their branches.” Maui set the bird free and went inland from Halawa and found dry land taro. He began to rub the stalks, but only juice came out like water. (ibid.:121)

On another occasion, Maui spied Alae with fire and the bird revealed to him the secret of fire, which Maui then applied to the head of the bird, “making a place where red and white feathers have grown ever since” (ibid.).

Waikele is mentioned in Kamakau’s version of events surrounding the rule of Alapa‘i Nui, the warrior chief who defeated the chiefs of Hawai‘i Island and united the island under his rule. Alapa‘i was related to the ruling families of Maui and O‘ahu, and it was during his rule, Kamehameha I was born to Kekui‘apoiwa and Keoua. Alapai’i helped defeat the ruling chief of O‘ahu and his army in the war on Moloka‘i, and set his sights on taking control of O‘ahu. After Alapai‘s arrival on O‘ahu, the O‘ahu chiefs sent for chief Peleioholani of Kua‘i and reinforcements. A chief and counselor named Na‘ili then advised the O‘ahu and Kaua‘i chiefs to make peace with Alapa‘i. Here, Kamakau mentions that Waikele was the home of Na‘ili’s sister Kamaka‘imoku, who was mother of Kalani‘opu‘u and Keoua, chief of Wai‘anae (1992:71). Later in the same account, Kamakau mentions Waikele as the birthplace of Kalani‘opu‘u:

> While Kuali‘i was still ruling Oahu, she [Kamaka‘imoku] had come to visit her mother ‘Umi-‘ula-i-ka-‘ahu-manu, who was living at Waikele with her younger brothers [Heulu and Na‘ili], and it was at the water of Alele just above Waipahu in Waikele, ‘Ewa, that Ka-lani-‘opu‘u was begotten by Pele-io-holani. (Kamakau 1992:75)

The legend associated with Waipahu spring (see Figure 21) also deserves mention here, for it provides the inspiration for the place name itself. According to the legend, a woman lost her tapa anvil in a stream in Kahuku, on the other side of the Koʻolaus and she later found it in Waikele bursting forth from the ground at the outlet of an underground stream known as Waipahu Spring (Sterling and Summers 1978).

The following, is an account of the same story as told by Simeon Nawaa to Elspeth Sterling on March 22, 1954:

> When the woman who had lost her tapa beater came finally to Waikele and found her beater being used by another woman she claimed it as hers rightfully. The woman who found the beater returned it to its owner and also offered her hospitality which she accepted. As the woman from Kahuku began her return trip the woman from Waikele accompanied her a little ways up the hill to the plain above. From her home to the plain above the trail was narrow so that the two women were obliged to go single file. When they reached the plateau aboe they were able to walk side by side which they did, linking their arms and thus they crossed this plain together before parting. Hence the name :Ke-one-kui-lima-laula-o-Ewa" (ibid.:27)

Another mention of Waikele appears in a section titled "Various Heathen Prayers" published in a *Collection of Hawaiian Antiquities and Folk-lore Volume VI* by Fornander (1919:46-52). This prayer depicts a ritual in which baskets are created, filled, and distributed within and throughout the islands:

> Who art thou, that comes to life with the drums?
> By the drum is that chief ennobled!
> A drum that is braided is being beaten.
> The basket is finished; open the basket;
> Fill up the basket, the basket, the roomy basket.
> Two baskets for Kaeleha, Two (for) Mamahauuula and others;
> At Oiolele double that action and derive four,
> From four to five, from five to six;Six (for) Honouliuli, Hoaeae and Waikele.
> From Waikele on to Waipio until the ninth;
> At the ninth pass by the bend in the pond at Makawa,
> For Kanaloa ten; Ten (for) Kipahulu, ten (for) Kaupo; Ten (for) Honuaula, ten (for) Kula;
> For Makawao one, for the ascent of Aalaloloa two, Two for Ukumehame, two (for) Olowalu, two (for) Launiupoko; For Lahaina ten, ten (for) Kauai, Ten (for) Oahu.
> Ten (for) Molokai, ten (for) Lanai, ten (for) Maui, Ten for joining and completing the islands of Kamalalawalu. (ibid.:46)

Waikele and ʻEwa are also mentioned in "The Story of Kahahana," an account of the fall and death of Kahahana, the King of Oʻahu in a *Collection of Hawaiian Antiquities and Folk-lore Volume VI* by Fornander (1919:282-291) and also presented in *Ruling Chiefs of Hawaii* (Kamakau 1992). Kahahana's father, Elani was of the ʻEwa line of chiefs and his mother Kaionuilalahai had familial ties to the royal families of Oʻahu and Maui. Kahahana was "handsome, brave, and gallant, he was the idol of the Maui court and the pride of the Pahu aristocracy" (ibid.:282). Around 1773, the Oʻahu chiefs elected Kahahana *mōʻī* (king) of Oʻahu to replace Kumahana even though Kumahana had been survived by adult children who could have been his successor. Kumahana, "had been deposed by the Oahu chiefs as an incompetent, indolent, penurious and unlovable chief" (ibid.:284). Kahahana went on to fight on the side of Kahekili, King of Maui, against Kalaniʻōpuʻu, King of Hawaiʻi; however, Kahekili turned on Kahahana after he refused to cede the land of Kualoa to him. Kahekili pretended to be Kahahana's ally whilst secretly undermining his reign by planting seeds of mistrust against Kahahana's high priest Kaopulupulu. Kahekili sent "his most trusted servant" Kauhi to further turn Kahahana against Kaopulupulu, which resulted in the murder of Kaopulupulu at Puʻuloa in ʻEwa in 1782 or 1783 (ibid.:287).

Soon, Kahekili invaded Oʻahu, and Kahahana and his wife Kekuapoiula fled the slaughter and hid in the mountains of ʻEwa for over two years (Fornander 1919; Kamakau 1992). According to Kamakau, they "were fed and clothed by the commoners, who had compassion upon them" and that "their last place of hiding was near Wailele at Waikele in ʻEwa" (1992:136). Kahahana sent his wife to visit her brother Kekuamanoha in Waikele to negotiate for their safety; instead, Kekuamanoha betrayed them and told Kahekili that Kahahana could be found in Waikele (Fornander 1919; Kamakau 1992). As a result, Kahahana was murdered and his body placed in a canoe in the ʻEwa lagoon and transported to Kahekili in Waikiki. According to Fornander, "the death of Kahahana closed the autonomy of Oahu" (ibid.:285). Kahekili and several Maui chiefs had taken over the island of Oʻahu; and the treachery against Kahahana inspired the Oʻahu chiefs to mount a revenge plot against Kahekili. Elani, along with Pupula and Makaioulu, lead the conspiracy to kill the Maui chiefs; Elani was to kill Kalanikūpule (son of Kahekili), Koalaukane, and Kekuamanoha who resided at ʻEwa. However, Kalanikūpule found out about the plot and sent word to his father who was able to escape his fate. The rebellion of the Oʻahu chiefs was known as the Waipiʻo *kīmopō* or the Waipiʻo assassination because it originated in Waipiʻo, ʻEwa.

Also of relevance are references to Kīpapa Gulch and Waikakalaua (see Figure 21), *wahi pana* that appear in accounts of the legendary battle that inspired the place name Kīpapa. The literal translation of *kīpapa* includes the following: "pavement," "to be close together, as clouds, or as taro neatly packed in a load," and "prone position on a surfboard; to assume such" (Pukui and Elbert 1986:154). While Waikakalaua is an upland *ʻili* in Waikele within which the Mililani Tech Park location is located. According to Fornander, three Hawaiʻi chiefs and one Maui chief invaded Oʻahu, "but were defeated and slain by *Mailikukahi*, the then sovereign of Oahu" (1880:70). The Battle of Kīpapa is described thusly:

> The invading force landed at first at Waikiki, but, for reasons not stated in the legend, altered their minds, and proceeded up the Ewa lagoon [Pearl Harbor] and marched inland. At Waikakalaua [see Figure 21] they met *Mailikukahi* with his forces, and a sanguinary battle ensued. The fight continued from there to the Kipapa gulch. The invaders were thoroughly defeated, and the gulch is said to have been literally paved with the corpses of the slain, and received its name, "Kipapa," from this circumstance. *Punaluu* [a Hawaii chief] was slain on the plain which bears his name, the fugitives were pursued as far as Waimano, and the head of *Hilo* [a Hawaii chief] was cut off and carried in triumph to Honouliuli, and stuck up at a place still called *Poo-Hilo* [Hilo head]. (ibid.::90)

The following legend regarding another relevant *wahi pana* appeared in a Hawaiian language article from 1899, published in Sterling and Summers (1978). The legend tells of Kapuna cave, located in Waipiʻo, and used by fisherman from Waikele, as follows:

> . . . The cave of Kapuna used to be occupied by chiefs in ancient times. That time has passed. A new generation came later and the cave was used by the fisherman of Waikele and Waipio to this day on which the writer mentions this. It was of this cave that the famous riddle of the ancients mentioned, "To Kapuna belongs the house, the sea dwells in it." (No Kapuna ka hale noho ia e ke kai). This is the answer to the riddle, "To a brother-in-law belongs the house, a sister-in-law dwells in it.". . . There is life for the people where fire is lighted. This cave is on the Waipio side and a sea passage separates Waipio and Waikele and Waikele and Honouliuli. The passage is obstructed by three small islands, a middle one and Manana and Laulaunui [see Figure 21]. (ibid.:24)

Excerpts from ethnological recordings of Mary Kawena Pukui that explain Waikele place names: are also found in Sterling and Summers (1978), and read thusly:

> The site of the present Waipahu Continuation School was called Kahapuupuu. Here lived the kapu Chiefess, Kalanikepoolauheaiku, who was called Waimahuʻi only by her own people. It was a custom of old to have a name by which a chief was called and a name for members of the household only. She was so very kapu that even her own children could not eat a portion of any food served for her and no other chief, except Keopuolani, could enter her house with a skirt on.
>
> The place where Lahilahi's (Webb) old house now stands not far from the fish pond, was known as Kupiko. A short distance from the pond was Keopuolani's canoe landing, called Kualalua. A spring is near it. Next to Kualalua is a small point called Hilo-pali-ku.
>
> Above the store, near the school house are two stones, known as "Kuʻaʻe Ewa, Noho iho Ewa." (Standing Ewa, sitting Ewa). Just why they were called by those names, she did not say, but I did hear her say that, "Kuʻaʻe Ewa, he Ewa alii; noho iho Ewa, he Ewa kanaka," that is, "Standing Ewa is the Ewa of chiefs and Sitting Ewa, the Ewa of commoners."
>
> The broad plain was called "Ke-one-kuhi-lima-laula-o-Ewa."
>
> Kuolo-kele was a legendary stone that used to lie in a stream but it has disappeared.
>
> Kike-nui-a-Ewa is also a legendary stone above Waipahu, the outlet of the subterranean stream.
>
> Pohaku-pili is also another, located up Poniohua stream, above the spot where Kaahupahau, the shark goddess of Ewa, used to swim up to be fed. This spot was called Ka-wai-ahuʻa-lele. . .
>
> Between the stream of Poniohua, between the bridge and the sea, was Kalou, a good place for swimming and diving. There were (are?) big stones there under which some trees (brought down from the mountains by swollen waters) lodged and remained preserved for years. . . (ibid.:26)

Pohaku-pili is further described in an excerpt from *Ka Loea Kalaaina* July 1, 1899, published later in the same volume:

> . . . a stone that belonged to Kane and Kanaloa, gods. It was they who divided the lands of Ewa when they came to earth. The divisions of the boundaries they made remained the same to this day. This stone is said to be a supernatural one and lies on the boundary of Waikele and Hoaeae and is on the edge of the cliff. There is nothing to hold it in place for it is on a sheer precipice but it has remained unmoved to this day. . . (ibid. :29)

Waikele is also mentioned in the “Legend of Palila” published in *Collection of Hawaiian Antiquities and Folklore Volume V* by Fornander (1918-1919:136-152). Palila was Hina’s grandson, and he was born on Kauaʻi as a piece of rope to his mother Mahinui, who discarded him like rubbish. Hina rescued him from the rubbish pile and brought him to her temple, Humuula, where she tended to him until his bodily form was completely developed. She then took him to Alanapo where she raised him alongside the spirits and he grew to be a powerful demi-god. Palila’s father Kaluaopalena ruled half of Kauaʻi and through Palila’s feats of strength, he was able to take over the entire island. After defeating his father’s enemies, Palila was inspired to fight the demi-gods and chiefs of other islands. Before he set off on his journey. Palila had a premonition of a demi-god named Kamaikaahui from Maui. Kamaikaahui’s human form included rows of shark teeth in his back, which he kept covered with tapa cloth. One day, he was forced to reveal his back, and he stripped down and ran away into the sea where he turned into a shark. According to Fornander, the legend continues as follows:

> After transforming himself into a shark he came to Waipahu in Waikele, Oahu, where he remained. As soon as he was settled in the place he again followed the same practice that he did in Maui. Every time he got his opponent under him his mouth at the back would bite and eat the man. This was done so often that the people of Ewa began to get afraid of him, and he lived as a king over them. (ibid.:142)

Palila chose Oʻahu as his first destination and landed at Kaʻena Point in Waiʻanae, from whence he proceeded to ʻEwa. Upon his arrival, Palila stood upon Keahumoa Plain,

> . . . and looked at the dust as it ascended into the sky caused by the people who gathered there; he then pushed his war club toward Honouliuli. When the people heard something roar like an earthquake they were afraid and they all ran to Waikele. When Palila arrived at Waikele he saw the people gathered there to witness the athletic games that were being given by the king of Oʻahu, Ahuapau by name. . .
>
> Ahuapau was a kapu chief and he was kept covered up away from the wind and rain. On going out he was carried from place to place inclosed [*sic*] in a palanquin, so high and sacred was his rank. He had two very fast runners, called Iomea and Ioloa. Every time the king traveled to Waikele to witness the games he would climb into his palanquin and be covered up and would only venture out in this way, whether on the way down or on the way home. (ibid.:142-144)

Palila boasted that if Kamaikaahui saw him, he would run away; to which the king replied, “If it is true that Kamaikaahui will run away from you this day, then you will be the first one to enter my sacred temple” (ibid.:144). Shortly after this, Palila confronted Kamaikaahui, who tried to escape into the sea, but Palila caught him and uncovered him “and the people saw his mouth and sets of teeth at his back; he was then killed” (ibid.).

Early Historic Accounts of Waikele and Hālawa ahupuaʻa and Greater ʻEwa District

According to Historic Period accounts, the *moku* of ʻEwa played host to Hawaiian royalty. Per Mcallister (1933), many *aliʻi* used to reside on an eastern point of Waipiʻo Peninsula known as Lepau (see Figure 21). ʻĪʻī also mentions Waipiʻo Ahupuaʻa as a place for chiefly residence, “in late 1803 or early 1804, while he was living with the chiefs at Halaulani, Waipio, Ewa, the king became ill” (ibid.:33). Thus, Kamehameha I resided for a time in Waipiʻo with the local chiefs. Also, Handy et al. (1972) attributed the location of the *aliʻi* stronghold within Waipiʻo Peninsula to the existence of the numerous fishponds throughout Pearl Harbor:

> The Pearl Harbor ponds were stocked with various kinds of fish, but especially mullet, because these inland waters were the summer home of the mullet of Oahu. There were traps in which deep-sea fish, especially *akule*, were caught. . .

> Another attraction was the great variety of shellfish found in Pearl Harbor. The most important was the Hawaiian pearl oyster or *pipi*, which was eaten raw. The shells were valued because they furnished shanks for bonito hooks. . . (ibid:470)

In addition to the abundance of marine life, the ʻEwa District had its own distinct taro variety native to the district, the ʻEwa *kai* variety (*kai o* ʻEwa). Handy et al. (1972) describe *kai o* ʻEwa as follows:

> One kind of *kai* sends off long rhizomes, hence was sometimes called *kai koi*, *kai*-that-pierces (Handy, 1940, p. 19). An ʻEwa *kamaʻaina* described this in 1899: "When planted, it sends up shoots, more shoots and still more shoots. Again and again it will send up new shoots, filling the mounds until they are mixed with the taro of other mounds." This description (*Ka Loea Kalaʻaina*, June 3, 1899) indicates that in the flat, wet lowlands of ʻEwa this famous taro was grown in mounds (*puʻepuʻe*) as in marshy localities. The article quoted above says that "*kai koi* multiplies itself over and over with one planting and often lasts as long as ten years." No other variety or locality can equal this. This fragrant taro was likened to a woman with whom a man falls in love. And it was said that anyone who married a native of ʻEwa would come and settle there and would never leave, because of the *kai ko*i of ʻEwa. . . (ibid.:471)

In 1931, Handy and his colleagues collected four varieties of *kai: kai koi*, *kai ʻulaʻula* (red *kai*), *kai ʻuliʻuli* (dark *kai*), and *kai keokeo* (white *kai*), the most fragrant *kai* variety from which the *poi* for the *aliʻi* was made.

> The area between the West Loch of Pearl harbor and Loko Eo (the fishpond at the north end of Waipiʻo peninsula) was terraced throughout, continuing for more than a mile up into Waikele Stream. The lower terraces were watered from the great spring at Waipahu. . . No area better exemplifies the industry and skills of the Hawaiian chiefs and their people than do the terraced plantation areas and numerous fishponds of ʻEwa. (ibid.:472)

Handy described:

> **Halawa.** The broad flatlands extending 1.5 miles below the highway along Halawa Stream are now under cane but were formerly terraces. The terraces also extended up the flats along the lower courses of Kamananui and Kamanaiki streams which join to form Halawa, and I am told that there were small terraces farther up both streams. Four and 5 miles inland, dry taro was planted on the banks of gulches. (1940:80)
>
> **Waikele.** In the flatland, where the Kamehameha Highway crosses the lower valley of Waikele Stream, there are the remains of terraces on both sides of the road, now planted to bananas, beans, cane, and small gardens. For at least 2 miles upstream there were small terrace areas. (1940:82)

Hawaiian historian Ioane (John) Kaneiakama Papa ʻĪʻī was born on August 3, 1800 in Kumelewai in nearby Waipiʻo Ahupuaʻa, ʻEwa (see Figure 21). At the age of ten, ʻĪʻī was taken to Honolulu to become a member of Liholiho's court; thus he became the attendant and companion of Kamehameha II. He mentions that Liholiho, the heir to the throne, stayed at the ʻĪʻī residence in Kumelewai. In one of his accounts of court activities, ʻĪʻī recalls the following details surrounding the festivities associated with a *makahiki* ceremony he witnessed during his youth. The ceremony itself was a celebration that occurred when "the *makahiki* gods went forth from the *luakini* heiau at Leahi" (1959:70) these gods were carried by attendants in a procession that circled the island beginning in Honolulu toward ʻEwa and beyond. The preparations and the ceremony lasted for weeks and included the implementation of various *kapu* as well as boxing matches.

ʻĪʻī learned the customs of the *makahiki* when he followed the procession from Honolulu to ʻEwa. He was very inspired by what he saw and proceeded to recreate the boxing matches and stone throwing battles he had witnessed. In one such story, a group of Waikele boys squared off against a group of Waipiʻo boys and shortly after this mock battle between the children, the adults entered into a sham battle between Honolulu and Waikele. ʻĪʻī provides the following story about the nature of the people of Waipiʻo, located adjacent and to the west of Waikele, from this period during his childhood:

> At about the time of the sham battle, a proclamation came from Kawelo, the overseer of the land of Waikele, for the men of the land to fetch the double canoe beached at Kupahu, on the northeastern side of Halaulani in Waipio. Because the proclamation came from Kaweleo, who said the order was from Kalanimoku, the men of Waipio made ready to detain the canoe. They felt that the command should have come from their own leader, Papa.

> When Kawelo and the men of Waikele had taken their places from prow to stern of the canoe and the command, "Go ahead," was given, the canoe did not budge. It was being held back by the men of Waipio. Kawelo's men tried again to make it go forward, but to no avail, so Kawelo asked the Waipio men why they held on. Kaimihau answered, "You cannot do this, for we were not told of it by our leaders. If Kalanimoku had made this request through our own leaders, we should have heard of it and therefore done nothing to prevent the removal of the canoe. If you persist in the idea of taking the canoe, day may change to night and night to day without its budging from its resting place. All things left here at Waipio are protected, from the sea to the upland, and we shall not let them go unless we hear from our own leaders." O companions, see how well the people served their leader. The peace of the land of Waipio was well known while the high chiefs were in charge and up to the time of Papa's death. (ibid: 76-77)

ʻĪʻī makes a few other interesting references to Waikele. In one, he mentions that Kapuna in Waikele was "a good place for dyeing tapa" (ibid:32) and continues thusly:

> There, patches of taro were grown, draw nets made, and houses built. The fishing was done in the sea of Honouliuli. Because the people of the place did not like Waikele's farm overseer, and for other reasons too, perhaps, they would say, "We are of Honouliuli." If the farm overseer went to Honouliuli, they would say, "We belong to Waikele." It was true that their homes were in Waikele, but all of their fishing was done in Honoluliuli. It was laziness and dislke of the oversser that made them point one way and then another" (ibid.)

In another account, ʻĪʻī refers to a *wahi pana* called Napehā, located in Hālawa where travelers would stop to rest on their journey from ʻEwa to Honolulu (ibid.:20). The literal translation of Napehā is "bend over breath" (Pukui et al.1974:163). Later in the same volume, as part of his discussion of Oʻahu trails, ʻĪʻī further describes Napehā as a deep pool, which earned its name because Kūaliʻi "went there and leaned over the pool to drink water" (1959:95).

According to ʻĪʻī (1959), subsequent to his conquering of Oʻahu in 1795, at the advice of chief Kamanawa, Kamehameha I divided the large *ahupuaʻa* on Oʻahu into smaller *ʻili ʻāina* (ʻĪʻī 1959). The subdivision of various *ahupuaʻa* affected how the land reformation known as the *Māhele* of 1848 was executed on Oʻahu. The *ahupuaʻa* of Waikele appears to have been subdivided into *ʻili* and awarded as such. The Mililani Tech Park location is situated in the *ʻili kūpono* of Waikakalaua, which makes up the *mauka* (northeast) end of Waikele Ahupuaʻa. In 1846, Waikakalaua was returned to the Crown by Haʻalilo and redistributed as a single Government Grant (Grant 6) to I. Gilman. This grant, consisting of 836-acres, includes the Mililani Tech Park property (Figure 22). In contrast, most of the land comprising the *ahupuaʻa* of Hālawa was divided among two *aliʻi:* Mataio Kekūanāoʻa (LCAw. 7712) and Grace Kamaʻikuʻi (LCAw. 8516B). In addition to their Land Commission Awards, nineteen *kuleana* awards were granted throughout Hālawa *ahupuaʻa*; none of which are located within or in the immediate vicinity of either the Animal Quarantine Station or HCF.

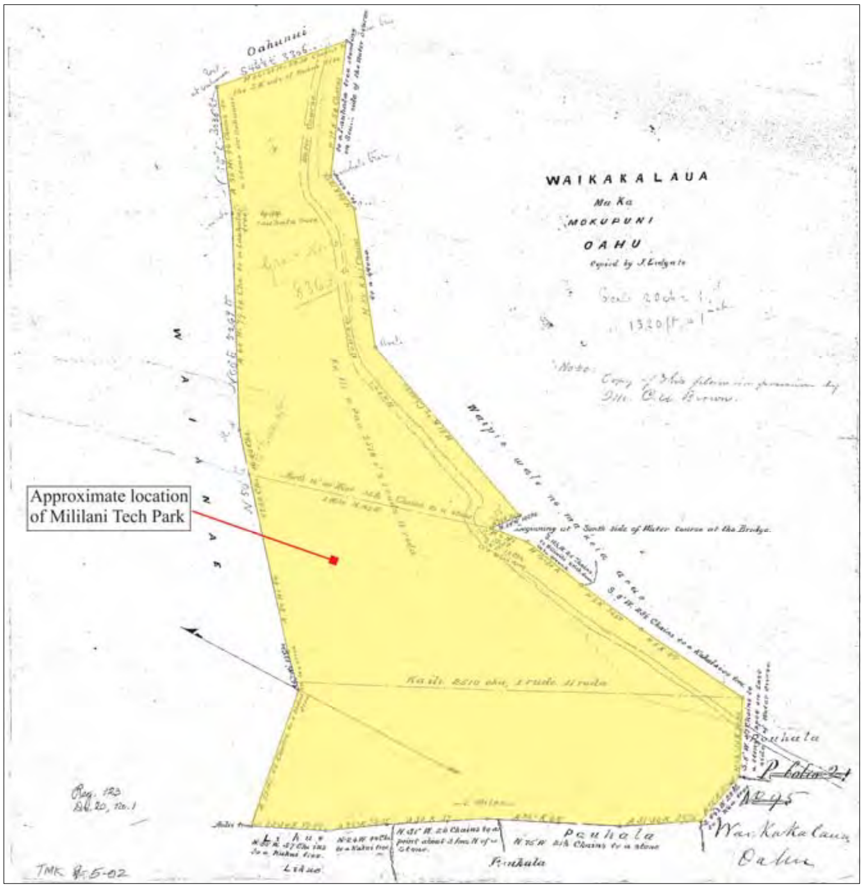


Figure 22. Registered Map 0123 showing Land Grant 6 and the approximate location of the Mililani Tech Park-Lot 17.

The Rice Industry in Waikele Ahupuaʻa and the Greater Waipahu Region (1870s-1942)

During the late 1800s, Waikele and neighboring Waipiʻo Ahupuaʻa were the site of the most productive rice fields in the Hawaiian Islands; “with the benefit of freshwater springs and the mountain waters of Waikele and Kipapa Streams, which merged to create the Kapakai Stream, wet crops and taro were easily cultivated” (Chong 1998:1). As previously mentioned, the region of Waipahu is comprised of Waikele, Waipiʻo and Hōʻaeʻae *ahupuaʻa* to the east and west, respectively. In 1892, 333 acres in Waikele and Waipiʻo were dedicated to rice production,

> . . . most of it was worked by two dozen or so major rice cooperative companies and the balance cultivated by approximately three dozen smaller group or family operations. Many of these smaller operatons combined their efforts during the planting and harvesting seasons and bonded socially through traditional arranged marriages between their children. (ibid.:16).

According to Chong, Homaikaia Waipiʻo was the site of one of the earliest documented rice plantations begun in 1875. Subsequently, Chinese planters leased abandoned *loʻi* and unused *kuleana* lands from Hawaiian families located in Waikele and Waipiʻo, taking advantage of the many artesian wells in ʻEwa district that were located between the coast and the inland plains. Chong states, “vast tracts of old and new, reclaimed land surrounding Waipahu from Pearl City to ʻEwa eventually were engulfed in a blanket of green rice fields [Figure 23]. By the early 1890s several rice mills were operating (ibid.:15).” The Chinese rice planters irrigated their rice fields by channeling the waters of Waikele Stream, which was also referred to as Kapakai Creek and Kapakahi River; a waterway that was sometimes “a source of great woe and destruction; during floods the stream would change its course, overflow its banks and inundate the rice paddies while destroying homes and claiming lives in its rampant race for the sea (ibid.).” Initially the Waipahu rice was taken by horse-drawn carriage to market in Honolulu; but with the advent of the rail road around 1889, rice was transported by train. Chong reports that in 1890 “more than ten million pounds of rice were exported, raised on sixteen thousand acres of rice paddies” (ibid.:15), which marked the peak of Hawaiian rice production and ranked Hawaiʻi as the third largest United States rice producer behind Louisiana and South Carolina.

Figure 23. “Waikele rice fields”(Photo: J.A. Gonsalves, Bishop Museum in Chong 1998:15).

According to the census of 1900 there were sixty-one rice farms in Waipahu (Waipiʻo, Waikele, Honouliuli, and Waiawa) including forty-nine family-operated rice farms; by 1910 the numbers decreased to fifty-five total farms of which only twenty-two were family-operated (ibid:18). Various systems of cooperative farming were implemented by the Waipahu Chinese. The largest and most complex of these systems was the *fun kung* (*or fung goong*) in which the “owner or lessee provided land and agricultural equipment, including all farm machinery and necessary animals, while laborers gave their energy and time to till the soil and raise the crop while supplying their own rations” (ibid.:16). Depending on the contract or agreement, both parties divided the crop or the money from its sale at the end of the season, “the laborers were bonded to a share of the profit,” which “depended in part on the laborers’ endeavors to carry the crop to a successful harvest, providing them an incentive for greater efficiency and responsibility” (ibid.).

Six major *fun goong* cooperatives averaging around 40 acres each were operated in Waipahu until the late 1920s. One of which was operated by eight partners and called Tung Wo Wai; it extended over more than forty acres on near Waipahu Depot Road (ibid.). According to Chong, Tung Wo Wai was believed to have been the site of the Mokoula Heiau, “which Bishop Museum described as being southwest of the upper road on the edge of a fifty foot elevation projecting into the rice fields” (ibid.:23). Another 40-acre *fun goong* in Waikele, called Tung Uck Wai was located to the east of Waipahu Depot Road and employed ten laborers. Another prominent rice plantation located in Waikele, *makai* of the railroad, was operated by Wong Say and named after him. By 1900, Wong Say “was already operating a fishpond, a piggery, and a Chinese labor camp for the sugar plantation” and “opened up his own rice mill to process the rice from his large rice plantation (ibid.:25).” Wong Say’s rice mill was the first in Waipahu and provided him and his family prosperity even after they moved back to China after the 1930s. In addition,

> Much of the Waikele land owned by Kaʻaiahua, his wife, Kamala, and his sons Manoanoa, Aniani, and daugher Pilahi Leialoha was leased out to Chinese rice farmers who lodged with neighboring Hawaiian families. According to land transactions around 1910, there were also a number of Chinese among them Tong Apo and Yin Poy, who purchased land from Hawaiians in this part of Waikele. (ibid.)

During the decades leading up to World War II, rice production suffered a steady decline due to increasing rental costs, blight, insect infestations, and less demand for rice locally exacerbated by cheaper rice production on the mainland. First generation farmers encouraged their offspring to purse business endeavors rather than continue rice farming. By 1942, only scant traces of the rice farming industry were evident in Waikele.

The Sugar Industry in ʻEwa District (1897-1940)

Once Dillingham had completed the original fifteen miles of rail he promised to the investors of the Oahu Railway and Land Company (OR&L) and the people of Oʻahu, he turned his sights on the commercial cultivation of sugarcane, which took over much of the ʻEwa area. Around 1892, Dillingham set up a coal elevator near the dock he had built between the railroad terminal and Honolulu Harbor. This venture provided the sugar plantations with coal to run their irrigation pumps and locomotives. However, the first few years of Ewa Plantation were barely productive, which cut into the OR&L’s profits because the low crop yield meant less sugar to haul. Ewa Plantation included Honouliuli lands up to 200 feet in elevation. However, by late 1896 Dillingham had plotted to plant sugar at higher elevations using water pumped from artesian wells, a plan which laid the groundwork for the Oahu Sugar Company (OSC) at Waikele Ahupuaʻa in Waipahu. By the end of 1894, he had arranged to lease Brown's ʻĪʻī lands at Waipiʻo between Waiawa and Robinson's holdings (Yardley 1981). OSC was incorporated on March 3, 1897 (Chong 1998:63).

The following information was gathered from a 1928 publication titled *Concerning—Oahu Sugar Company Limited Waipahu, Oahu* written by E. W. Greene, manager of the plantation. The acreage of OSC extended eight miles from Waiawa to Honouliuli and from "tidewater on the Waipio Peninsula to Robinson, eight miles on a northeasterly line" (1928:5). OSC covered 12,000 acres (roughly 20 square miles) of which 11,350 acres were planted with sugar cane, the remaining acreage was comprised of "village sites, roads, and waste lands" (ibid.:5). The plantation was divided into seventy-seven cane fields between 50 and 280 acres each, situated at elevations ranging from "10 feet above sea level on the Waipio Peninsula to 650 to 700 feet above sea level at the Waiahole ditch, which is its upper boundary" (ibid.). The OSC cane lots in Waikele did not reach the elevation of the Mililani Tech Park location. Nearly ninety-seven percent of the OSC plantation lands were leased (11,622 acres). The ʻĪʻī Brown Estate were the lessors of 4,912 acres and the OR&L were the lessors of 4,080 acres owned by the Bishop and Campbell Estates, while the Robinson Estate were the lessors for 2,630 acres. The remaining lands were owned by OSC in fee simple and were primarily not part of the cane fields; rather, these lands were host to the following:

> the mill, office, hospital, store sites, and a portion of the section occupied by skilled men's residences, the main labor village, the land occupied by five of the small pumping stations, a small area of cane land, and several small parcels in the village of Waipahu" (ibid.).

The Waipahu sugar mill in Waikele Ahupuaʻa, was located south of the Mililani Tech Park location, near the highway, as seen in a 1954 USGS map, a portion of which is reproduced as Figure 24 below. In addition, sections of the OR&L. tracks are visible along the coast of Pearl Harbor as well as a portion of the plantation railroad system (see Figure 24), which in 1928 consisted of "56 miles of main line track. . . with eight locomotives and 860 cane cars" (Greene 1928:9). The OSC mill yard with rice fields beyond are depicted in a historic photograph in Figure 25. OSC harvested its first crop in 1899 and by 1928 the Waipahu mill had "a normal daily capacity of 3,200 tons of cane producing about 425 tons of sugar" (ibid.:23). In 1928, OSC broke a world record for their average output of 12.02 tons of sugar per acre largely due to the twelve-roller mill, the first of its kind, which had been installed in 1907 (Saito 1984).

According to Yardley, "no other deal which B. F. Dillingham ever put together did so much to enhance his prosperity and prestige and that of the railroad as did the formation of the Oahu Sugar Company" (1981:191). The early success of OSC was directly tied to that of the OR&L in a mutually beneficial relationship. However, the price of sugar plummeted in the early 1900s, which affected commercial sugar production across the Hawaiian Islands. In early 1904, in order to rescue the industry from collapse Dillingham and his son Walter organized the Sugar Factors Company (predecessor of C&H), a cooperative jointly owned by the plantations, which shipped raw sugar to a refinery in Crockett, California. Yardley suggests, "it is doubtful that the industry could have survived for the next seventy years without this established outlet for its product" (ibid.:257). OSC continued to produce high yields for over sixty years.

Another key development that contributed to the longevity of OSC was the construction of a water tunnel to transport water from the windward side of Oʻahu, through the Koʻolau Mountains to irrigate the arid ʻEwa plains (Chong 1998). This massive feat of engineering took three years to complete (from 1913 to 1916). All 12,000 acres were dependent on irrigation for successful cultivation. The average daily amount of pumped water delivered to the fields was 11,000,000 gallons (Greene 1928:9). Greene makes the following observation regarding the scale of the irrigation entailed, "more water is pumped daily, on an average by the Oahu Sugar Company, Limited, than by many of the larger cities in the United States" (ibid.:9). In addition to the pumped water, 32,000,000 gallons of water from surface intakes and collection tunnels were also utilized daily depending on seasonal variations (ibid.).

The aforementioned Chinese community of Waipahu provided much of the workforce for the thriving OSC plantation. In addition to providing labor to the plantation, the Chinese also provided for the needs of the plantation, "supplying rice, fresh fruits, vegetables, poultry, pork, and fish" (Chong 1998:xiv). Additional laborers came from all over the world to work in the fields and the mill, primarily from the Philippines, Japan, Portugal, and Norway (Saito 1984). By 1920, as a result of the booming sugar industry, Waipahu had become the second largest city in Oʻahu with a population of roughly 4,000 (Yamamoto et al. 2005:50). Regarding daily life on the plantation, the Hawaiian Sugar Planter's Association recounts the following details:

> Each employee received a house free of charge, complete with firewood, fuel, and water for domestic purposes. By the 1930s, garbage collection, street cleaning and sewage disposal were provided. . . OSC provided clubhouses, athletic field, and playgrounds. . . The Company donated labor and materials to local schools. A hospital was built in 1920. . . By 1925, the population of the plantation ranged between 9,500-10,000 people. There were approximately 2,850 names on the payroll and it was estimated that at least ¾ of the residents of Waipahu earned a living in connection with the production of sugar. (Saito 1984:2-3)

Figure 24. 1954 USGS 7.5-Minute series Waipahu Quadrangle showing relevant landmarks from discussion.

Figure 25. OSC mill yard, dispensary, and plantation store with rice fields in background (Bishop Museum Photo from Chong 1998:34).

In 1928, Greene summarized the then success of OSC and what he saw as the plantation's contributions to O'ahu and the Hawaiian Islands as a whole thusly:

> In the thirty-one years of its corporate existence it has transformed an arid cattle range into highly productive farming property. It has drilled artesian wells into the earth, and has pierced a mountain range with tunnels in order to develop an adequate and reliable supply of water for irrigation.
>
> It has not exploited natural resources, but has conserved and developed them. This is demonstrated by the fact that the crops yielded by the land today, after thirty-one years of continuous one-crop agriculture, are considerably larger than they were when cultivation was commenced on virgin soil. The sources of its water supply have not been depleted.
>
> It provides year-round employment at good wages to a large number of men.
>
> Through taxes paid to the territorial and Federal Governments, it bears its full share of the public expense. (Greene 1928:27)

The Pineapple Industry in Waikele Ahupua'a

According to a University of Hawaii research publication titled *Land Utilization in the Hawaiian Islands*), eighty to eighty-five percent of the world's pineapple production originated in Hawaii (Coulter 1933:88); "Hawaii is the pineapple's paradise, for here it thrives best and attains that sweetness and lusciousness of flavor not present in the pineapples grown in other lands" (ibid.). The first pineapple venture was initiated by Americans, Kidwell and Emmeleuth, on 140 acres of leased land near Pearl Harbor during the 1880s (Taylor et al. 1976:163). By 1892, Kidwell had 100,000 plants and organized the Hawaiian Fruit and Packing Company; however, the neighboring Ewa sugar plantation's management persuaded Kidwell to switch to sugar cane—a venture that failed and allowed for Ewa plantation to take back the land (ibid.).

A man by the name of Byron O. Clark found some discarded pineapple plants near Kidwell's abandoned farm and took them home to Wahiawa, where he planted them in rows (ibid.). Thus, Clark proved that pineapple is a rather hardy and adaptable fruit, "raised at sea level, at an altitude of 3,000 feet, in soils with much potash, in soils with little potash, in semi-arid areas without irrigation, and in areas having a rainfall of 60 inches" (Coulter 1933:89). Most pineapple cultivation on O‘ahu was located at elevations between 500 and 1,000 feet above sea level (ibid.). In 1899, James Drummond Dole, a distant cousin of Sanford Dole, acquired a 60-acre homestead in Wahiawa (Taylor 1976). In 1901, Dole organized the Hawaiian Pineapple Company dedicated to the production and canning of the fruit for export (Coulter 1933). Dole built his first cannery was in 1903 in Wahiawa but “when Dillingham laid rails between Wahiawa and Honolulu in 1907, Dole moved his cannery to the city, where labor and water were plentiful” (Taylor 1976:164). The new cannery located in Iwilei was also closer to shipping routes and the harbor. During these early years of the industry, pineapple planters often doubled their output from the year before (Coulter 1933). The 1906 Report of the Governor of Hawaii states,

> recently a branch of the Oahu Railway, 9 miles in length, has been extended up the bed of a gulch, over the plains, to Wahiawa for the benefit of the pineapple industry. The largest single area devoted to theis fruit in the Territory is found at that place. . . . Organizing as companies under the general incorporation act they established factories for preserving the fruit, one of which has been removed to spacious premises at the Honolulu Railway terminus, where a factory has also been erected for making the cans. (Governor 1906:66)

Additionally, according to Coulter, around 1910:

> There was no lack of land apparently suitable for raising the fruit. Scarcely any competition for the same land existed between pineapple planters and sugar cane planters. Some areas newly devoted to pineapples were hitherto used for raising cattle; others were formerly used for sisal. Thousands of acres of pasture were still available for the more profitable use of pineapple culture. (Coulter 1933:92)

The development of the Ginaca machine in 1911 revolutionized pineapple canning. This machine “could size, peel, core, and cut the ends from the fruit and deliver perfect hollowed cylinders to the packing table at speeds of 80 to 100 pineapples per minute” (Taylor 1976 :164). Thanks to an aggressive advertising campaign that extolled the virtues of the island fruit in cans, the North American and European demand for canned pineapple drove the industry forward. In addition to the large-scale commercial producers, small-scale farmers also grew pineapples and sold them to the canneries. Plantation workers usually harvested pineapples from June to September, a period which coincided with the off-season for sugar cultivation. Thus, plantation laborers often would migrate from one crop to the other and one plantation to the other, depending on the season. Filipino men made up most of the pineapple labor force in the fields, while women, boys, and girls worked the canneries. On some plantations, harvesting activities were carried out around the clock with laborers working through the night.

Even with some setbacks, such as over-productive years in which the industry suffered a loss because the market could not keep up, the pineapple industry continued to expand until the 1930s. By 1928, there were thirteen pineapple companies and eleven canneries across the islands, all of whom were competing for dominance of the seller’s market. When the depression struck the mainland, housewives stopped buying canned pineapple, which left Dole with a surplus in the fields and the canneries along with mounting debts (Taylor 1976). In response, Hawaiian Pineapple was reorganized and Castle & Cooke took over the management of the company in 1932; by the late 1930s, Hawaiian Pineapple was back on track and turning a hefty profit (ibid.). The depression also spurred change throughout the pineapple industry; in 1932, seven companies “entered into an agreement to limit production to the needs of the market, sell the combined pack through a marketing committee, and pool their advertising” (Coulter 1933:98).

A comparison of the land utilization maps of 1906 and 1930 (Figure 26) reveals the striking contrast in the amount of land used for pineapple cultivation, which is significantly greater in 1930. Much of the pineapple lands were former pasture/grazing lands. The largest pineapple farming area was located in Wahiawa. In 1930, of all the islands, Oahu had the largest percentage of land area in cultivation 21.63 percent (ibid.:47); of which, 42.45 percent was dedicated to pineapple while 51.86 percent was planted in sugar cane and 5.69 in other crops (ibid.:53).

Coulter goes on to describe some of the land areas set aside for pineapple cultivation that “were not equally suited to raising that crop” as follows:

> On the island of Oahu some of them were in scattered locations on the leeward side of the rain forest, difficult of access, where the soil was thin and pests numerous and active. They could only by a stretch of the imagination be classed as arable land. Nearly all such land has now been abandoned. Some of it will probably remain waste land. Part of it may be afforested. (1933:98)

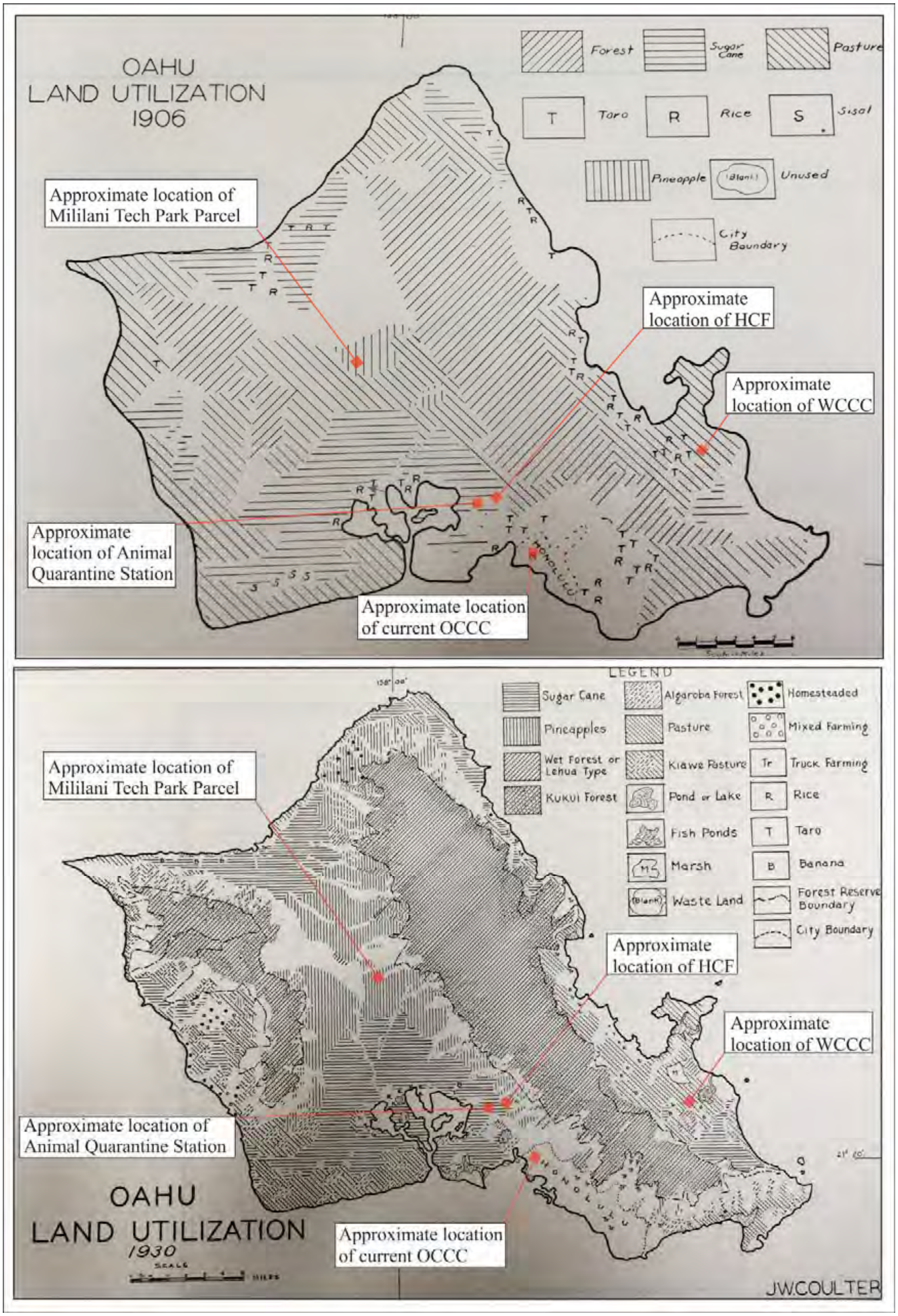


Figure 26. Land utilization on O‘ahu in 1906 (top) and 1930 (bottom) relative to subject areas (Coulter 1933:36-37)

In the early 20th century, in addition to the development of sugar and pineapple plantations in ʻEwa, the U.S. government purchased coastal lands surrounding Pearl Harbor to develop a naval base. Among other lands, the government appropriated the Waipiʻo Peninsula from the ʻĪʻī Estate and the military extended their land holdings *mauka* of the peninsula in the 1930s, including portions of the Kīpapa Gulch (Perzinski et al. 2004). During the lead up to World War II, plantation workers began finding better paying jobs in defense which spurred a shift to mechanization for harvesting in both the sugar and pineapple industries (Taylor 1976). After a series of controversial decisions, Dole was forced to retire and Castle & Cooke management took his place. One such individual was Henry White, a Honolulu born self- made businessman, who helped Hawaiian Pineapple through the challenges of World War II and increased sales (ibid.). In 1950, White arranged the purchase of the ʻĪʻī Estate, which added roughly 15,000 acres of arable land to Hawaiian Pineapple's land in Wahiawa. Regarding the former sugar plantations, the OSC lands were undisturbed during World War II; however, the military utilized the existing plantation rail system leading to the sugar fields to haul ammunition to and from Pearl Harbor (Hammatt et al. 2004).

By the 1950s, Hawaiian Pineapple had changed its name to Dole and had merged with Bumble Bee, formerly Columbia River Packers (CRP), into Castle & Cooke, which turned the Hawaiian business into "an important segment of the American food industry, in addition to its interests in shipping, stevedoring, and merchandising" (Taylor et al. 1976:237). The formation of the subsidiary Oceanic Properties soon followed, which would have a lasting impact on the vicinity of the Mililani Tech Park location and Oʻahu. Oceanic Properties managed and developed Castle & Cooke's 155,000 acres of land across the Hawaiian Islands. On Oʻahu, Castle & Cooke had land holdings that consisted of "42,000 acres (almost half in sugar and pineapple), plus property in the business, industrial, and waterfront sections of Honolulu" (ibid.). In 1961. Oceanic took over the planning of their first major project, "a large new satellite city called Mililani Town, ultimately expected to cover 3,500 acres of former Dole pineapple land above Pearl Harbor" (ibid.:238). According to Taylor, "it was to prove Oceanic's most successful project because it satisfied Oʻahu's great pent-up demand for housing by creating a sensitively designed, affordable new community of a type unique in Hawaii" (ibid.). The progression of development in the vicinity of the Mililani Tech Park property is noticeable in a comparison of two aerial photographs taken as part of the United States Government Survey in 1962 and 1977 with a recent satellite image captured in 2001 (Figure 27). The Mililani Tech Park and much of the surrounding land was still planted in pineapple in the early photographs; while the 2001 image shows marked urbanization and development.

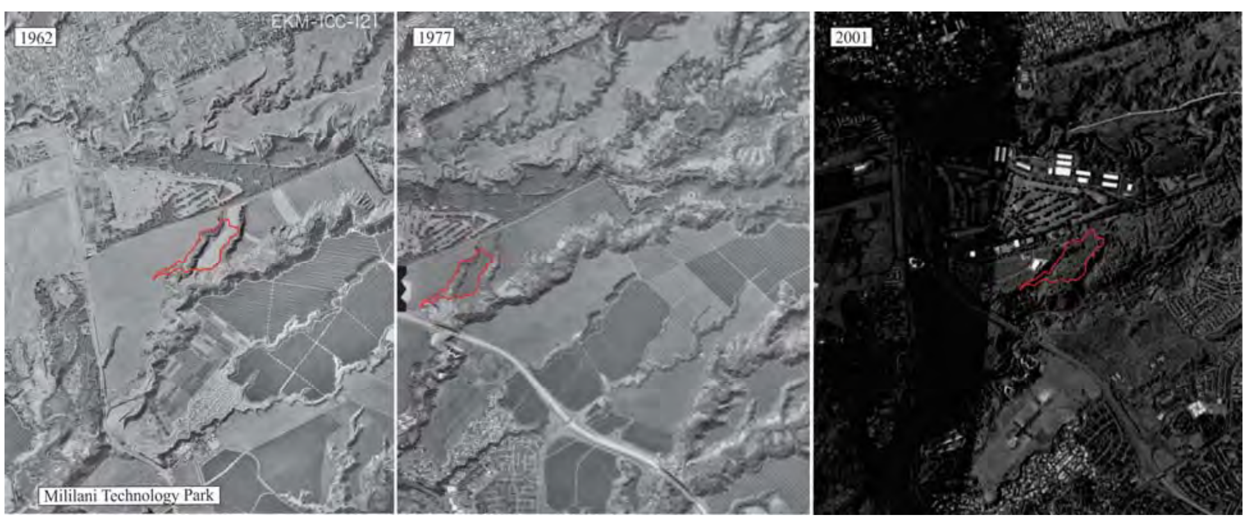


Figure 27. USGS aerial images (1962 and 1977) and Google Earth™ satelite image (2001) with Mililani Tech Park location outlined in red.

Hālawa Ahupuaʻa WWII to the Present

With the advent of WWII, the area in the vicinity of the present-day Animal Quarantine Station experienced some unexpected land use alterations. As a result of the December 7, 1941 attack on Pearl Harbor, more than 2,400 service members and civilians were killed. As this was an overwhelming number of dead to lay to rest in existing cemeteries, by December 9, 1941, as instructed by the Commandant of the 14th Naval District, a new location for a naval cemetery was selected in Hālawa (Honolulu Star Advertiser 2014). "Navy burial records obtained by Pearl Harbor survivor Ray Emory show that there were more than 115 burials at Halawa on December 9, 1941, alone" (ibid.). Burial continued at the Hālawa cemetery into early 1947, at which time about 1,500 graves were present, some of which contained multiple sets of remains. "Between August and September 1947, the U.S. military exhumed . . . 1,516 [graves] at Halawa, according to a 1957 government report" (ibid.). As the use of this cemetery was short-lived, its location was soon forgotten. As documented in a May 25, 2014 article in the Honolulu-Star Advertiser (Honolulu Star Advertiser 2014), the existence of this cemetery may have gone unrecognized if not for research conducted by Pearl Harbor survivor Ray Emory. Emory also set out to identify the location of this former cemetery, and he concluded that it was located in an area currently occupied by a Hawaiʻi Department of Transportation (HDOT) field office (Figure 28). This area is located to the west of the Animal Quarantine Station near the confluence of the Moanalua Freeway and the H3 Freeway. In an effort to corroborate Emory's location analysis, a review of historical photographs of the cemetery (i.e., Figure 29) and 1950s aerial imagery (Figure 30), and a field inspection were conducted. As seen in Figure 28, the cemetery was located near a three-way intersection on a flat landform below North Hālawa Stream, with a bridge clearly visible crossing the stream. This intersection was identified on Figure 29 as was the apparent flat landform that the cemetery had occupied. During our recent field inspection, we identified the old (1937) bridge (Figure 31 and 32). Combining all of this information we were able to generate an overlay projection (Figure 33) potentially identifying the location of the former Hālawa Naval Cemetery. This location is in the same general vicinity as surmised by Ray Emory, but situated a little to the south and east of the current HDOT field office, and to the west of the Animal Quarantine Station in an area significantly impacted by the construction of the H3 Freeway.

The 1952 aerial imagery (see Figure 30) indicates that the land where the Animal Quarantine Station is currently located, had been the site of several large buildings, perhaps associated with the extensive quarrying operation that continues today on the opposite site of Hālawa Valley Road. According to a recent architectural study (Louis Berger 2017), the Animal Quarantine Station was built by 1969, more or less conforming to construction plans prepared in 1967 and 1968, with several renovations and additions occurring through 2005. The current administrative and primary kennel facilities are not the 1969 facilities, but rather were built in the 1990s.

The 1952 aerial imagery (see Figure 30) as well as Figures 26 and 27 above show that the current location of the HCF was in intensive sugarcane cultivation prior to the construction of the first building in 1962 associated with the Special Needs facility. HCF is comprised of two units, the Special Needs facility and the Medium Security facility (Figure 34). The Special Needs facility was constructed in 1962 and currently houses primarily maximum and closed custody inmates as well as inmates with mental health issues who require protective custody. In a 2003 Corrections Master Plan, it was noted that the Special Need facilty "should be demolished once the inmates are temporarily or permanently relocated and the site should be reused for new correctional capacity if possible" (Carter Goble Associates, Inc. 2003:3-13). Prior to 1975, HCF was known as the Halawa Jail and housed primarily pre-trial detainees. On June 20, 1975, Halawa Jail was turned over to the State and converted into a maximum-security prison. Although the prison was intended to function as a maximum-security prison, it was not officially converted until June 1981, when HCF transferred forty-six pre-trial inmates to OCCC in exchange for three maximum security inmates (Claveria 1982). The Medium Security facility was constructed in 1987 and houses medium security male felons. Prison overcrowding at HCF has led to the transfer of approximately 1,400 male inmates to prison facilities located in Arizona.

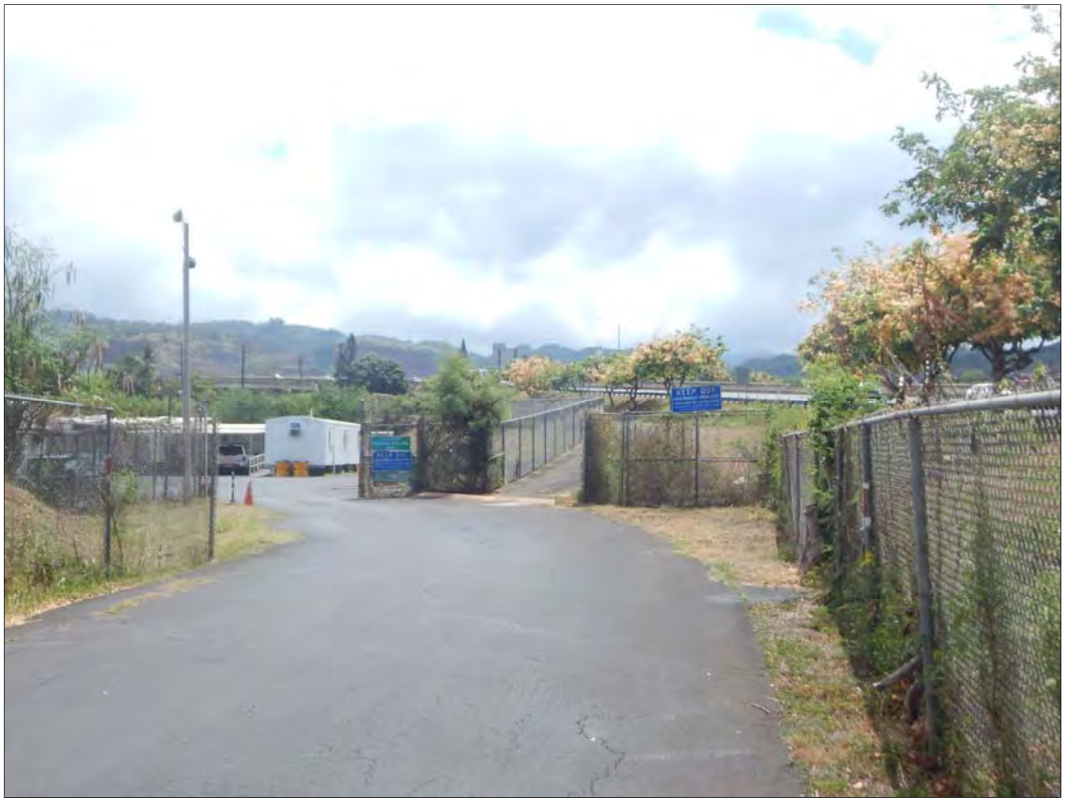


Figure 28. Entrance to HDOT field office near the confluence of the Moanalua Freeway and the H3 Freeway.

Figure 29. Hālawa Naval Cemetery circa 1945.

Figure 30. 1952 aerial image with then former Hālawa Naval Cemetery location projected in red.

Figure 31. Bridge crossing north branch of Hālawa Stream.

Figure 32. Date cast in Hālawa Stream bridge.

Figure 33. Overlay projection of former cemetery location (outlined in red) onto recent aerial image.

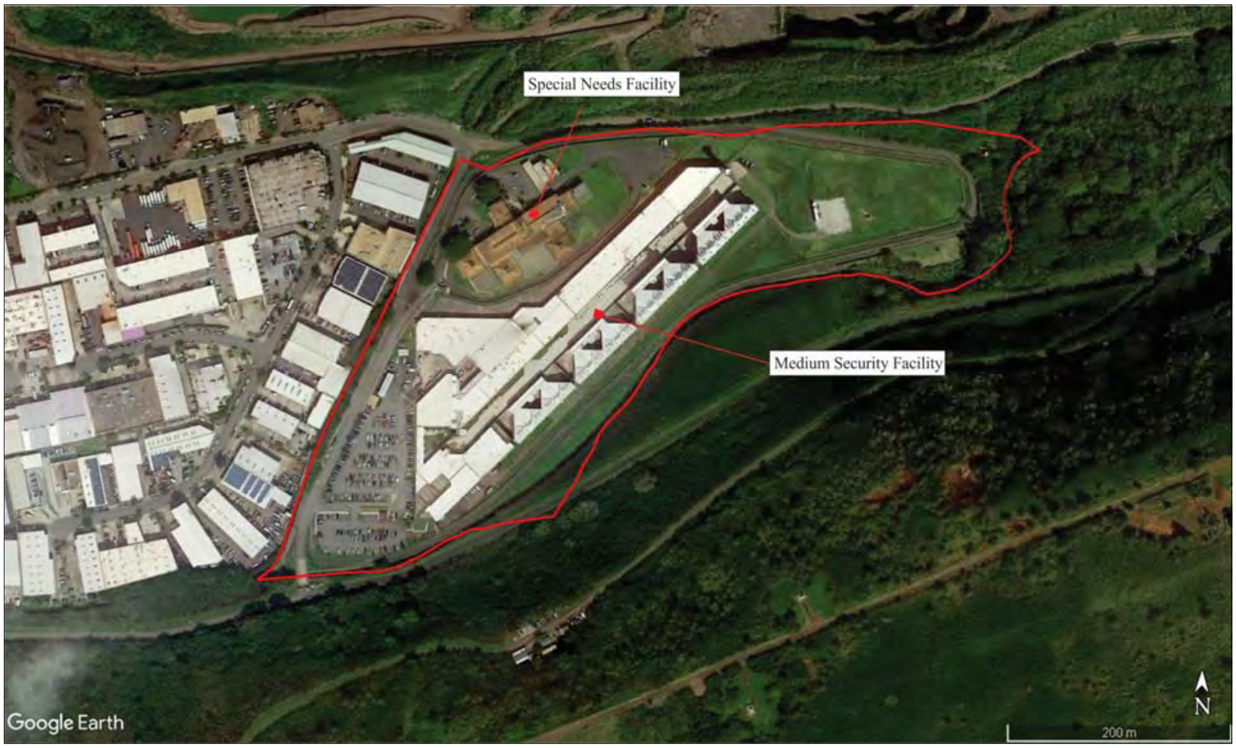


Figure 34. 2013 Google Earth™ image of HCF.

Kona District (Current OCCC Location)

As previously mentioned, the current OCCC facility located in Kalihi Ahupuaʻa, Kona District, is a candidate location for the proposed replacement project. Handy et al. described the ancient Kona Coast of Oʻahu thusly,

> This area is subject to the cyclonic southerly (kona) storms in winter months, but through most of the year is cooled by trade winds sweeping through low gaps in the Koʻolau range at the top of Moanalua, Kalihi, Nuʻuanu and Manoa Valleys. There were abundant rain, ever flowing streams, springs, pools, verdant interior valleys, broad slopes and well-watered low-lands, fishpond areas, harbors, beaches, and lagoons. Altogether Kona was, for Oahu, the area richest in natural resources and most pleasant for abundant and comfortable living. (1972:473-474)

Legendary Accounts of Kona

Kona and Kalihi are also briefly mentioned in the legendary account "History of Kualii" (Fornander 1916-1917:364-434) presented above. According to Fornander, prior to Kākuhihewa's time (ca. AD 1650), Oʻahu was ruled by four kings; Lonohulimoku was king of Koʻolaupoko, Lonokukaelekoa was king of ʻEwa and Waiʻanae. Lonohulilani ruled over Koolauloa and Waialea, and Lonoikaika over Kona. At this time, Kūaliʻi, resided in the Kona District but had become unsatisfied with Lonoikaika. He rebelled and overstepped himself when he dedicated the temple known as Kawaluna located above Waolani (Figure 35), an action that angered Lonoikaika. As a result, Lonoikaika gathered his warriors and surrounded the young chief. As told by Fornander,

> When he looked down the bottom of Waolani, one wing of the army was climbing Puuiwa; the army from Koolau was coming down Kaniakapupu, while one of the wings of the army from Koolau was already on the Kalihi cliffs, and still another wing from Kona was coming. . . (ibid.:410)

Legendary Accounts of Kalihi Ahupuaʻa

Most legendary references to Kalihi Ahupuaʻa focus on Kalihi Valley and the *mauka* reaches of the land division. Although the current location of the OCCC facility lies within the *makai* reaches of Kalihi, a selection of legends featuring Kalihi Valley are presented below.

As previously mentioned, Kalihi Valley is featured in the legend titled "Kahalaopuna Princess of Manoa" recorded by E. Nakuina and compiled and published in *Hawaiian Folktales* by Thrum (1907:118-132). Kahalaopuna was brought up in seclusion, but two disfigured men who lived in the nearby mountains fell in love with her sight unseen. Their obsession based solely upon the various *mele* sung about her unsurpassed beauty. They knew they would never win her love in real-life; thus, they spread rumors far and wide of their respective conquests of the fair maiden. Word reached her betrothed Kauhi, who believed their lies and felt that the only way to get over the betrayal was to kill her.

He travelled from Kailua to Mānoa Valley and brought her back with him through the forest trails, where he struck her with the branch of a *hala* tree and killed her. He hastily buried her where she fell; but shortly thereafter, an owl god dug up her body and restored her to life. After being resurrected, Kahalaopuna found Kauhi again, and he made her follow him deeper into the mountains where he killed her a second time and buried her again where she fell. Once again, the owl revived her and Kauhi killed and buried her a third time; and the owl revived her yet again. Then, upon hearing her voice pleading to him to spare her a fourth time, "his only thought was to kill her for good, and thus obtain some satisfaction for his wasted poi and fish" (ibid.:125). The legend continues, "He returned to her and ordered her, as before, to follow him, and started for Kilohana, at the head of Kalihi Valley (see Figure 35), where he again killed her" (ibid.). The owl revived her one last time and in his rage, Kauhi led Kahalaopuna still further away and killed her again, but this time buried her under a large tree. The roots of the tree kept the owl from reaching, her but her spirit revealed itself to a young man who, with the help of his sisters, resurrected her. The legend ends with the punishment of the two disfigured men who started the vicious rumor and Kauhi who were all burned in an *imu*. In addition, Kahalaopuna finds love in her union with the young man who saved her and avenged her suffering. However, their happiness lasted only two years; for Kauhi had turned into a shark upon his death and when Kahalaopuna decided to go surfing one day, Kauhi finally took his revenge and ate her body so that she would never be resurrected again.

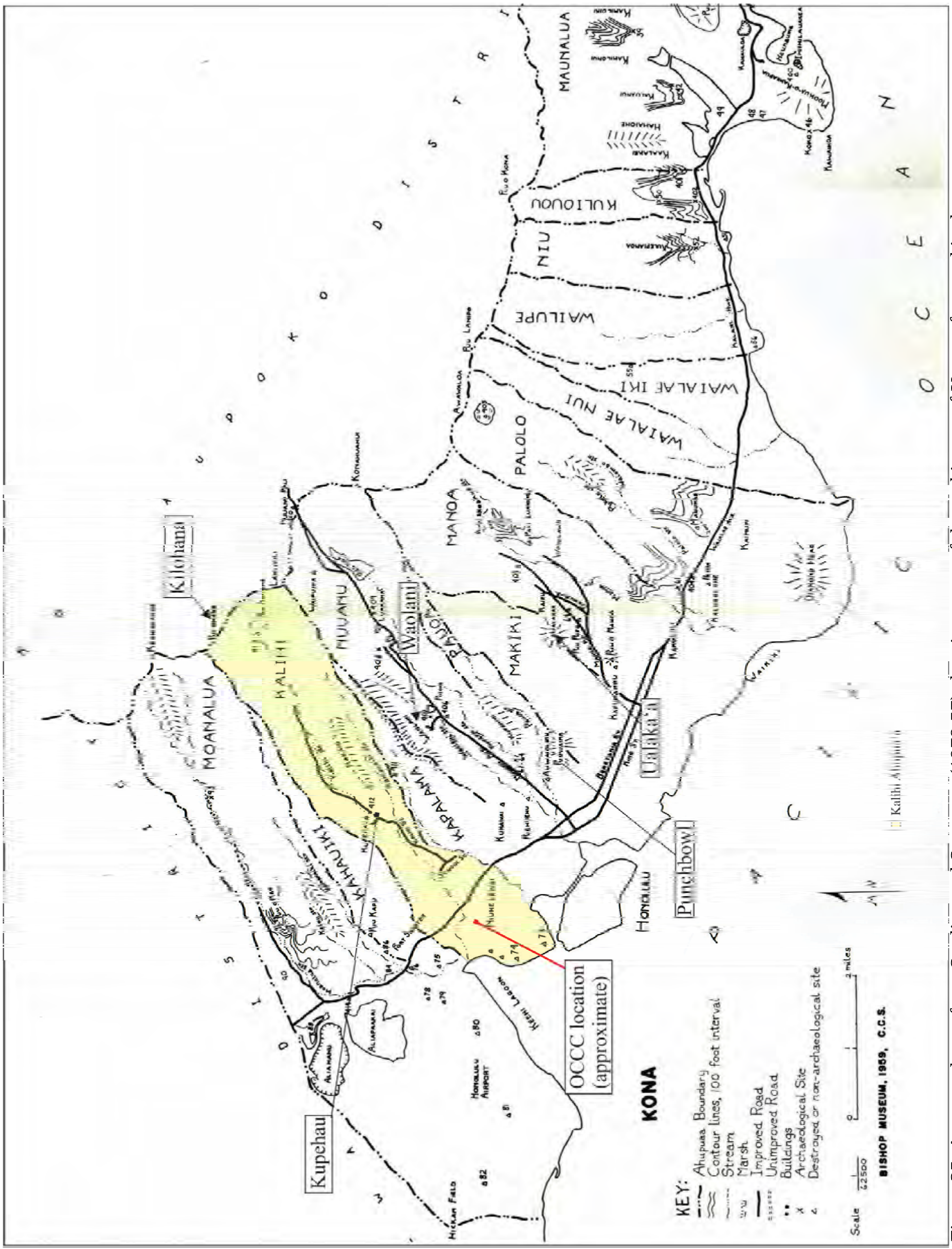


Figure 35. Annotated map from Sterling and Summers (1978:57) showing some of the *wahi pana* of Kona referenced in the text.

In her collection titled *Hawaiian Mythology*, Beckwith (1970) cites Westervelt and Poepoe's version of the myth surrounding Pele's sister, and daughter of Papa (or Haumea) and Wakea, Kapo-ula-kinaʻu (Kapo). Both myths state that Kapo was born in Kalihi Valley. From Westervelt's version, Beckwith reports: "some say that she was born from the eyes of Papa. She is of high rank and able to assume many shapes at will" (ibid.:186). While Poepoe's version relates how a strict *kapu* imposed by the gods forbade the birds to sing about Kapo's home in Kalihi Valley, and continues as follows:

> There at noon when the sun is shining brightly she may be seen on the hillside beyond the upland of Kilohana where stands her tapu stone into which she entered, shaped like a house in front, like a fish's tail behind. (ibid.)

Another reference to Kalihi is made regarding Kapo's supernatural ability to separate her vagina (*kohe*) from her body, which inspired her alternate name Kapo-kohe-lele (Kapo with the traveling vagina). The legend that features Kapo-kohe-lele begins when Kamapuaʻa attacks Pele near Kalapana, at which time Kapo sent her *kohe* as a lure, and Kamapuaʻa followed it all the way to Koko Head, Oʻahu. There, "it rested upon the hill, leaving an impression to this day on the Makapuʻu side" shortly afterwards, "she withdrew it and hid it in Kalihi" (ibid.:187).

According to Beckwith, Kapo's mother Papa is identified with Haumea, when she is in spirit form; while in human form, as Papa, she resides with Wakea, as his wife. Beckwith continues:

> In her spirit body as Haumea she returns to the divine land of the gods in Nuʻumealani and changes her form from age to youth and returns to marry with her children and grandchildren. Some place these transformations on Oahu at the heiau of Ka-ieie (The pandanus vine) built for her worship in Kalihi valley. (ibid.:278)

Beckwith then cites Kamakau who lists the different names of her divine and bodily forms as follows:

> Papa-hanau-moku (Papa giving birth to islands); Haumea-ka-hanau-wawa (Haumea giving birth noisily); Ka-haka-au-koko (The place of blood); Hai-uli, because of her visits to the "blue sea" of Kahiki (on Oahu); Lau-mihi, from her gathering crabs (ku-mihi) and seaweed (lau) there; Kamehaikana, from her entering a growing tree—the last three names referring to the time when she lived as a woman in Kalihi valley. (ibid.::279)

Another legend about Haumea explains the origin of her alternate name Kamehaikana, and mentions Kilohana and Kalihi Valley as recorded by Westervelt and retold by Beckwith:

> Papa and Wakea sail from Kahiki to Oahu and make their home up Kalihi valley near the cliff Kilohana. Lelehoʻomao is the ruling chief of that section. He finds trespassing going on and his men snatch and bind Wakea while his wife is away at the sea, and carry him down to sacrifice him at the heiau of Pakaka. Papa rescues him by entering the tree with him, and as they flee up Kalihi she leaves behind fragments of her skirt, from which spring the wild blue morning-glory vines of that region. All attempts to cut down the tree fail until the men have rubbed their bodies with coconut oil. They then carve from it the goddess Kamehaikana and it is worshipped on Oahu until taken to Maui, where it becomes a god of Kamehameha. It is known as a god to win land and power and to preserve the government. (Beckwith 1970:282)

An alternate version of the legend recorded by Westervelt attributes the growth of the wild *akala* (Hawaiian raspberry) in Kalihi Valley to the fragments torn from Haumea's *pāʻū* or skirt (ibid.).

Additional legends are associated with rock formations located within Kalihi. McAllister reported in his monograph *Archaeology of Oahu* that two pointed stones that stood roughly 4 feet high located the head of Kalihi Valley, about a mile past the end of the road were known as Hapuu and Kalaihauola (1933:89). According to McAllister, a legend about the breadfruit tree in Honolulu mentions the peak on the northeastern side of Kalihi Valley called Kilohana, the home dark with mist, of Wakea and Papa" (ibid.:90). In addition, Kilohana appears in another legend about two stones recorded by Poepoe and reproduced by McAllister. Poepoe provided the following description of the stones:

> Those stones are Hapuu and Kalaihauola, and the place is called (to this day) by the name of Hapuu. These two were said to belong to the mysterious little people of Nuuanu valley who wandered to that place because of the war going on in Nuuanu when some fled. These two came to live in the uplands of Kalihi, where are the others! Strangers who visit the vallley should pull leaves, braid them into a wreath and lay the wreath on the stones in order to meet with no such difficulty as mists and cold or the loss of their road on the way to Kilohana and back. Should the michievous little

> people see that there are no wreaths on the stones when visitors are in the way to Kilohana, they will break a branch of the flowering mountain apple or the leaf of a treefern, dip it in water and sprinkle the two stones. Soon after, the summit of Kapo will cover with mist and a drenching rain cause the stranger to shiver with cold. Sometimes the little people will throw away the wreaths and do the same. (ibid.:89)

The existence of another landform located in the Kalihi Valley recorded by Poepoe and reproduced in Mcallister's monograph

> Ka-elemu-wai-o-Kalihi or, as it was formerly termed, "Puka-kukae-wai-o-Kalihi." When almost out of the hill valley of Kalihi, close to Joe Kalama's place, on the mauka side is the spot called "The anus of Kalihi," "Ka-elemu-wai-o-Kalihi." The exact place is in a solidly planted rock in the middle of the stream in the center of which when the flow is low one can see a little hole shaped like an anus out of which the water flows and runs down below. The rock about the hole is shaped like the buttocks.
>
> On the Ewa side of the stream the home site is still to be seen at a place called Kupehau (see Figure 35) where the chiefs of Hawaii resorted because of the delicious poi and tender taro tops to be had there. Kamehameha the First was one of the chiefs who visited the spot. After his battles on Oahu he went to rest at Kupehau and one day the chief came down to the stream to bathe when the water was low. Kamehameha stuck his finger into the hole and said, "Kahana! The water of Kalihi comes from an anus!" and from that day the name stuck to the place. (Poepoe in McAllister 1933:89-90)
>
> The Rain of Kalihi that sharpens the Head. In the old days there were a man and a certain woman who loved unlawfully. They stole each other and ran away without the knowledge of the girl's parents to hide in the forest where they could indulge in their passion. There a little patter of rain fell upon them, but they paid no attention to it. After a time one went to see if the rain had cleared, but it had not and they fell asleep again. After some hours they awoke, found the rain still falling, and slept again. For some days and nights the rain fell and the two kept on sleeping so long while the rain fell day and night. Hence that rain at Kalihi is called "the rain that sharpens the head at Kalihi," "Ka ua Poolipili-o-Kalihi." (ibid.:90)

Another legend refers to Ka-puka-Wai-o-Kalihi and the journey of the gods Kāne and Kanaloa:

> They journeyed along the coast of the island of Oahu until they came to kalihi, one of the present suburbs of the city of Honolulu. For a long time they had been looking up the hillsides and along the water courses for awa—but had not found what seemed desirable.
>
> At kalihi a number of fine awa roots were growing. They pulled up the roots and prepared them for chewing. When the awa was ready Kanaloa looked for fresh water, but could not find any. So he said to ka-ne: "Our awa is good, but there is no water in this place. Where can we find water for this awa?"
>
> Ka-ne said, "there is indeed water here." He had a "large and strong staff," in some of the legends called a spear. This he took in his hands and stepped out on the bed of lava which now underlies the soil of that region. He began to strike the earth. Deep went the point of his staff into the rock, smashing and splintering it and breaking open a hole out of which water leaped for them to mix with their prepared awa. This pool of freshwater has been known since the days of old as Ka-puka-Wai-o-Kalihi (the water door of Kalihi). (Westervelt 1915:34-35)

Early Historic Accounts of Kalihi Ahupuaʻa and Greater Kona District

Hawaiian Historian Samuel Kamakau mentions in *Ruling Chiefs of Hawaii* that Kamehameha I "cultivated land at Waikiki, Honolulu, and Kapalama" (1992:190), prior to conquering Kauaʻi and uniting all the islands under his rule. Similarly, Hawaiian historian John Papa ʻĪʻī, reports in *Fragments of Hawaiian History* that Kamehameha personally farmed with members of his court throughout the Kona District, "especially in Nuuanu. . . He also farmed at Ualakaʻa in Manoa, in Waikiki, and in Kapalama" (1959:68; see Figure 35). ʻĪʻī relates that "[t]hey found innumerable people all over the farming area" (ibid.).

Following the death of Kamehameha I in 1819, the Hawaiian religious and political systems began a radical transformation; Kaʻahumanu proclaimed herself "*Kuhina nui*" (Prime Minister), and within six months the ancient *kapu* system was overthrown. Within a year, Protestant missionaries arrived from America (Fornander 1969; ʻĪʻī 1959; Kamakau 1992). In 1820, American missionary Hiram Bingham and members of the American Board of

Commissioners for Foreign Missions (ABCFM) toured the island of Oʻahu seeking out communities in which to establish church centers for the growing Calvinist mission. Bingham recorded observations made during his twenty-one-year residence in the Hawaiian Islands in a journal (Bingham 1848), which offers a rare glimpse at the project area vicinity during the early 1800s. Bingham made the following observations when he first glimpsed Oʻahu upon his arrival in 1820, which are applicable to the general cultural landscape of Kalihi Ahupuaʻa and the greater Kona District:

> Early in the morning of the 14th April, that island rose to our view, and, as we approached rapidly, presented successively its pointed mountains, covered with trees and shrubbery, its well-marked, extinguished craters near its shores, its grass covered hills, and more fertile valleys, its dingy thatched villages, its cocoanut groves, its fort and harbor, and its swarthy inhabitants in throngs. . . We cast anchor in the roadstead abreast of Honolulu village, on the south side of the island, about 17 miles from the eastern extremity. (ibid.:92)

Shortly after their arrival, they scaled Punchbowl Hill or Pūʻowaina (see Figure 35) and reported the following details from the view:

> From the highest part of the rim we had a beautiful view of the village and valley of Honolulu, the harbor and ocean, and of the principal mountains of the island. On the east were the plain and groves of Waikiki, with its amphitheatre of hills. . . Below us, on the south and west, spread the plain of Honolulu, having its fish-ponds and salt making pools along the sea-shore, the village and for between us and the harbor, and the valley stretching a few miles north into the interior, which presented its scattered habitations and numerous beds of *kalo* (arum esculentum) in tis various stages of growth, with its large green leaves, beautifully embossed on the silvery water, in which it flourishes. Through this valley, several streams descending from the mountains in the interior, wind their way, some six or seven miles, watering and overflowing by means of numerous artificial canals, the bottoms of kalo patches, and then, by one mouth, fall into the peaceful harbor. (ibid.:93)

Another Missionary, William Ellis also visited the islands and documented his experience; including the following excerpt regarding the geology of Honolulu:

> The plain of Honoruru exhibits in a singular manner the extent and effects of volcanic agency; it is not less than nine or ten miles in length, and, in some parts, two miles from the sea to the foot of the mountains; the whole plain is covered with a rich alluvial soil, frequently two or three feet deep; beneath this, a layer of fine volcanic ash and cinders extends to the depth of fourteen or sixteen feet; these ashes lie upon a stratum of solid rock by no means volcanic, but evidently calcareous, and apparently a kind of sediment deposited by the sea, in which branches of white coral, bones of fish and animals, and several varieties of marine shells, are often found. A number of wells have been recently dug in different parts of the plain, in which, after penetrating through the calcareous rock, sometimes twelve or thirteen feet, good clear water has been always found: the water in all these wells is perfectly free from any salt or brackish taste, though it invariably rises and falls with the tide, which would lead to the supposition that it is connected with the waters of the adjacent ocean, from which the wells are from 100 yards to three quarters of a mile distant. The rock is always hard and compact near the surface, but becomes soft and porous as the depth increases. . . (1917:24)

Ellis made the following observation about the city of Honolulu in 1823:

> The harbor is the best, and indeed the only secure one at all seasons, in the Sandwich Islands, and is more frequented by foreign vessels than any other; seldom having within it less than three or four, and sometimes upward of thirty, lying at anchor at the same time.
>
> The town has also, since the number of shipping has increased, become populous, and is one of the largest in the islands, usually containing 6000 or 7000 inhabitants. It is the frequent residence of the king and principal chiefs, who are much engaged in traffic with foreigners visiting the islands, or residing on shore, for purposes of trade.
>
> There are twelve or fourteen merchants, principally Americans, who have established warehouses on shore for foreign goods, principally piece goods, hardware, crockery, hats and shoes, naval stores, &c., which they retail to the natives for Spanish dollars or sandal wood. (ibid.:27-78)

In 1859, "for taxation, educational and juridical purposes," Kona District was officially renamed and defined as the lands "from Maunalua to Moanalua inclusive, to be styled the Honolulu district" (Coulter 1935:216-217). This change was made because people often referred to the district of Kona as Honolulu.

In 1931, E.S. Handy began making observations to include in an ethnographic study of traditional Hawaiian agricultural activities, which were extant on the island prior to European contact. According to Handy (1940), sweet potatoes were also cultivated throughout the island of Oʻahu; while breadfruit plantings were focused on the southerly side of the island. In his chapter on taro in a section titled “Planting Localities” the following historical descriptions of Honolulu and Kapālama were compiled and published by Handy:

> **Honolulu.** Of the specific section in early days known as Honolulu, Meyer [1834] writes [of his visit in 1830-1832]:
>
> If one were to visit the great plains of Honoruru and see all the beautiful cultivated land in the transverse valleys, that extends onto the plains of Honoruru, and also the tremendous quantity of food plants that are cultivated in the valley of the Pearl river, one might perhaps be persuaded to believe that a great excess of food prevails here, although that is not the case. The taro plantations occupy a great deal of space and yield far less nourishment than our potato and grain fields. In fact, the high price of fresh supplies at the market of Honoruru we might directly ascribe to inadequate cultivation.
>
> Kotzebue, traveling in the islands from 1815 to 1818, was more impressed. He writes:
>
> Woajoo is the most fertile of the Sandwich Islands, from which Owyhee receives a part of the taro necessary for its consumption. The cultivation of the valleys behind Hanarura is remarkable; artificial ponds support, even on the mountains, the taro plantations, which are at the same time fish ponds; and all kinds of useful plants are cultivated on the intervening dams.
>
> Elsewhere Kotzebue describes the method of taro cultivation in greater detail:
>
> The artificial taro fields, which may justly be called taro lakes, excited my attention. Each of them forms a regular square of 160 feet, and is enclosed with stone all round like our basins. . . In the spaces between the fields, which are from three to six feet broad, there are very pleasant shady avenues, and on both sides bananas and sugar cane are planted. . . I have seen whole mountains covered with such fields, through which the water gradually flowed; each sluice formed a small cascade, which ran through avenues of sugar cane, or bananas, into the next pond, and afforded an extremely picturesque prospect. (1940:77)

In addition to his ethnographic work, Handy also produced an annotated map of Oʻahu (reproduced as Figure 36, below), which included planting localities for taro as well as climate details. Regarding Kalihi, Handy et al. provided the following description:

> Kalihi had a shallow seaside area, now the shore of Kalihi basin, that was, like that of Moanalua, ideal for the building of fishponds, of which there were six. On the flatlands below the valley there were extensive terraces on both sides of the stream, while along the stream in the lower valley there were numerous areas with small terraces. The interior valley was tough and narrow and not suitable for loʻi but it would have been good for sweet potatoes, yams, wauke, and bananas, which probably were planted there. (1972:475)

In his *Narrative of a Whaling Voyage Round the Globe, From the Year 1833 to 1836*, English Frederick Bennett provides the following description of one of “the principal valleys to the westward of Honoruru” (1840:198), Kalihi Valley, as he saw it in late 1833:

> The valley of Kalihi succeeds to that of Anuana, but is less bold and diversified in its scenery. Human dwellings and cultivated lands are here very few, or scattered thinly over a great extent of, probably, the finest soil in the world. The commencement of the valley is a broad pasture-plain—the tall grass waving on every side, and intersected by a footpath, reminding one forcibly of the rural scenes which precede the hay-harvest in England. Kalihi has a pass to the vale of Kolau similar to the pari of Anuana, though more precipitous, and only employed by a few of the islanders who convey fish from Kolau to Honoruru. I descended it in company with a native guide, but found the task difficult, and scarcely practicable without the aid afforded by the boughs of trees. (ibid.:202)

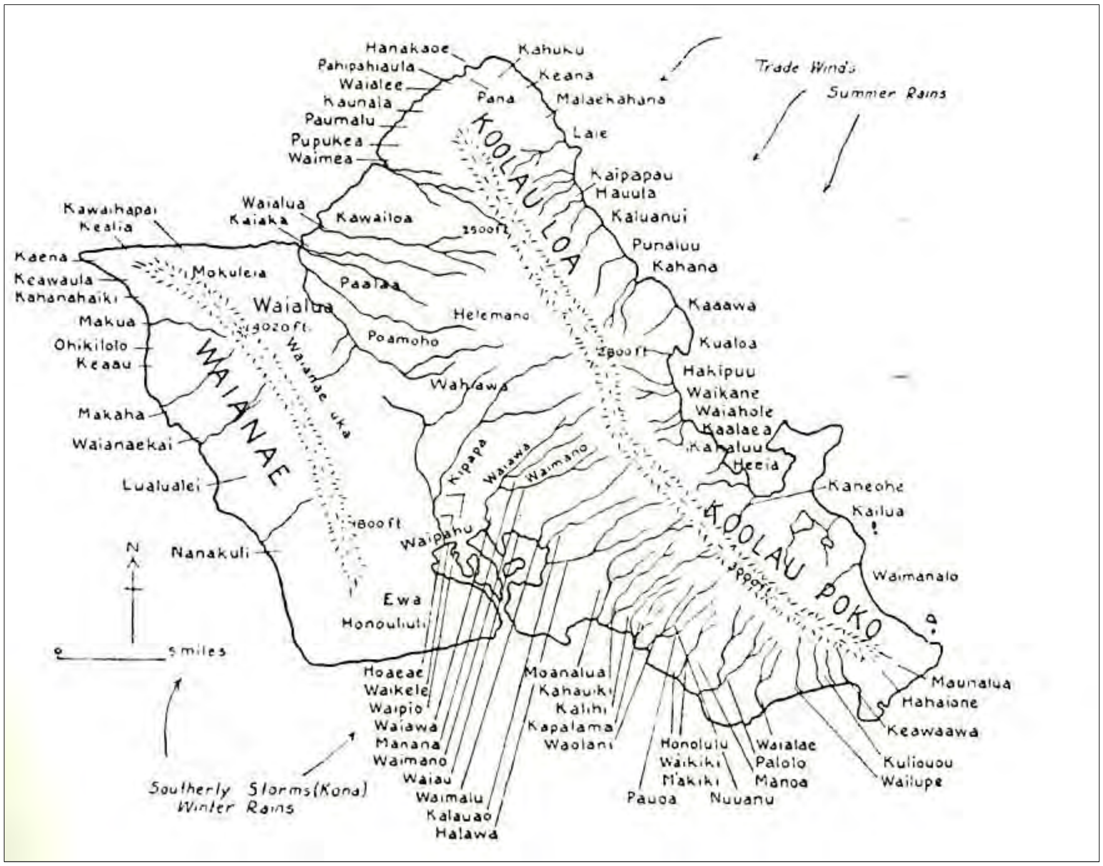


Figure 36. Planting localities for taro, wind direction, and climate in O‘ahu (Handy 1940:75).

‘Ī‘ī recounts the following memory of a visit to Kalihi from a time, roughly two years after Liholiho became king, when “a proclamation was sent to the people of Kumelewai to get materials for thatching heiau houses” (1959:45)

> All the people who went on the journey arrived in the upland of Kailhi, near the diving pool of Waiakoae, for they thought that that would be the nearest place to obtain dry ti leaves, timber, thatching sticks, and *‘ie* fibers for tying on the thatch. Here the boy joined the children of the region in bathing and diving while the men, including his attendant, went inland for all the supplies needed, At this place there were many expert canoe makers, whose children were among Īī’s playmantes. (ibid.)

Malo (1951) described a *holua* slide in the Kalihi Valley, which Mcallister reported in 1933 as being located “at a site not now known” (1933:89). The following excerpt is a note written by Emerson on the description by Malo:

> The course of an old-time *holua* slide is at present writing [1898] clearly to be made out sloping down the foot-hills back of the Kamehameha School. The track is of such a width,—about 18 feet,—as the preclude the possibility of two sleds travelling abreast. It is substantially paved with flat stones, which must have held their position for many generations. The earth that once covered them has been mostly washed away. (1951:224)

Two entries in the Dictionary of Hawaiian Localities Saturday Press reproduced in Sterling and Summers’ *Sites of O‘ahu* define places located in coastal Kalihi Ahupua‘a. A place called Kahakaaulana was “the narrow place in the Kalihi harbour inlet, and formerly the place where travellers used to swim across to Kalaekao or Puuloa to avoid the long detour by way of Moanalua” (Sterling and Summers 1978:322). Another area referred to as Apili or “caught, snared or stuck” was comprised of the following:

> Land surrounding the fishpond in Kalihi, Oahu, belonging to the Adams’ family. It was there that capt. Alexander Adams had his famous gardens, which was quite a place of resort for strangers and whale men, about 1850. The fishpond is yet famous for the superior flavor of its fish, particularly the awa, which, eaten raw, is esteemed a rare treat by native epicures. (ibid.:323)

An article by Clarice Taylor from the Honolulu Star-Bulletin dated August 19, 1954 and reproduced by Sterling and Summers tells about a shallow cave called Keana Kamano located on the Kamaniki side of Kalihi Valley.

> It was called the cave of the sharks because the big shark gods from Pearl harbor often went there to rest.
>
> Keana kamano led into the fabulous underground cave believed in olden times to occupy the center of the Island of Oahu.
>
> One branch of the cave led around and under the mountains to Pearl Harbor. Another branch of the cave led to the center of the Island where there was a sacred pool for swimming. Hawaiians living today can tell of elders who once traveled these caves and who once swam in the sacred pool. An earthquake about 1900 closed up the caves and no one has been knwn to tavel them since.
>
> It may be that the cave-in of the Wilson Tunnel occurred over the old lava tube leading to Pearl Harbor. (ibid: 323)

In the middle 1800s, during the *Māhele*, the *ahupua‘a* of Kalihi was awarded as a series of *‘ili kūpono* (independent land division within an *ahupua‘a*) and *‘ili lele* (discontinuous land division), similar to Waikele. The current OCCC site extends across three of these subdivisions, the southernmost half of the property lies within the *‘ili lele* of Kawaiholo, while the northernmost half falls within the*‘ili kūpono* of Kaluaopalena, with the exception of the northwestern corner of the property, which is situated in the*‘ili kūpono* of Haunapo (Figure 37). The *‘ili* of Kawaiholo (along with the *‘ili* of Umi and Paikika, and the fishpond of Apili) was awarded to the Scottish Captain, Alexander Adams (LCAw. 803). Adams was born in 1780 and moved to Hawai‘i in 1811 and became part of Kamehameha I’s retinue. In 1817 he assisted Kamehameha I with removing the Russians from Kaua‘i (Royal Hawaiian Agricultural Society 1854). The *‘ili* of Kaluaopalena was relinquished by Kaunuohua and became Government lands, while the *‘ili* of Haunapo was retained by Laumaka (*Māhele* Award 50). *Kuleana* awards and grants are prevalent throughout Kalihi to the extent that nearly every acre of land was claimed. In addition to the Land Commission Award to A. Adams, an additional ten *kuleana* were awards within the immediate vicinity of the current OCCC location: LCAw 5011:5 to Kahaha, LCAw. 2710 to Haupu, LCAw. 1210 to Pawai, LCAw. 818 to George Beckley, LCAw. 591 to John Meek, LCAw. 3237:2 to Hewahewa, LCAw. 1519:2 to Kapule, LCAw. 1530:1 to Weuweu, LCAw. 2324:2 to Puniuala, and LCAw. 926:1 to Kamalanai. Two Government Grants within the *‘ili* of Kaluaopalena were awarded to Alexander Young (Grant 73) and the other to Mary Hipa (Grant 3184) (see Figure 37). A review of the Native and Foreign testimonies for the Land Commission Awards revealed that this area contained *lo‘i kalo* (wetland taro patches) and *pā hale* (residential sites). Additionally, Figure 37 indicates that the coastal portion of Kalihi contained at least five named fishponds, Apili, Pahounui, Pahouiki, Auiki, and Ananoho.

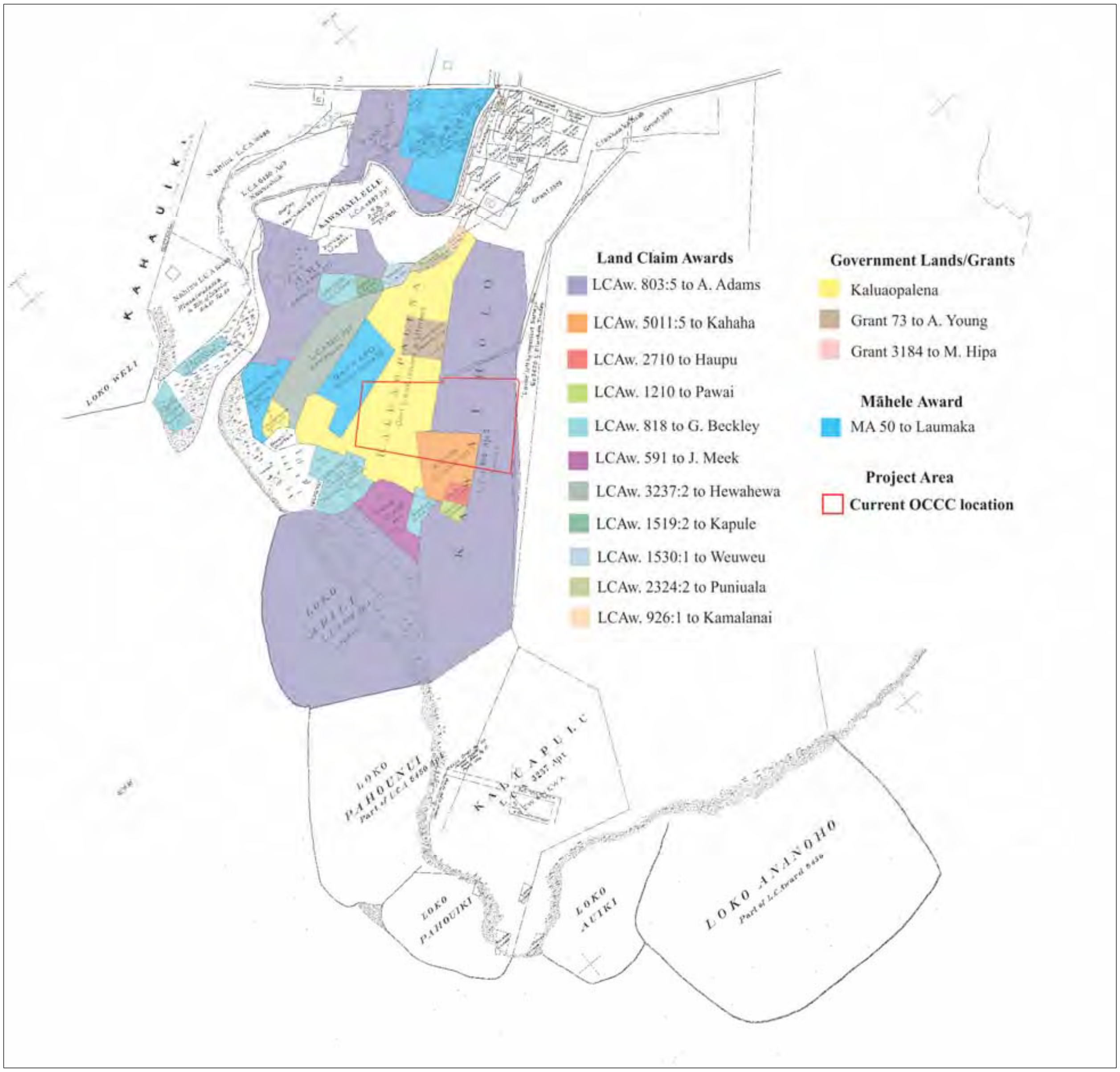


Figure 37. Portion of Registered Map 2284 (ca. 1904) by A.C. Alexander showing Land Comission Awards and Government Grants located in the vicinity of the current OCCC location.

The Legacy of Frank Dillingham and the Oahu Railway and Land Company (1888-1947)

The following discussion of the history of the Oahu Railway and Land Company is included in this report because a portion of the railway formerly extended along the southern boundary of the current OCCC property in Kalihi. The history of the Oahu Railway and Land Company (OR&L) began in June of 1888, when William R. Castle introduced a bill that did the following:

> . . . it specifically empowered the Minister of the Interior "to contract with B.F. Dillingham, his associates and successors and their assigns, or such corporation as shall be formed and organized by him or them under the laws of this Kingdom. . . for constructing and operating on the island of Oahu a steam railroad or railroads of not less than three feet gauge, for the carriage of passengers and freight." The bill allowed B.F. Dillingham eighteen months in which to give "satisfactory guarantees" to the government that he would build a steam railroad to connect Honolulu with Pearl River lagoon within three years of the passage of the bill; he would have exclusive rights to whatever territory (excluding Honolulu) the railroad covered within three years. (Yardley 1981:125)

This discussion is drawn largely from Paul T. Yardley's biography on the career of B. F. (Benjamin Franklin or "Frank") Dillingham (Yardley 1981). Frank Dillingham was an entrepreneur from Massachusetts, who came to Hawai'i as a first mate aboard the *Whistler* at the age of twenty-one in July of 1865. He made landfall at Honolulu and shortly thereafter was injured in an accident while on horseback, his recovery lasted forty-five days and caused him to be left behind when the *Whistler* set sail on her return voyage. This accident would change his life forever. Shortly after being stranded on O'ahu, Dillingham married Emma Smith, daughter of the Reverend Lowell Smith, a missionary stationed in the Hawaiian Islands. Then, in April of 1869 Frank Dillingham opened Dillingham and Company, a hardware store, with his business partner Alfred Castle. Alfred's father Samuel Castle secured the funding for the young men. Five years later, Alfred Castle died suddenly and Samuel Castle and Dillingham begrudgingly entered a partnership that would last over twenty years. In 1879, Dillingham acquired fourteen acres of land at the corner of Beretania and Punahou streets. This lot would become his family's home, known as Woodlawn, where they would remain for forty years. More importantly, this land acquisition inspired another venture of Dillingham's which would become the largest dairy in the Hawaiian Kingdom in 1886. Despite the moderate success of the hardware store and dairy, which despite its size failed to deliver profits, and a few successful real estate deals, Dillingham had mounting debts. In 1885, in a desperate effort to pay off his creditors (including Castle), Dillingham set up a land holding company, which failed miserably by 1888. His so-called Great Land Colonization Scheme offered investors stock in his Hawaiian Colonization Land and Trust Co. but fell flat for lack of interest, due in part to the kingdom-wide depression spurred by falling sugar prices.

The Dillingham Bill, discussed above, was not approved as it was initially proposed. Whilst the government drafted another bill, Dillingham received strong public backing from Charles A. Brown. Brown's wife, Irene 'Ī'ī, was the only child of John Papa 'Ī'ī; thus, "through her, Brown controlled the immense estate of Waipio, including Waipio Peninsula in Pearl Harbor. Brown's prestige with the Hawaiians was thought to be immense" (ibid.:127). When put to a vote, Hawaiian voters supported Dillingham while *haole* voters voted primarily against him; however, on September 11, 1888 King Kalakaua signed the railroad bill in favor of Dillingham (ibid.). According to Yardley, "Kalakaua's signing of the railroad bill signaled the start of a year and a half of frenetic activity during which B. F. Dillingham changed the map of Oahu forever" (ibid.:131).

Although railroads, largely associated with the sugar industry, were already in operation around Hawai'i Island, O'ahu was undeveloped in comparison and the Pearl Harbor region was not a sugar production area. Furthermore, according to Yardley, "the great dry plains of Ewa produced nothing but cattle and firewood" (ibid.:130). Yardley describes Dillingham's seemingly fool-hardy venture thusly:

> Frank planned to open up a whole new district and make its economy thrive on account of the railroad. The satrisit who described the Oahu railway as "starting nowhere and ending up a tree" was really not far shy of the mark. (ibid.:129)

The main landholders of 'Ewa, Brown, Mark Robinson, and James Campbell were all amenable to the planned railroad and the promise of increasing the value of their holdings. By November of 1888, Charles H Kluegel had begun surveying the narrow-gauge railroad right-of-way. Kluegel estimated the cost for fifteen miles of 3-foot gauge railroad at $241,000 (ibid.:133).

On February 4, 1889, Lorrin A. Thurston, Minister of the Interior, issued a charter for the Oahu Railway and Land Company (OR&L) as a railroad as well as a land development company. As Yardley described:

> This charter ran for fifty years, provided for an original capitalization of $700,000 increasable to $5 million, and empowered the corporation not only to build and operate a railroad but also to purchase, own, develop, sell lease, and otherwise deal in lands "along and near the line or lines of the railway. . . for the purpose of inducing the settlement of population along or near said line. (ibid.:137)

On March 8, 1889, the formal groundbreaking took place at Moanalua near the intersection of Middle Street and Kamehameha Highway. This location was chosen because the spoils from the cut were needed to fill in the underwater parts of the proposed line; 148 men were working by May (ibid.:140). Once again, Dillingham struggled to secure funding and Samuel Castle's investment kept him afloat, "without Mr. Castle's backing the whole railroad project might never have got off the ground" (ibid.:142).

On September 4, 1889, nearly 150 people rode a little over a mile from the terminal at Iwelei Road to the rice fields in Kapālama; the terminal was located to the southeast of the current OCCC facility in Kalihi. The *Pacific Commercial Advertiser* reported the event under the headline "A Successful Experimental Excursion, and the Redemption of Mr. B.F. Dillingham's Promise Given One Year Ago" (ibid.:145). A few months after the first ride of the OR&L, Dillingham hosted opening day for the railroad and provided free rides for nearly 4,000 passengers on November 16, 1889 (ibid.:146). By this time, the railroad extended eight miles from the Honolulu depot to Hālawa near present day Aloha Stadium, located to the west of the Animal Quarantine Station and HCF. By January of 1890, the railroad extended to Pearl City and seven months later, the full fifteen-mile section Dillingham originally promised was complete. On July 1, 1890, the railroad reached Hōʻaeʻae, to the southwest of the Mililani Tech Park site (ibid.:158).

As 1890 was ending, Dillingham shifted his focus to developing portions of Campbell's 60,000 acres in ʻEwa into sugar plantations and constructing a wharf in Honolulu Harbor that could accommodate ships loaded with sugar for export, as well as imports for transport by rail. Dillingham continued to run parts of the Campbell lands as ranches while renting out portions for other uses, which resulted in the establishment of Ewa Plantation Company. In addition, he began selling lots in Pearl City for residential development. As a means of mitigating his financial troubles, in 1891 Dillingham incorporated the Hawaiian Construction Company and in 1892 went to the mainland to try and secure more funding for his various projects. Construction of the rail had gone dormant since 1890; but in 1893, Dillingham secured a contract to extend the OR&L to Waianae and beyond to Kahuku, a total of fifty-four miles. This extension suffered many delays and it took more than two years before the rail line was completed from Ewa Mill to Waianae (Figure 38). On July 4th, 1895, the railroad celebrated its completion to Waianae, which "made it possible to reach the remote Waianae coast in an hour and a half, instead of by a day's ride on horseback, and ended the isolation of this remote corner of Oahu" (ibid.:189). In June of 1898 the OR&L finally reached Waialua Mill and by January 1st, 1899, the main line was complete having reached Kahuku Plantation, seventy-one miles from Honolulu (ibid.:199). Yardley summarized the success of the OR&L around this time thusly:

> The "toy railroad," as Frank liked to refer to it, now served six flourishing sugar plantations and all the thousands of workers who lived on them. During the year 1899 it carried 236,000 passengers and nearly 200,000 tons of freight, and earned a net profit of $212,000. (ibid.:199)

The railroad took advantage of the wave of prosperity that swept through the islands near the turn of the twentieth century and re-laid the rail line between Ewa mill and Honolulu with upgraded steel rails. In 1905, work began on extending the line ten miles inland from the Waipahu sugar mill (to the south of the Mililani Tech Park parcel) to Wahiawa. This section of rail was completed during the summer of 1906 and was extremely profitable thanks to the booming pineapple industry. The profits allowed for Dillingham to cover his outstanding debts. Then in 1908, the OR&L hooked up with the naval railway and constructed branches that extended off the Wahiawa line to reach pineapple fields in Waipiʻo, Schofield Barracks, Kunia and Halemano. The completed railway is shown in Figure 38 below. The railway continued to flourish through the end of World War II, and provided transport for millions of passengers and freight during the war proving itself indispensable to the U.S. Army and Navy. However, after the war as infrastructure improvements to Oʻahu roadways were implemented and a shift to automobiles, trucks, and buses for the transport of people and goods was underway, the OR&L could not compete. The year 1947 marked the close of the main line while limited operations between the docks and pineapple canneries continued before complete abandonment of the railway a few years later.

Without the OR&L, it is likely that leeward Oʻahu would not be as it is today, nor would it have been possible to plant the parched ʻEwa plains with commercially cultivated sugar cane. In the early 1900s, Dillingham summarized his feelings regarding the link between his railway and the sugar industry in his report to the directors of the railroad thusly, "It is not too much to say that the development of the sugar industry on this Island [Oʻahu] since 1890, is directly due to the presence of . . . railway transportation" (ibid. 212). According to Yardley, another aspect of Dillingham's legacy was his hand in bringing water to the ʻEwa plains,

> . . . thousands of green acres which had produced nothing but kiawe and cactus in the yers before the railroad, while out on the Ewa plain the great pumps sucked water out of the earth to give life to the land. This had been his life work: more than any other man, he had brought life and prosperity to that part of Oahu which stretched from Pearl Harbor to Kahuku. (ibid.:316)

Figure 38. Map of completed OR&L railroad.

The Sugar Industry in Kona District (1897-1940)

In 1899, another sugar plantation relevant to the current study was founded; known as Honolulu Plantation, this enterprise raised cane throughout the Kona District. The lands commercially cultivated as Ewa Plantation, Honolulu Plantation, and OSC (labeled “Oahu Plantation”) appear in a 1902 Hawaii Territory Survey map by Walter E. Wall reproduced as Figure 39 below.

In 1935, the Honolulu Star Bulletin ran a series of articles about the history of the various sugar plantations across the Hawaiian Islands. The thirty-third installment focused on Honolulu Plantation Company, which was founded in 1899 with roughly 1,400 of acres planted cane between Waimano and Kalihi including portions of Hālawa Ahupuaʻa, and its base of operations at Aiea. The article states that Honolulu Plantation Co. was “distinctly an annexation plantation, the youngest on Oahu, but its boundaries included lands that were planted to cane back in the [18]50s and early [18]60s” (*Honolulu Star-Bulletin* October 12, 1935 Section 2:9). The Hālawa section of the plantation was originally part of J. R. Williams’ sugar plantation; Williams planted cane in the valleys and *makai* lowlands and milled on site. He abandoned the enterprise after three separate incidents of the mill burning down, “for a quarter of a century or longer the property was then used for cattle ranches before being turned again to the use of sugar production” (ibid.).

According to another newspaper article, the Honolulu Plantation began in 1899 with the lease of “27,000 acres of pasture, wasteland and forest” with “7,000 acres of potential cane land” (*Honolulu Advertiser* December 7, 1946:11). Sugar plantations often leased or owned forest land and maintained it as a reserve as part of water conservation efforts (Coulter 1933). By 1935, Honolulu Plantation included “5,500 acres of leased cane lands and 1,000 acres of pasture and waste land, together with 83 acres of land owned in fee simple” (ibid.). Like OSC, Honolulu Plantation was entirely dependent on irrigation and took water from artesian wells along the shores of Pearl Harbor, using pumps to reach the highest planted areas at 500 feet in elevation. In 1905, Honolulu Plantation installed a refinery, and in 1935, it was the only sugar estate with its own refinery. The article states, “in addition to refining its own raw sugar, the plantation buys the entire output of Waimanalo plantation” and that “during the war [World War I] it refined some of the raw sugar from Ewa, Oahu, and Waialua plantations” (ibid.).

Figure 39. 1902 map showing OSC, Ewa Plantation, and Honolulu Plantation lands relative to the proposed OCCC locations.

A 1940 article titled "Aiea Fields Now Chiefly in Uplands: Rich Flats Formerly Used by Plantation Are Now Devoted to City, Military Establishments" described the shift from cultivation to development in the *makai* lands of Honolulu Plantation. Author Jared Smith begins the article by describing the plantation as he first experienced it in 1923, "at that time there was 6,500 acres of cane land, of which about 2,000 were the rich flats extended from Puuloa along the shores of Pearl Harbor, as far east as Kalihi basin and up the low valleys surrounding Salt Lake" (The Honolulu Advertiser June 5, 1940:1). Smith continues his description thusly:

> three deep gulches, Waimano, Waimalu and Halawa, running east to west transect the cane area, with other lesser valleys branching from them. . . it is all broken country with hill-side cultivation on varying slopes, steep or gentle. Bottoms and deltas are alluvial and darker in color, but with this exception the red soils prevail. They are of uniform derivation as well as physically and chemically similar. To that extent this plantation is more favorable situated than its neighbors.

Smith continues as follows:

> In the last 17 years the army has taken the latter; the navy and city highway department have bitten off 1,050 acres; and city expansion has absorbed the Damon tract and cane fields in Kalihi for residential use. All these are casting hungry eyes on further absorption of cane lands on either side of Dillingham boulevard. (ibid.)

As a result of the loss of its lowlands, Honolulu plantation expanded cane fields further *mauka* to higher elevations, primarily in Aiea, which brought total acreage to roughly 5,200 acres. He concludes the article thusly, “Honolulu Plantation company’s lost 2,000 acres are lost for good. The only way it can fill its quota is to make the land that is left produce more sugar” (ibid.).

In 1947, OSC bought Honolulu plantation in its entirety. According to an article titled “Oahu Sugar Co. Buys Honolulu Plantation Co.” published in the *Honolulu Advertiser* (December 7, 1946) OSC purchased the raw sugar mill, refining plant, and roughly 21 acres at Aiea on behalf of California and Hawaiian Sugar Refining Corp. (C&H). The purchase included 14,595 acres: “about 3,000 are in cane, 1,250 acres are pasture, and 72 are truck gardens. In addition, there are 2,200 acres of wasteland and nearly 7,500 acres in forest reserve”. Cultivation maxed out when “more than 6,500 acres were in crop” but declined “as its most productive lands were lost to the army and navy for home and business development as Honolulu expanded in the direction of Pearl Harbor” (*Honolulu Advertiser* December 7, 1946:).

In 1961, AMFAC, Inc. (formerly American Factors, Ltd.), originally a Hawaiian land development company founded in 1849 under the name H. Hackfield & Company, Ltd., acquired OSC (Harvard Business School-Lehman Brothers Collection, Contemporary Business Archives). Since its incorporation in 1918, AMFAC’s acquisitions had been primarily comprised of Hawaiian sugar plantations across the islands (ibid.). In 1970, shortly after AMFAC took over, OSC merged with Ewa Plantation when it was unable to renew its lease for the Campbell Estate lands (Yardley 1981). As a result of the merger, OSC became “the second largest sugar plantation in Hawaii and the third largest in the U.S.” (Yamamoto et al. 2005:43). By 1982, OSC covered fifty-five square miles of land with 15,488 cultivated acreage (ibid.). OSC continued to produce high yields well into the 1980s and the Waipahu sugar mill was in operation until April 8, 1995. Dillingham’s arrangement with C&H guaranteed the future of the Hawaiian sugar industry up until earlier this year; for the last shipment of raw sugar (from the last remaining sugar plantation on Maui) to set sail from the Hawaiian Islands bound for the Crockett refinery was delivered on January 17, 2017, a full 111 years after the refinery opened its doors (*East Bay Times*: January, 19 2017).

Establishment of OCCC

In 1914 Governor Lucius Pinkham of the Territory of Hawaiʻi identified a 9.8-acre site in Kalihi-Kai as the new site for the Oʻahu Prison (Governor 1914). The newly selected site was situated southeast of Kalihi Stream and bordered on its *mauka* side by Dillingham Boulevard/Kamehameha Highway. The OR&L railway alignment formed the *makai* boundary of the then newly established Oʻahu Prison site (Figures 40 and 41). By 1915, construction of the new prison was underway and upon its completion in 1918, it was renamed the Territorial Penitentiary (Governor 1915). The new Territorial Penitentiary served as the main detainment center for convicted felons, misdemeanants and inmates awaiting trial (Governor 1918). Registered Map 2921 (see Figure 40) dated 1932 shows the location of the main facilities including the administration building, dormitories, holding cells, mess hall, pavilion, laundry room, toilet and bath house, incorrigible ward, workshop, athletic field as well as several smaller structures. Between 1932 and 1954, the northwest side of the property was expanded to include additional structures (see Figure 41).

After the Statehood Act of 1959, the then nearly fifty-year-old Territorial Penitentiary had fallen into disrepair. Not only was the building in dire need of an overhaul, but the correctional system itself was dysfunctional with various parts of the system managed by different state departments and agencies. Throughout the 1960s and 1970s, Hawaiʻi’s correctional system was the subject of several master plans, of which it included updating the dilapidated Territorial Penitentiary. In 1970, the John Howard Association, an independent nonprofit organization presented a proposal to the Legislature that called for a small central prison in Kalihi (on the site of the former Territorial Penitentiary) with an additional five community-based correctional centers located on the outer islands. In 1973, the State in contract with the National Clearinghouse on Criminal Justice Planning and Architecture provided a design for the new community-based correctional facility (Lind 2016). By 1975 the facility came under the control of the City and County of Honolulu, and was subsequently renamed to the present Oʻahu Community Correctional Center (OCCC). By the late 1970s, most of the buildings constructed for the Territorial Penitentiary were demolished except for the Holding Unit (now known as OCCC-10; Figure 42), which was constructed in 1912.

The redesign was dramatically different from the previous penitentiary as it replaced the large single structure with multiple wings design, to one with multiple interdependent structures. Since its establishment, OCCC has expanded to the current 16-acres and is the largest jail facility in Hawaiʻi with a capacity of 628 beds and an operational capacity of 954 beds, however OCCC consistently operates above these capacities (Schwartz 2017).

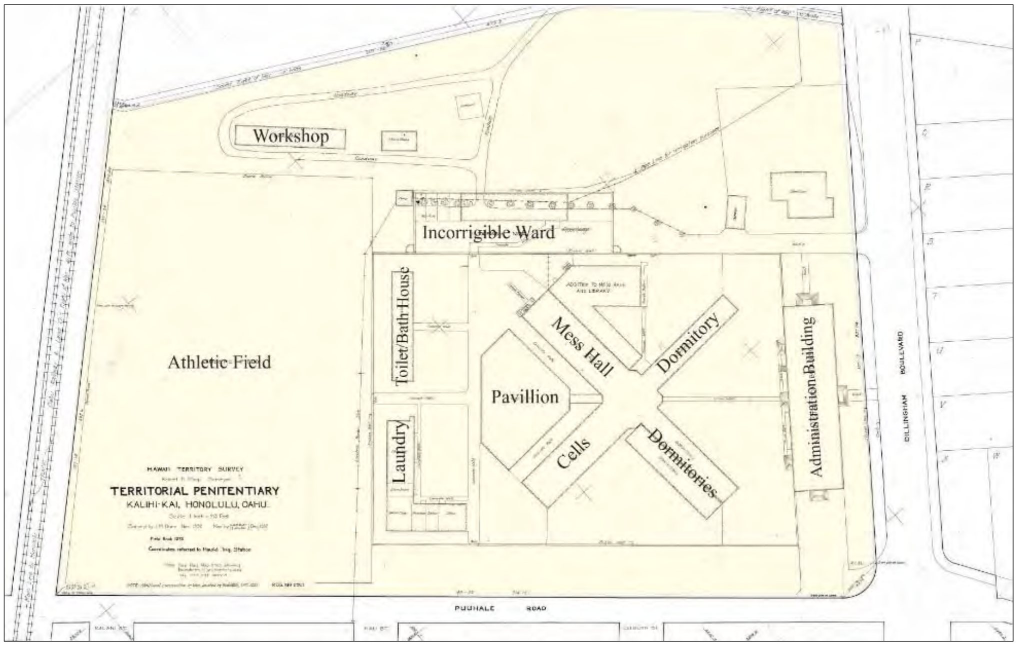


Figure 40. Portion of Registered Map 2921 (dated 1932) showing the Territorial Penitentiary.

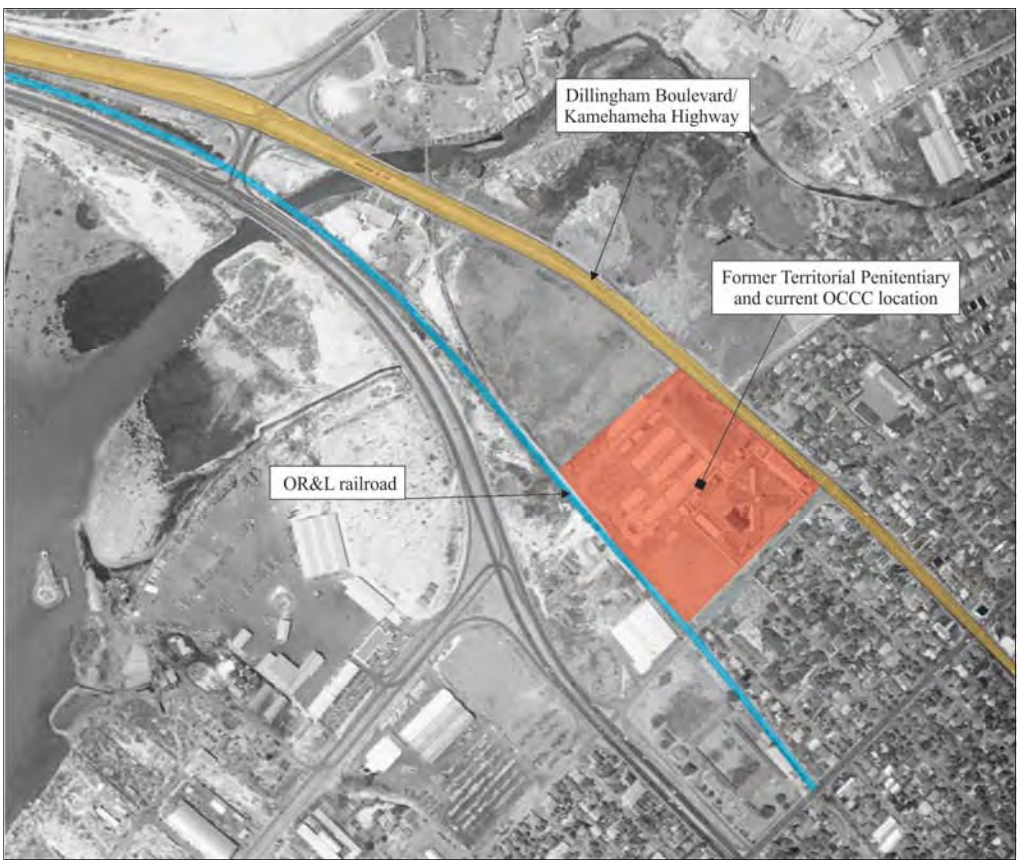


Figure 41. 1954 USGS aerial showing the Territorial Penitentiary located in Kalihi.

Figure 42. Current OCCC-10, original Holding Unit built ca. 1912.

Koʻolaupoko District (WCCC)

The final subject area of the current study, the WCCC lies within Kailua Ahupuaʻa, Koʻolaupoko District. According to Handy et al., "the area that included what is now Kaneʻohe and Kailua, which was rich in fishponds and tillable lands, was the seat of the ruling chiefs of Koʻolaupoko" (1972:272). Koʻolaupoko was also one of the only places known to host "bottom lands," referred to as such by Kamakau before them. This terrain was "planted in the summer when it is dry, as *palawai*" (ibid.:138). Handy et al. provided the following description of the traditional planting method favored in such terrain:

> The only areas we know of that answer to this description are in Koʻolau Poko on windward Oahu. A large area was burned over. After a week, stubble and grass were dug out and then it was left for a month. When the moisture in the ground rose to about a half an inch below the surface, it was ready for planting. *ʻUala* slips (*lau*) were broken off and allowed to dry in the sun, after which all the leaves were plucked off except four at the top and the terminal leaf bud (*muʻo*). The slips were bound in bundles of 80 or 100 and wrapped in ti or other leaves to keep them moist. A week later came the day for planting, a festive day (*la haʻaheo*). Dressed in finery (fine loincloths, shoulder capes, and head gralands of *ʻilima*) each man took up his long heavy digging stick. . . The first row was laid out with fishline. Little mounds (*puʻe*) were spaced three or four armspans (*anana*) apart, allowing room for spreading vines. The men stood in line, and swinging in unison, dug the holes. Their women, also dressed in their finery, followed carrying bundles of slips, and, dropping two into each hole, packed earth around them with their feet. In a single late afternoon a field (*mala*) of five acres or more could be planted. No prayers were needed when planting bottom lands for they were fertile and well watered. (ibid.:138)

Legendary Accounts of Koʻolaupoko

According to Kamakau (1992), Liloa's wife Pinea, was from Koʻolaupoko and ʻEwa. He also mentions the origin of place names in the district, such as Ulupau, Holomakani, Aniani, and Olomana all of which were named after chiefs (Figure 43). In addition, Kamakau cites a saying "*Kauo ulupau ka holo Kahiki*" that translates as "A sailor has dragged his anchor in all ports," and opines that "the young people" in his day "use the words without knowing their connection with the people who came from Kahiki and landed first at Mokapu in Koʻolau-poko" (ibid.:325; see Figure 43).

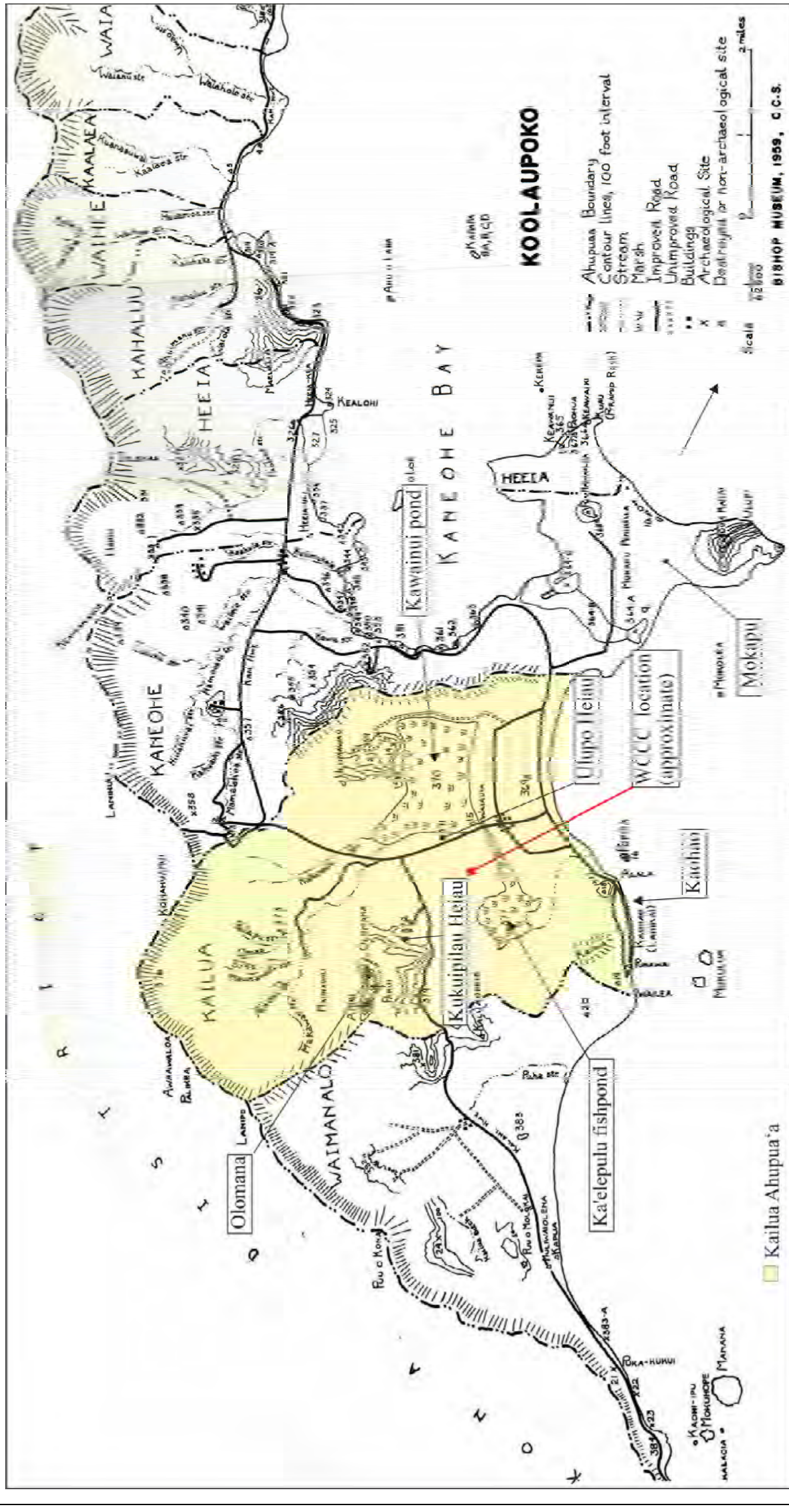


Figure 43. Annotated map from Sterling and Summers (1978:57) showing some of the *wahi pana* of Koʻolaupoko referenced in the text.

Legendary Accounts of Kailua Ahupuaʻa

Kailua is mentioned in the legendary account titled "History of Kualii" published in a *Collection of Hawaiian Antiquities and Folk-lore Volume IV* by Fornander (1916-1917:364-434). This story tells of Kūaliʻi, a king of Oʻahu who Fornander suggests is often left out of Hawaiian history. According to Fornander, some accounts attribute Kūaliʻi with having a relationship with the gods while others speak of his supernatural powers. When he was a young man he rebelled against the king of his district Lonoikaika and in response, Lonoikaika's armies surrounded him. Rather than surrender, Kūaliʻi prayed at the temple and then fought with such courage that he forced the enemy to retreat. According to the legend,

> Kualii was therefore victorious in this his first battle and he became the owner of all the land from Moanalua to Maunaloa. Shortly after this Kualii went and lived in Kailua, Koolaupoko, in a great palace called Kalanihale. (ibid.:412)

According to Fornander, Kūaliʻi usually accompanied his soldiers into battle, "but later on when Kualii saw that his soldiers were proficient and that they showed great strength he decided to let them go to war by themselves, while he stayed behind at Kailua" (ibid.:426). Kūaliʻi died in Kailua, apparently his favorite residence, at the advanced age of 175,

> Through the uprightness of his law, and the honesty with which he administered the government, God preserved him, so that he lived a long life, and his is that notable life spoken of in the annals of the ancient people, of the king of Oahu, who lived four times forty and fifteen years. In the last stage of life he was bent with age and withered, with the eyes reddened and bedimmed; and was carried about in a netting. He died at Kailua, in Koolaupoko, in A.D. 1730, in the one hundred and seventy-fifth year of his life. (ibid.:432)

Later in the same volume, in the "Legend of Kaulu" (Fornander 1916-1917:522-532), Kailua is referred to as the birthplace of the legend's protagonist Kaulu, a *kupua* (demi-god) who had many adventures. The peaks known as Olomana that overlook Kailua are attributed to Kaulu's cunning, which is particularly relevant to the current study because the *wahi pana* Olomana is located to the southwest of the WCCC (see Figure 43). At his home in Kailua, Kaulu accidentally insulted Lonokaeho, king of Kona, who also resided there. Lonokaeho had "a very prominent forehead" and Kaulu had enquired after "the man with the sharp forehead" (ibid.: 530). In response, "Lonokaeho's forehead then ascended to heaven and came down again, with the idea of striking Kaulu and killing him" (ibid.). However, Kaulu told his hands: "the upper jaw, hold it up; the lower jaw, hold it down" and "Lonokaeho's forehead was thus made fast to the ground; ohia trees and the grass grew over him and Lonokaheo was killed on that famous hill of Olomana, which stands to this day" (ibid.:532).

In the same volume, Fornander mentions a fishing ground for Akaka, located "directly out of Kailua, at a point from which Kahuku in Koolauloa and Mokuoniki on the east of Molokai could be seen" (ibid.:290). Another mention of a *wahi pana* in Kailua is found in the "Story of Lonoikamakahiki" (ibid.:256-363) and refers to the stretch of land between present-day Kailua beach and Waimanalo beach, known as Kaohao (see Figure 43), located *makai* of the WCCC facility:

> . . . Because of this Hauna took the women and tied them together with a loin cloth and led them to the place where the canoes were lying. Because these women were led by Hauna, the place where this act took place was given the name Kaohao and it so remains to this day. (ibid.:314)

Kailua briefly appears in the aforementioned legend of Kahalaopuna, the princess of Mānoa, and Kauhi, the young chief of Kailua, to whom she was betrothed. According to the legend, Kauhi's parents "always sent the poi of Kailua and the fish of Kawainui for the girl's table" (Kalakaua 1888:120). Kailua is also mentioned in a note found within the introduction composed by Martha Beckwith (1919:293-331) to "The Hawaiian Romance of Laiekawai" published in the *Thirty-Third Annual Report of the Bureau of American Ethnology for 1911-1912.* The note refers to a mythical tree called Makaliʻi, which grew near Kawainui Pond, located to the northwest of the current study area (see Figure 43). The note reads thusly,

> At Paliuli grew the mythical trees Makaliʻi, male and female, which have the power to draw fish. The female was cut down and taken to Kailu, Ohau, hence the chant:
>
> "Kupu ka laau ona a Makaliʻi,
>
> O Makaliʻi, laau Kaulana mai ka pomai" (Beckwith 1919:305)

Another reference to this powerful tree (with a slightly different spelling) appears in a legend about the goddess Haumea as retold by Beckwith (1970). Haumea, who is sometimes equated with Papa, the mother to all Hawaiians, is also spoken of as a goddess "who has the power to change her form and to alter her appearance from youth to age or from age to youth through the possession of a marvelous fish-drawing branch called Makalei" (ibid.:276).

Kailua is mentioned in "Lono and Kaikilani" published in *The Legends and Myths of Hawaii* by Kalakaua (1888:318-331). This dramatic romance tells of Lonoikamakahiki (Lono), descended from Umi and Liloa on his father's side and O‘ahu royalty on his mother's side. He was physically powerful and cunning, so much so that his brother Kanaloa turned his wife Queen Kaikilani over to him; through his union with Kaikilani, Lono became king of Hawaii Island (ibid.). During a journey to O‘ahu, the royal couple were stranded for a time on Moloka‘i where they engaged in a game of *kōnane* while waiting for the weather to improve. During this game, Lono heard a voice say "Ho, Kaikilani! Your lover, Heakekoa, is waiting for you!" (ibid.:325), from the *pali* above them. Lono struck Kaikilani with the *kōnane* board and left her for dead, convinced of her infidelity. He then set sail for O‘ahu and made land at Kailua where he concealed his name and rank but was welcomed into the court of Kākuhihewa, the *mō‘ī* of O‘ahu.

Meanwhile, Kaikilani recovered from her wound, but could not understand why Lono thought he had heard a voice. While convalescing on Moloka‘i, a young woman named Kaikinane admitted to Kaikilani that Lono had actually heard her lover Heakekoa calling for her and not Kaikilani. When Kaikilani returned to Hawai‘i, she found the island in a state of rebellion against Lono for his attack on her; but, she still loved him and soon set off to find him. After visiting Maui, Lāna‘i, and Moloka‘i, Kaikilani arrived at Waikīkī and then went on to Kailua. The legend continues thusly,

> But Lono's stay in Kailua was drawing to a close, for one day, while he was playing *konane* with the king within the enclosure of the palace grounds, Kaikilani's canoe was being drawn up on the beach below. She saw, to her great joy, the canoe of her husband, and ascertained where he might be found. Proceeding alone toward the royal mansion, with a fluttering heart she approached the enclosure, and through an opening in the wall discerned the stalwart form of Lono. Stepping aside to avoid his gaze, she began to chant his *mele inoa*—the song of his own name. He was startled at hearing his name mentioned in a place where he supposed it to be unknown. He raised his head and listened, and, as the words of the *mele* floated to him, he recognized the voice of Kaikilani. Rising to his feet, with dignity he now addressed the king:
>
> "My royal brother, disguise in so longer necessary or fitting. I am Lonoikamakahiki, son of Keawenui and *moi* of Hawaii, and the gods have sent to me Kaikilani, my wife. It is her voice that we now hear."
>
> Then, turning and approaching the wall behind which Kaikalani was standing, Lono began to chant her name, coupled with words of tenderness and reconciliation; then, springing over the obstruction, he clasped his faithful wife in his arms, and the past was forgiven and forgotten. (ibid.:330)

After their reunion, Lono returned to Hawai‘i Island to take back the island from the rebels, a mission at which he succeeded. According to Kalakaua, Lono and Kaikalani "both lived to good old ages, and when they died were succeeded in the sovereignty of Hawaii by lineal blood" (ibid.: 331).

Kailua is also featured in Kamakau's version of events regarding Alapa‘i Nui, the aforementioned *ali‘i ‘ai moku* who united the islands under his rule. After the defeat of Kapi‘iohookalani, chief of O‘ahu at Moloka‘i, Alapa‘i "determined to sail to Oahu and take possession of that island; for he heard that it was without a ruling chief" (1992:71). He tried to land at Waikīkī, Wai‘alae, Koko, and Hanauma but was driven back by warriors at each place. However, "the coast of Oneawa in Ko‘olau was an isolated place suitable for the landing of the expedition, and he sailed thither and beached between Kane‘ohe and Kailua in Ko‘olaupoko, at a good place for camping his numerous forces" (ibid.). While in Kailua, Alapa‘i appointed Kalani‘opu‘u and Keoua as captains of his army and prepared his forces to attack Kapi‘iohookalani's son Kanahaokalani's army. As previously discussed, Alapai‘i opted to make peace with his enemies rather than war.

Later in the same volume, Kamakau mentions Kailua as the place where Kahekili lived "with most of his chiefs" (ibid.:138). Kalapawai, another *wahi pana* located in Kailua is also mentioned in the context of Kamehameha's conquest of O‘ahu. Kalapawai was the site of reconciliation between Ka‘eokulani, the ruling chief of Maui, Lāāna‘i, and Moloka‘i, and Kahekili's son Kalanikupule, and mourning for one of Kalanikupule's favorite war leaders:

> Ka-lani-ku-pule called off the fighting and the two had a friendly meeting at Kalapawai, in Kailua, Koʻolaupoko. It was a day of mingled joy and weeping joy for the ending of war, weeping for the dead in battle and also for the death of Ka-hekili. (ibid.:168)

Early Historic Accounts of Kailua Ahupuaʻa and Greater Koʻolaupoko District

Handy et al. provide the following description of Kailua Ahupuaʻa and greater Koʻolaupoko, as it had once been:

> Kailua was the home of the *aliʻi* Kualiʻi in the early 18th century, and presumably had been the seat of the high chiefs of Koʻolaupoko from very early times. The beach, the bay, and the living conditions were and are very attractive. Waimanalo and Kaneʻohe, both rich farming areas, were neighboring. Access to the northern districts of Koʻolaupoko was easy over the waters of the great indentation in the coast now called Kaneʻohe Bay, which extends from Kaneʻohe harbor along the whole Koʻolaupoko coast. . .
>
> Undoubtedly further reasons for the attractiveness of Kailua as a place of residence for an *aliʻi nui* with his large entourage were the great natural fishponds, Kaʻelepulu and Kawainui, and the complex of artificial salt-water ponds that are between Kailua and Kaneʻohe in the Mokapu area: Halelou, Nuʻupia, and Kaluapuhi.
>
> Kailua must formerly have been very rich agriculturally, having one of the most extensive continuous terrace areas on Oahu, extending inland one and a half miles from the margin of Kawainui Swamp. Terraces extended up into the various valleys that run back into the Koʻolau range. There were some terraces watered by springs and a small stream from Olomana mountain along the western slope of the ridge that lies southeast of Kawainui Swamp, and another system of terraces was east of the seaward end of the ridge, watered by the stream which joins Kawainui and Kaʻelepulu Ponds. There were also terraces north of the Kawainui Pond, and several terrace areas flanked Kaʻelepulu Pond at the base of the ridge to the eastward. Much former taro land reverted to swamp when abandoned; this has since been drained. (1972:457)

ʻĪʻī mentions Kailua in the following excerpt, which describes the gathering of *noni* (Morinda citrifolia) fruit:

> When Ii’s father was ready to go to Kailua in Koolaupoko to hew *noni* trees for the red dye used for coloring malos, the boy begged for his mother’s permisssion to go too. . .
>
> The party continued, climbing to Nuuanu Pali, and then down. . .
>
> . . . Finally they reached the houses where they were to stay, located near a hillock and a group of hills. These were at Kailua, whence some of his father;s people hailed. When they had all of the *noni* they wanted, they returned to their residence in Ewa. (1959 :30-32)

American Missionary Maria Sartwell Loomis recorded the following account in her journals regarding an *akua* stone located along the ridge between Kailua and Kaneohe ca.1820, which McAllister included in his monograph:

> On approaching the brow of a rocky hill we discovered a long black stone set upright, having several strips of tappah tied round at the top and bottom. This we knew to be an object of worship from the numerous fragments of grass, leaves, etc., which lay around it, while it afforded the melancholy evidence that Idolatry still exists among this ignorant and poluted [sic] people. I threw down this altar of abomination and proceeded on, but in descending the hill, we observed another idol which seemed to be more regarded than the first, being completely covered with painted tappers [sic, tapa] of various colours, and having great abundance of offerings lying around. Grieved to see these vestiges of idolatry I tore in pieces the covering and threw down the idol. Soon after, I observed a man who was coming towards me gathering spires of grass, etc., which I supposed were intended for the Idol I had just destroyed. (Loomis, M.S. journal in McAllister 1933:182-183)

The following reference from the same volume, tells of people consuming the soil from Kawainui pond:

> Solomon Mahoe said that from this pond a soil was taken which resembled starch. John Bell remembers eating of this soil when he was with Kalakau. The area is now swamp land. (ibid.:186)

Kailua was also the site of a mansion built by Kākuhihewa called Pamoa that measured 240 feet by 90 feet (Fornander 1880). Kamakau further describes Pamoa thusly:

> At Alele in Kailua, he erected a government house for himself forty fathoms long, and fifteen fathoms wide, which was named Pamoa. The main purpose of this house was for debating land divisions, claiming ancestors, genealogy registration, practice with war club, spearthrusting, astrology, designing, astronomy, konane, instruction in royal ancestral songs, royal songs, running, cliff leaping, bowling, sliding, boxing. (in McAllister 1933:186)

During Kamehameha I's reign, prior to the *Māhele*, Kailua Ahupuaʻa was subdivided into *ʻili*. The WCCC location is situated within the *ʻili kūpono* of Kawailoa. At the time of the *Māhele*, Kawailoa was relinquished by Victoria Kamāmalu and retained by the Crown. Within the immediate vicinity of the WCCC, two *kuleana* were awarded. The first Land Commission Award was to Kuahine (LCAw. 6969) and the other to H. Kalama (LCAw. 4452). Additionally, one Government Grant was awarded to Kamanu (Land Grant 1932) located within the *ʻili* of Kapakapa. A single *Māhele* Award (MA 44) located in the *ʻili* of Kaulu was granted to Kalaau (Figure 44). An analysis of the Native Testimony for Kuahine reveals that taro cultivation was once practiced in this area.

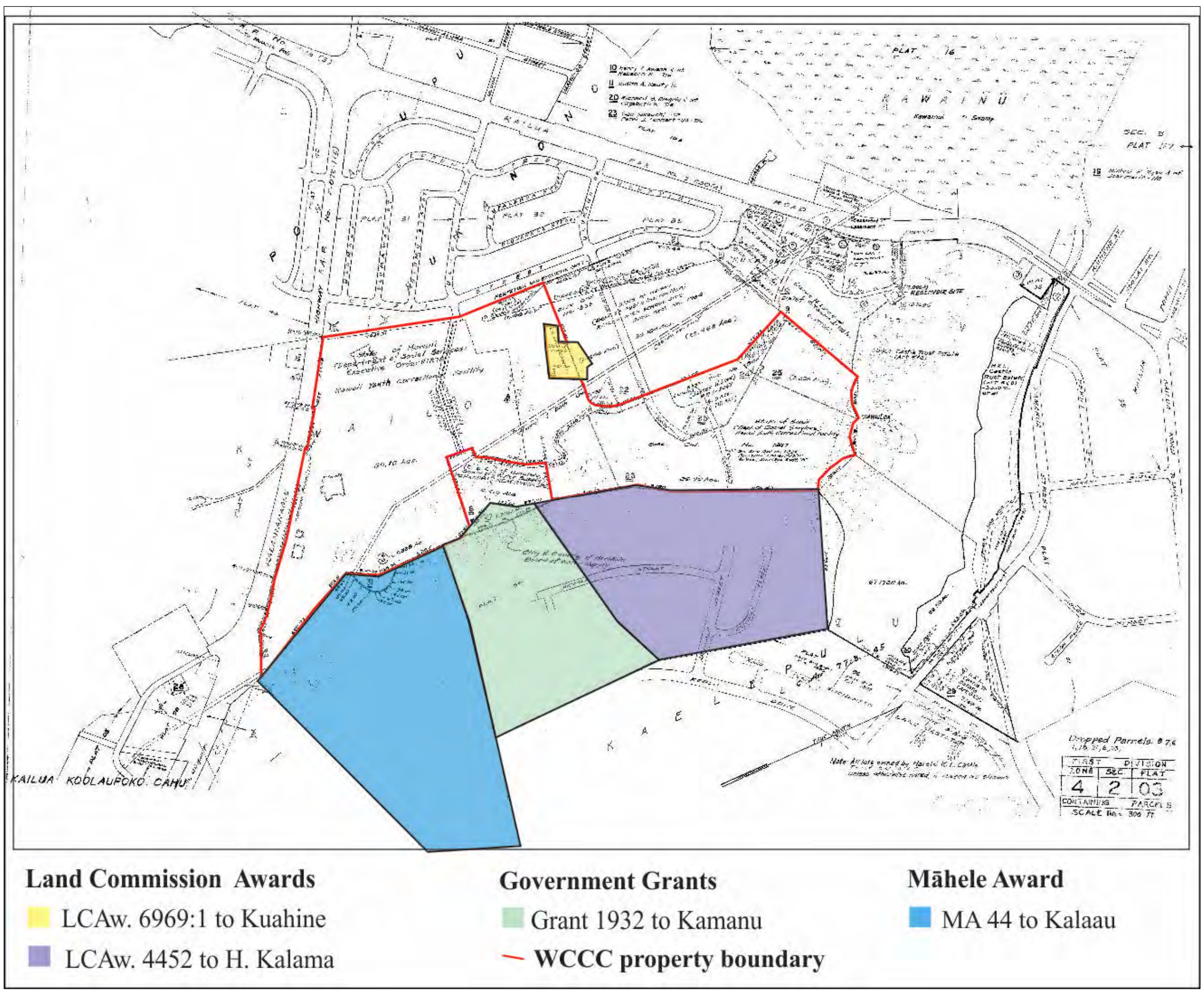


Figure 44. TMK map with LCAw., Government Grants and Māhele Awards located in the vicinity of the WCCC.

The WCCC is located within a roughly 130-acre *makai* portion of the 573-acre Koolau Correctional Complex property owned by the State of Hawaiʻi (DHM Planners Inc. 1990). The only all-female facility in the islands is located on the site of a former Hawaii Youth Correctional Facility, known as the Koolau Boy's Home, which was constructed in 1950 (Legislative Auditor 1986). A 1957 Hawaii Registered Map (No. 4099) shows the buildings and associated infrastructure of the Koolau Boys Home facility within the boundaries of the WCCC property (Figure 45). The first such facility was established in March of 1865 in Kapalama, and known as the Keoneula Reformatory School (Kamehameha V 1870). This original facility was established under the supervision of the Board of Education "for the care and education of helpless and neglected children, as also for the reformation of juvenile offenders" (Kamehameha V 1870:59). Juvenile offenders were classified as under the age of fifteen who live "an idle or dissolute life, whose parents are dead, or if living, from drunkenness or other vices or causes, shall neglect to provide suitable employment for, or exercise salutary control over such child" (ibid.). Over the next century, the youth correctional facility was relocated and changed names and jurisdictions several times (Legislative Auditor 1986). In 1950, the Territory of Hawaii built the boys a new facility called the Koolau Boys Home across from the Kawailoa Girls' Home (also known as Kawailoa Training School) facility, which had been built in 1920 (1986). Then in 1961, the boys and girls' homes were combined into the Hawaii Youth Correctional Facility under the jurisdiction of the Department of Social Services.

Three of the residential structures built during the initial construction of the facility remain within the WCCC property: Olomana Cottage, Kaʻala Cottage, and Maunawili Cottage. These so-called cottages are two-story concrete residential buildings with central courtyards within. These three original buildings are arranged in a semi-circular fashion around a more recently constructed administration building, pavilion, armory, and guard building (gate house), which are located where the Koolau Boys Home office used to be (see Figure 45); and currently serve as housing and support services. Four other structures from the days of the original facility are also extant within the WCCC property. The roughly U-shaped building in the central western portion of the property, closest to Ulupii Street, is labeled "repair" on the 1957 map and is today referred to as the warehouse. Remnants of the so-called "hot house" also remain, which is used for gardening-related activities. Lastly, two of the smaller buildings whose uses are unspecified on the 1957 map, located at the southeast corner of the WCCC facility property on the east side of a short cul-de-sac are also still standing. At least one of these buildings appears to have undergone renovations including the construction of an addition at some point as can be seen in Figure 46.

A comparison of a series of aerial photographs (see Figure 46) of the WCCC property illustrate the following progression: Olomana Cottage, Kaʻala Cottage, and Maunawili Cottage, the office, and the three easternmost small buildings are clearly visible in a May 26, 1952 USGS aerial photograph, as well as a portion of the repair building. By January 30, 1959, the repair building is present in its entirety as is the larger square hot house building and the remaining smaller structures in the southeastern corner of the property. Between 1992 and 1994, minor renovations were made to the original buildings; and a fourth building called Ahiki Dormitory was added to the facility in 1999 concurrent with the installation of portable housing known as Hoʻokipa cottage.

The same series of aerial photographs (see Figure 46) clearly demonstrates the development and urbanization of the vicinity of the WCCC facility. In particular, the construction associated with the residential subdivision known as Enchanted Lake, located to the east of the WCCC facility surrounding Kaʻelepulu Pond is absent from the 1950s photographs but strikingly present in the 1978 image. According to the Enchanted Lake Residents Association (ELRA) website, development of Enchanted Lake began with Keolu Hills in 1960 and included the reduction of the area covered by Kaʻelepulu Pond and marsh from roughly 280 acres down to a mere 79 acres (ELRA 2017). This modification of the natural landscape is also clearly visible in the aerial images.

In 1991, the Public Safety Department began relocating female prisoners from the old WCCC to the remodeled Koolau Boys Home facility (Carter Goble Associates, Inc. 2003:B-4). Around this time, the WCCC was considered to be temporary in nature; renovations and improvements to the former Youth Correctional Facility were begun due to litigation against the state over confinement conditions for women (Carter Goble Associates, Inc. 2003). These renovations were completed in 1994 and WCCC became "the State's primary women's all-custody facility" (ibid.:3-2). Today, the WCCC serves as the primary facility for female sentenced (felons, probation, and misdemeanor), probation/parole violators, and "any female prisoner who presents a significant management, security or healthcare risk at the County CCCs" (ibid.:3-3). The facility began in 1991 with 150 beds and by 2001, had an overall capacity rating of 232 beds (ibid.). The current rated capacity of the WCCC is 260 beds (Louis Berger 2017a).

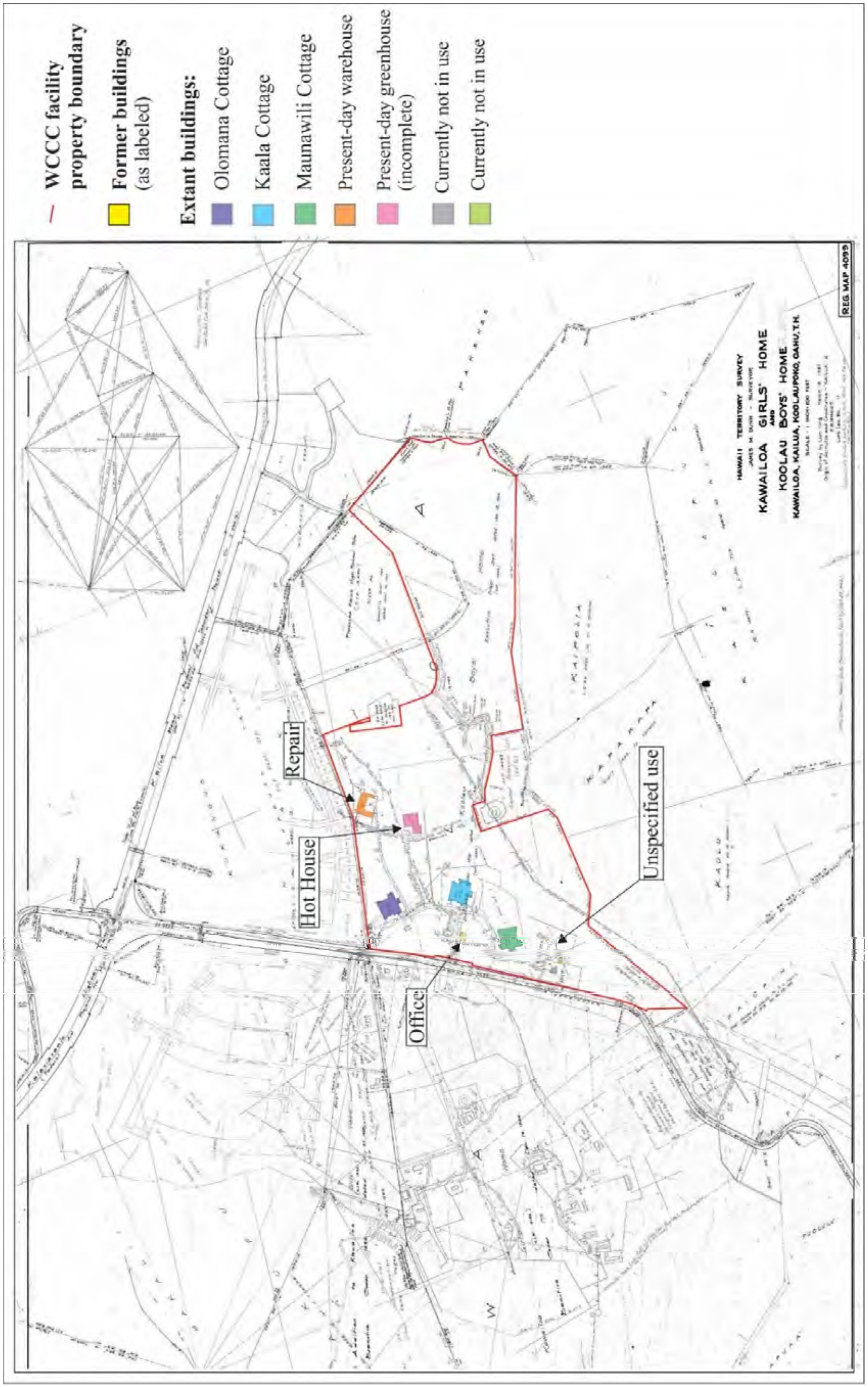


Figure 45. Hawai'i Register Map 4099 (dated 1957) of the Koolau Boys' Home and the Kawailoa girls' Home

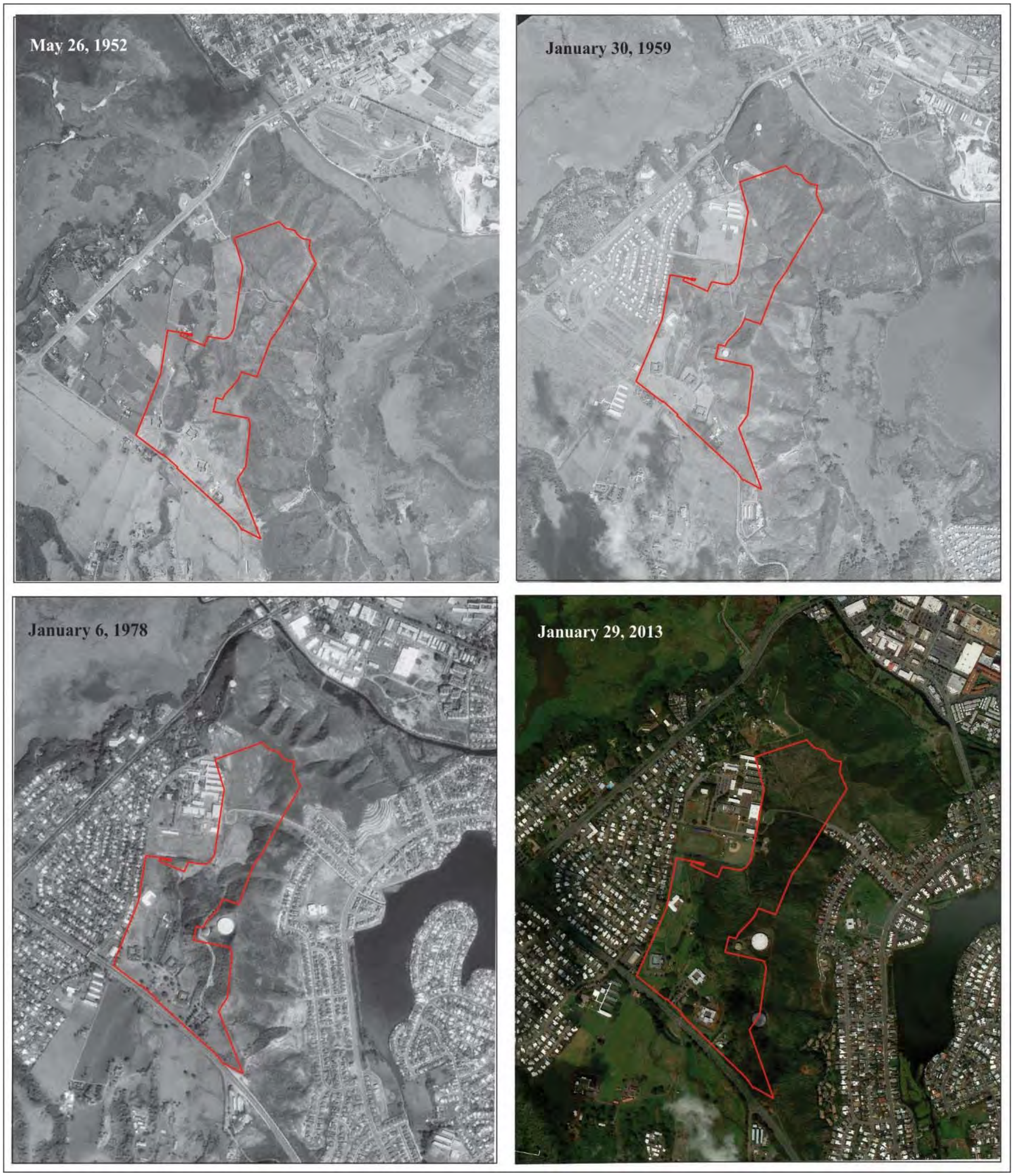


Figure 46. Series of aerial imagery 1952 to 2013.

PRIOR RELEVANT STUDIES

The following discussion summarizes previous archaeological and cultural studies conducted within the immediate subject area vicinities that are relevant to the current study. The earliest relevant archaeological study conducted appears to be that of Thomas G. Thrum, who created a list of the *heiau* of ancient Hawai'i in the early 1900s. Thrum published his list of *heiau* in a series of entries in the *Hawaiian Almanac and Annual*, beginning with the 1907 edition. Of his investigations, Thrum noted the following:

> This much is being realized, and expressions of regret have been freely made, that we are at least fifty years too late in entering upon these investigations for a complete knowledge of the matter, for there are no natives now living that have more than hear-say information on the subject, not a little of which proves conflicting if not contradictory . . . While these difficulties may delay the result of our study of the subject, there is nevertheless much material of deep interest attending the search and listing of the temples of these islands that warrants a record thereof for reference and preservation. (1906:49-50)

Thrum and his associates compiled information on over seventy *heiau* on O'ahu. One must take into consideration that Thrum included data on *heiau* that had already been destroyed prior to his data collection efforts in the early 1900s. The results of his informal investigations relative to the subject *ahupua'a* are reproduced in Table 1 below.

Table 1. *Heiau* sites recorded by Thrum* in the vicinity of the current subject areas.

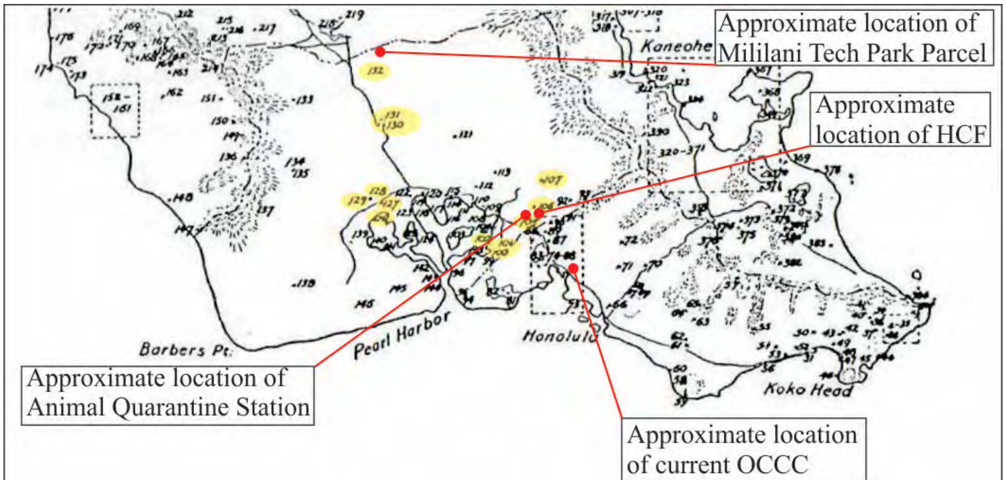
Name	***Location***	***Thrum's Remarks***
Keaiwa	Waikele, Ewa	Site not identified. Heiau pookanaka, where the chief Hao was surprised during temple worship and slain with his priest and attendant chiefs by direction of the Moi of Oahu, about 1650. (1906:46)
Keaiwa	Waimalu, Ewa	Built by Naulu-a-Maihea in 12^{th} century. Class and size unknown. Foundations were noticeable in 1880; site now lost. (1906:46)
Kaieie	Kalihi-uka	On premises of Dr. Huddy; of hoouluai class. Haumea its deity. Parts of foundation only remain. (1908:41)
Kaaleo	Kalihi-kai	No particulars ascertained. (1908:41)
Haunapo	Kalihi-kai	No particulars ascertained. (1908:41)
Kaumahaloa	Hālawa	Mauka of main road, about 70x80 feet in size, built before time of Kakuhihewa, 1560; destroyed during Kam. IV reign, about 1860. (1906:46)
Waikahi	Hālawa Valley	At Honolulu side of stream, on upper side of government road, from which it may be seen. About 80 feet square, of pookanaka class; Manuuokao its kahuna. (1906:46)
Kanahau	Kailu	A small-sized structure of the hooulu ai, or husbandry class. (1915:88)
Makini (Mookini)	Kailua	In Kaonia, on the Kapaa slope, facing the range of hills dividing Kaneohe. This had been reported as Makini, but is generally known to the people of Koolau as Mookini. . . This Kailua heiau, like its namesake, is a walled structure, measuring 120 by 180 feet, laying N.W. and S.E., with an adjoining structure on the northern side 32 by 38 feet, though this may be of modern service. Unfortunately a heavy growth of guava, lantana and other shrubbery within the heiau enclosure precluded the possibility of an examination of its features, to learn its condition and judge its character, which doubtless, like Ulupo, was of the pookanaka—or human sacrifice—class. . . its paving had been disturbed to permit some agricultural effort. Some little distance up the slope a rocky ledge from which an advantageous view of the heiau would have been obtained but for the dense growth referred to. It proved of interest, however, in possessing a large, flat stone with a peculiar natural grooved surface, and of sufficient size to accommodate a man's body if it had any connection with the ancient temple sacrifices. (1915:86)

*Adapted from Thrum (1906,1908, and 1915)

The earliest relevant formal archaeological survey of O‘ahu was conducted by J. Gilbert McAllister on behalf of the Bishop Museum during nine months in 1930. McAllister's purpose was "to collect information regarding the archaeology of Oahu" (McAllister 1933:3) and he made it clear that his investigation was a beginning rather than a complete account of all the cultural resources on O‘ahu. McAllister also made the following statement in his introduction regarding the state of cultural resources on O‘ahu at the time:

> As the archaeological remains are those of the people found in Hawaii by the early voyagers, contact with Hawaiians was an indispensable part of the work. Not only are the sites being destroyed by the changes wrought by European culture, but with the introduction of exotic vegetation many sites have been completely hidden. Such remains would be as good as lost, were it not for the knowledge of them still treasured by old residents (*kamaaina*) of Oahu. With the passing of these old people most of this information will disappear. (ibid.)

The locations of some of the sites recorded during McAllister's investigations, relative to the subject areas on the leeward side of O‘ahu are depicted in Figure 47. McAllister's remarks for sites recorded in the subject *ahupua‘a* are reproduced in Table 2 below. Lastly, the locations of sites recorded to the north-northwest of WCCC in windward O‘ahu are depicted in Figure 48. Like Thrum before him, McAllister also included data on sites that had already been destroyed prior to his data collection efforts.



Partial map of O‘ahu showing McAllister's Sites: 72, 73, 105-107, and 127-132 highlighted yellow (1933:57).

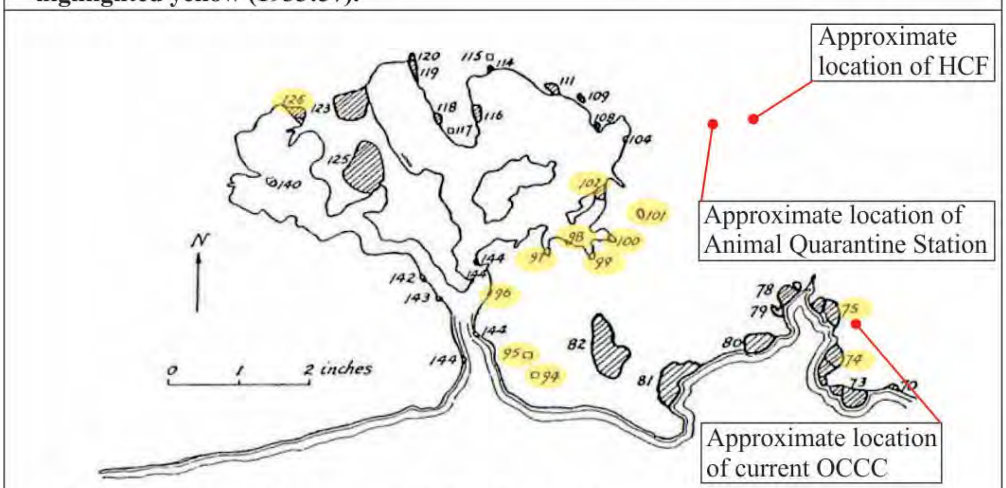


FIGURE 2.—Pearl Harbor and Kalihi Basin. Areas marked by diagonal lines are fishponds; those indicated by squares are ancient ponds now filled in. The numbers refer to sites described in the text.

McAllister's Sites: 74, 75, 94-102, and 126 highlighted yellow (1933:29).

Figure 47. Site locations per McAllister in the vicinity of the subject areas in leeward O‘ahu.

Table 2. Sites recorded by McAllister (1933) in the vicinity of the subject areas.

Site #	*Site Name*	*Location*	*McAllister's Remarks*
72	Kalihi Valley	Kalihi	If any archaeological remains yet exist in Kalihi Valley, they are not known to the Hawaiians. David Kama, who is caretaker of the water reserve, tells me that he has heard the drums on nights of Kane, above his house, but he has never found the heiau.
73	Ananoho fishpond	Kalihi	An oval-shaped pond 52 acres in area. The walls approximate 4700 feet in length and average 6 feet in width. They are primarily of coral and average 3 feet in height. There are now two houses on the wall, but houses and *makaha* are modern. Auiki is a small adjoining pond partly filled. It is 12 acres in area with a 900-foot wall.
74	Pahouiki, Pahounui, and Apili fishponds	Kalihi	Pahouiki is the smallest, being 14 acres in area with a wall 1050 feet in length. The wall is of coral, with one house and two *makaha* now. It is open to Pahounui, a pond of 26 acres with a wall 2600 feet long. The walls are also of coral with one house and two *makaha*. It adjoins but does not open to Apili pond, which is 28 acres in extent, with a wall 1500 feet long.
75	Weli and Kaikikapu fishponds	Kailhi	Between Kahauiki and Mokumoa Island; Said to be 30 acres in area. The greater part of its walls appear to be earth embankments, mostly natural. It is now separated from Kaikikapu pond by a roadway. Kaikikapu is 20 acres in area with a wall from Mokumoa Island to Moanalua 900 feet long.
94	Loko Waiaho	Hālawa	Known as Queen Emma's pond, was located near Watertown. The walls were of coral rock and sand, 6.5 feet wide, 2 feet high, with five outlets (*makaha*). It covered an area of 32 acres.
95	Loko Ke'oki	Hālawa	Was a pond near the present site of Watertown in Halawa. It had narrow wall [sic] of coral rock and sand. It has been filled in.
96	Papiolua fishpond	Hālawa	Was located opposite the tip of Waipio Peninsula. It was a small pond, about 1 acre in area with a wall 150 feet long, 4 feet wide and high, There were no outlet gates (*makaha*).
97	Loko-a-Mano	Hālawa	[Also referred to as] Loko Amana, filled in before 1900, was located at the present site of the Navy yard.
98	Loko Pohaku	Hālawa	Was a small pond of 2.5 acres at the present site of the Navy yard.
99	Wailokai fishpond	Hālawa	Was another very small pond.
100		Hālawa	Possibly the site of Wailowai fishpond.
101	Makalapa Crater	Hālawa	Now being used for a fresh-water pond. Believed to be recent.
102	Loko Kunana and Loko Muliwai	Hālawa	Between Halawa and Kuahua Island. Kunana has been partly filled in but was formerly 25 acres in extent. Kuahua island forms one side and the opposing wall is formed by Halawa. The two walls running between the land and the island are 1800 feet and 1950 feet long, approximately 5 feet wide, and 3 feet high. Loko Muliwai is only 4 acres in extent, a portion of which has been filled. Its wall is 500 feet long with one outlet. *(makaha)*
105	Waikahi Heiau	Hālawa	On the flat area on the mountain side of the road where the two gulches of Halawa meet. The site is now planted in cane and completely obliterated.
106	Waipao Heiau	Hālawa	Near the mouth of Kamananui Gulch. The structure was on a narrow flat at the entrance of a small ravine running into the north wall of the gulch. The heiau was destroyed a few years ago when there was an attempt to plant cane on this land, and the lines of stones which follow the old furrows are all that remains. My Hawaiian informant told me that the surrounding caves were formerly used as places of burial.

table continues next page

Table 2 continued.

Site #	***Site Name***	***Location***	***McAllister's Remarks***
107	Keaiwa Heiau	Hālawa	A small rectangular structure, 100 feet by 160 feet, of one terrace with low surrounding walls. The only definite feature within the inclosure [sic] is a short low stone wall running parallel with the sides. The walls average about 4 feet in height and about 5 feet wide and are evenly faced with one-foot stones with a rubble fill. A small outer step or terrace on the southwest corner may formerly have been an entrance. Since the surrounding area was once under cultivation, any adjoining features were obliterated. The slope west of the heiau must have eroded very rapidly after being plowed, for that wall has been almost completely destroyed by the large amount of soil that has washed over and into the heiau. The great number of loose stones lying in the whole of the west end would indicate former platforms or terraces. The heiau faces south, overlooking Puuloa.
126	Kaaukuu and Pouhala ponds	Waikele	(The ponds formerly adjoined) According to Cobb [1901,1902], Kaakuu was 41 acres in extent and Pouhala was 22 acres. The ponds have now been made into a number of smaller ponds and rice fields. Cobb also lists two other ponds in Waikele, Maaha of 48 acres, and Mokuola of 23 acres.
127	Mokoula Heiau	Waipahu	The heiau has been completely destroyed for building purposes of the neighborhood. The site is at the edge of a 50-foot elevation which projects out into the present rice fields and was pointed out by Kaluawai, a *kamaaina* undoubtedly more than 100 years old.
128	Waipahu spring	Waipahu	Famous in tradition as the place at which the tapa mallet appeared after having been lost in Kahuku. A pump has been placed over the site.
129	Hapupu heiau	Waipahu	The Waipahu plantation stables on the mountain side of the road across from the schoolhouse west of the town now occupy the site of the former heiau at Waikele. Nothing remains of the heiau. The site was pointed out by Kapano. [listed by Thrum as Keaiwa Heiau in Waikele]
130	Moaula heiau	Kipapa Gulch	On the Honolulu side of Kipapa Gulch just above Heaiu o Umi, to which it is said to be a companion structure. The site is now covered with cane.
131	Heiau o Umi	Kipapa Gulch	Was just northeast of the government road in the bottom of Kipapa Gulch on the slight elevation at the foot of the pali on the Honolulu side. The level elevation can still be seen, though planted in cane.
132	Waikakalaua and Kipapa Gulches		Waikakalaua is the place where the invading chiefs from Hawaii met Mailikukahi, moi of Oahu, in battle. [McAllister cites Fornander here]
353	Kinikailua-Manukaneohe	Kailua	A spring on the land known as Kaena (now Kokokahi). It is said that the people from both Kailua and Kaneohe died in great number from drinking its waters.
359	Pahukini Heiau	Kailua	This heiau is known by Mahoe, Bell, Kaleleiki, and Kalani as Pahukini. It is a large, walled structure approximating 110 by 175 feet in interior dimensions, located across the top of a ridge. There is a small inclosure [sic] adjoining the north wall which Thrum believes is of "modern service." All that remain[s] of heiau features are the small terrace against the west wall and a ledge along the interior of the south wall. The paving has been disturbed and has been piled into small mounds through the heiau. There is a 5-foot break in the west wall at the south corner, which probably served as an entrance. [listed by Thrum as Makini Heiau]
360	Holomakani Heiau	Kailua	Located in Kapaa, Kailua. This heiau, on the mountain side of Kawainui fishpond, was destroyed and the land used for agricultural purposes. It was just beneath Pahukini.
361	Keealau fishpond	Kailua	Covering 3 acres, is adjacent to Keealau.
362	Hanalua fishpond	Kailua	Takes its name from the adjacent land. It is a small pond a few acres in size and marks off an inlet.
363	Papaa fishpond	Kailua	Named for the land to which it is adjacent. It is a small pond.

table continues next page

Table 2 continued.

Site #	*Site Name*	*Location*	*McAllister's Remarks*
363-A		Kailua	Akua stone probably located on the ridge between Kailua and Kaneohe.
369	Pamoa	Kailua	The approximate location in the coconut grove of the famous house built by Kakuhihewa at Alele in Kailua.
370	Kawainui pond	Kailua	Once a large fishpond. The pond belonged to the alii. Any person coming from this section, particularly Waiauia, which is near the small bridge near the sea side of the Mackay radio and telegraph station, had royal blood in his veins and could go where he wished, apparently taking precedence over alii from other sections. My informants, John Bell and Mahoe, were both much impressed with this fact. Hauwahine was the goddess (*moo*) of this pond, as well as of Paeo pond, Laie, where she stayed only when leaves and other refuse (*amoo*) covered that pond. At other times she departed to Kailua. The old Hawaiians at Kailua, however, insist that she never left Kawainui.
371	Ulupo Heiau	Kailua	Kaneohe side of the road to Kailua, near the head of the former Kawainui fishpond, Kawailoa, Kailua. Its earlier importance and size is indicated by the large open terrace 140 feet in width and 30 feet high. The paving is now very rough, undoubtedly having been disturbed by relic hunters. The stones used average about 1.5 feet in size. The sides of the terrace are not evenly faced, but are roughly piled at about a 45-degree angle. This huge mass of stones completely dominates the surrounding taro patches, and it is little wonder that the construction of the temple is attributed to the menehunes, who built in their usual fashion of passing stones from hand to hand for long distances. The pathway leading up from the spring on the northwest corner is called the "menehune pathway" and the oldest Hawaiian, Mahoe, insisted on clambering over the site to see that I did not overlook this interesting feature. It is most clearly visible on the side of the heiau, but at the top is confused with the disturbed paving. Several of the small inclosures [sic] and mounds of stone on the edge of the high terrace are described in figure 64 [Figure 49]. The south half of the structure is completely covered with *hau* so dense that it is necessary to cut one's way through. There is evidence of a small inclosure [sic], but the southern walls and extent of the heiau were obliterated in the construction of a cattle pen at the time the district was used for a pasture.
372	Kukuipilau/ Heinau Heiau	Kailua	In front of the superintendent's house at the Maunawili Training School. Kukuipilau was given as the name of this heiau by Solomon Mahoe, but the site indicated was one ridge further toward Waimanalo. As no heiau could be found at the place pointed out by Mahoe, it is believed that this is the heiau which Mr. Benkman found had been in front of his home. The stones were removed in building the road on the school ground, but the evidence on the edge of the ridge facing the sea indicates a heiau of more than one terrace. My informant, Kalani, could not remember the name of this site, but when Kukuipilau was suggested he insisted that it was correct. He also said that the small gulch on the side of Olomana, in back of the school, is known as Kukuipilau, because the kukui nuts from there were not edible. Below the heiau and near the road is a spring known as Kawailoa, said to have been formerly a part of the heiau. When Thrum was in Kailua in 1915 he was told of Heinau heiau. According to available information the land name upon which the Training School is situated is Kawailoa. However, I feel quite certain that Heinau and Kukuipilau are one and the same.
377	Kaʻelepulu fishpond	Kailua	Formerly a fresh-water pond of much importance. It is located inland, about two-thirds of a mile from the shore. The Alexander map of 1884 shows a water area of 190 acres, with marsh land amounting to 90 acres. After carefully studying the conditions relative to this pond, Mr. J. McComb is of the opinion that the entire area of 280 acres was the pond. According to Cobb, the pond covered 216 acres. The pond was limited by natural contours and some earth embankments. There was an outlet (*makaha*) on the sea side. Formerly there were taro patches between the pond and the stream from the Kawainui swamp. The stream was diverted into patches and from the taro terraces ran into Kaelepulu. When the taro land was being dried, there was a ditch which could be used to bring water from the Kawainui stream to the pond. It was from this pond that Ulanui, the celebrated foot-runner, was said to be able to carry a fish by way of Waialua to Waikiki while it was still alive and wriggling.

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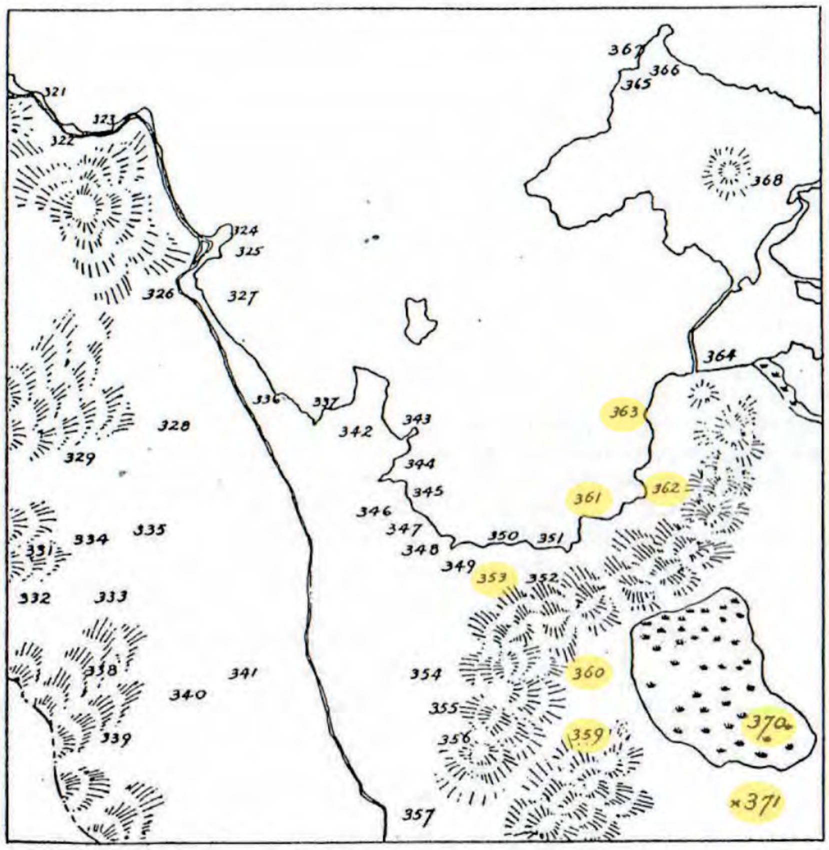

FIGURE 59.—Map of the Kaneohe-Kailua region showing location of Sites 321-371

McAllister's Sites 353, 359-363, 370, and 371 highlighted yellow (1933:172), located to the north-northwest of WCCC (not pictured).

Figure 48. Site locations per McAllister (1933) in WCCC vicinity.

Of the thirty-five sites recorded by McAllister and selected for inclusion in this discussion only four of the sites retain some of their original construction. All four sites are *heiau* that are listed on the National and Hawaii Registers of Historic Places. Keaiwa Heiau (SIHP Site 80-09-0107) is situated at the entrance of a 384-acre park known as the Keaīwa Heiau State Recreation Area, which includes a campground amidst groves of Norfolk pines and eucalyptus trees that were planted in the late 1920s. According to the DLNR website, Keaīwa Heiau is a *heiau ho'ola* or healing/medicinal *heiau* that may have been named after its *kahuna* Keaīwa, who served under Kakuhihewa around the sixteenth century. The sacred area measures 100 feet by 160 feet and is enclosed by a 4-foot high rock wall; the *heiau* itself suffered extensive damage during World War II because soldiers took stones from the structure to build a nearby road. Keaīwa Heiau was rededicated in 1951.

The remaining three sites are located within Kailua. The location of Ulupo Heiau (SIHP Site 80-11-0371) appears clearly marked, to the northwest of the WCCC on the USGS topographic map (see Figure 3). According to the DLNR website, the *heiau* platform measures 140 by 180 feet with walls up to 30 feet high, which corroborates McAllister's records of the site ca.1930 (see Figure 49). Ulupo Heiau was transferred to Territorial Parks in 1954 from the Territorial Board of Agriculture and Forestry. Kukuipilau Heiau (SIHP 80-15-0372), located to the south-southwest of the WCCC, was still in good condition ca. 1999; with three intact terraces, walls, and paving (Becket and Singer 1999). Pahukini Heiau (SIHP 80-11-0359) is found to the west of Ulupo Heiau off Kapa'a Quarry Road. It is a 120 by 180 feet rectangular enclosure that has sustained damaging impacts for decades of erosion and disturbances associated with the nearby quarry and landfill. Pahukini Heiau underwent restoration in the 1980s but still appears much as it did ca. 1930 when McAllister reported that the paving stones had been piled into mounds within the enclosure. Access to this historic site is very limited unlike the others mentioned above, which are eaily accessed by the public.

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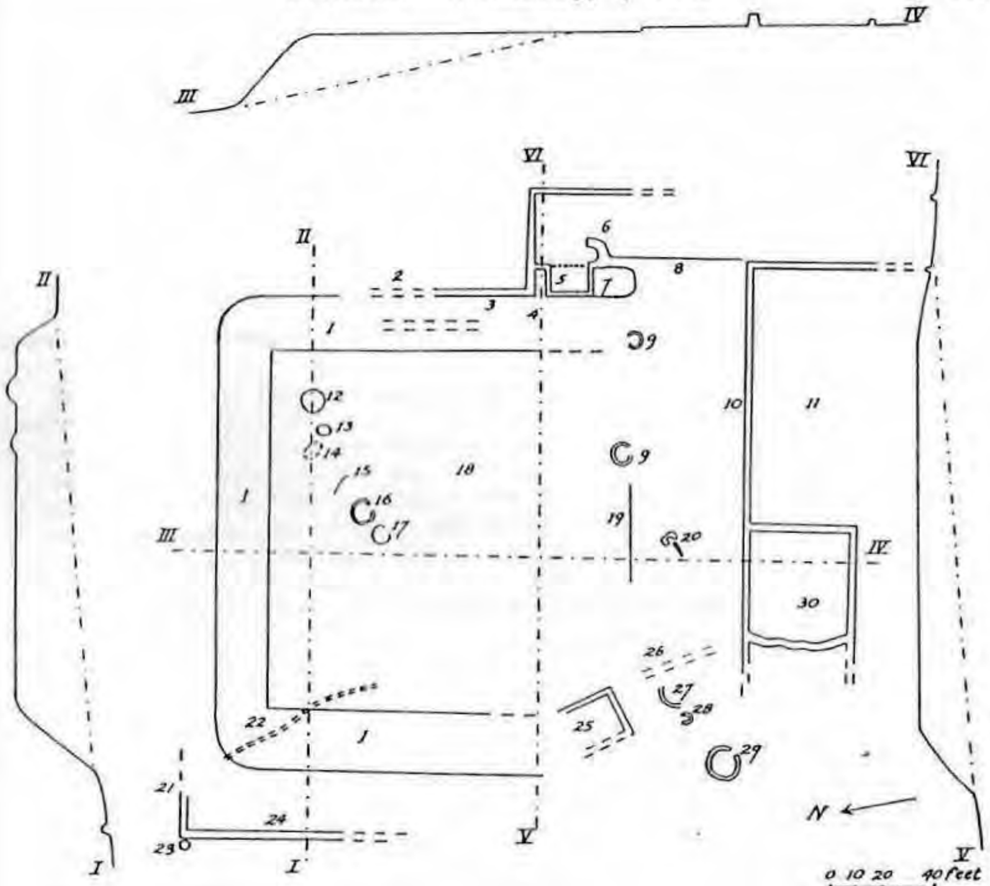

FIGURE 64.—Ulupo heiau, Kailua, Site 371. 1, sides of terrace form slope 30 feet high roughly piled with stones (pl. 4, *A*); 2, crudely built wall 40 feet from top of terrace, 5 to 6 feet high, broken lines indicate slight evidence of terracing; 3, wall evenly faced with 2-foot stones, 4 to 5 feet high outside, paved flush with 6-inch stones on heiau side; 4, small inclosure 4 feet wide, 7 feet long, walls 2 feet high and wide on three sides, open on heiau side; 5, inclosure 14 by 7 feet, with wall 5 feet high on heiau side, and a line of stones on outside; 6, curved arm of large 2-foot stones 6 feet wide, 3 feet high; 7, stone-paved area, slightly depressed; 8, slope 5 feet high probably formerly stone-faced; 9, circular inclosures with low surrounding walls similar to pens 16 and 17; 10, outer wall to pen 11; 11, former cattle pen now planted in bananas; 12, stone mound 4 feet high, 10 feet in diameter, with several large flat stones about base; 13, round pile of stones 4 feet in diameter, larger stones on outside and small stones in center; 14, small mound of stones; 15, irregular wall built of 6-inch stones, 10 feet long, 2 feet high and wide; 16, pen similar to pen 17 with better constructed walls 2 feet high, but rough paving, small break in wall to south; 17, circular pen paved with 3-inch and 4-inch stones, 9 feet in diameter, with walls of roughly piled stones 1 foot high, small break in wall to south; 18, open terrace 140 by 180 (?) feet by 30 feet high; 19, portion of low terrace 1 foot high; 20, partial inclosure, with flat stones forming pathway; 21, portion of low stone wall; 22, menehune pathway visible for about 60 feet, formed by placing a double row of flat stones (pl. 5, *C*) in line, usually sloping, but occasionally placed one above the other so forming narrow steps; 23, well 3 feet in diameter; 24, portion of low stone wall; 25, partial inclosure 20 feet square on side of slope and open to the north; 26, line of stones formerly a wall; 27, semicircular wall 4 feet high, 8 feet long; 28, small partial inclosure, sides 1 foot high; 29, circular inclosure, 10 feet in diameter with wall 3 feet high and small entrance on the south; 30, inclosure 40 feet square. Roman numerals indicate cross sections.

Figure 49. Plan view and description of Ulupo Heiau from McAllister (1933:187).

During the decades that followed McAllister's initial survey of O'ahu, no archaeological studies of the subject *ahupua'a* were produced. However, beginning in the late 1970s, lands within the subject *ahupua'a* became the focus of multiple archaeological investigations related to the ongoing residential and commercial development of the area as well as transportation related projects, such as Interstate and rail. Many of these studies reported extensive agriculture related modification to the landscape. The results of previous archaeological and cultural studies conducted within subject area vicinities are discussed in detail below.

Previous Studies near Animal Quarantine Station and HCF

Beginning in the late 1960s, Hālāwa Ahupua'a was the subject of archaeological studies related to the planning and construction of the H-1 Interstate (Cluff 1970) and later for the H-3 Interstate (summarized in Hartzell et al. 2003). While other studies focused on resources in Hālāwa Valley (Rechtman and Henry 1998; McGuire et al. 1999; Hartzell et al 2003). The results of previous studies conducted within closest proximity to the Animal Quarantine Station and HCF study areas (Table 3) are presented below, and their locations relative to the current subject area are depicted in Figure 50 below.

Table 3. Previous studies conducted in the Animal Quarantine Station and HCF study area vicinity.

Year	*Author*	*Ahupua'a*	*Type of Study*
1970	Cluff	Hālawa	Survey
1970	Ayers	Hālawa	Archaeological survey
1971	Denison and Foreman	Hālawa	Archaeological survey
1972	Crozier	Hālawa	Archaeological survey
1976	Sinoto	Hālawa	Reconnaissance Survey
1994	Hammatt and Winieski	Hālawa	Reconnaissance Survey
1998	Rechtman and Henry	Hālawa	Reconnaissance Survey
1999	McGuire et al.	Hālawa	Archaeological Assessment
2003	Hartzell et al.	Hālawa	AIS
2008	Cleghorn and Kahahane	Hālawa	Archaeological Assessment
2013	Kay et al.	Hālawa	AIS

In 1969, DLNR staff conducted a reconnaissance survey (Cluff 1970) of the 28-acre site for the then-proposed Hālawa Interchange of the H-1 Interstate, located to the northwest of the Animal Quarantine Station (see Figure 50). After the pedestrian survey, the field crew conducted intensive survey of a 42-meter by 344-meter area along the southern edge of Saratoga Drive, a short street that formerly extended across the site of Aloha Stadium. As a result of the survey, DLNR recorded eight Historic features, including a possible *heiau* site (Feature 1), a stone paving with concrete slab (Feature 2), stone walls (Feature 3), possible burials (Features 4 and 5), and three burial plots (Features 6-8). They conducted test excavations of the possible *heiau* site (Feature 1), which revealed evidence of human occupation but did not indicate a specific function architecturally. Based on the abundant historic artifacts encountered, Cluff suggested that the site had possibly been a *heiau* that was later converted to a habitation platform. No further archaeological work was recommended for the features encountered; however, Cluff urged that qualified archaeologists be involved in the disinterment and reburial process, and that cultural materials be salvaged if encountered during construction of the interstate and the stadium.

In 1970, Bishop Museum conducted a phase I archaeological survey and excavations (Ayers 1970) in two discontinuous portions of south Hālawa Valley and Kamana Nui Valley; the Hālawa Valley study area crosses the central portion of the HCF property (TMK Parcel 030) and extends west to the eastern boundary of the Animal Quarantine Station (TMK Parcels 046 and 070; see Figure 50). A total of forty-eight archaeological sites were identified within south Hālawa Valley, located primarily to the east and north of the quarry: many were of agricultural function and included terraces, house platforms, walled residential structures, walls, mounds, and a stream diversion feature; in addition to caves, a C-shaped feature, a well, a road, and animal enclosures. Ayers (1970) recommended mapping and excavation for twenty out of the forty-eight sites he identified.

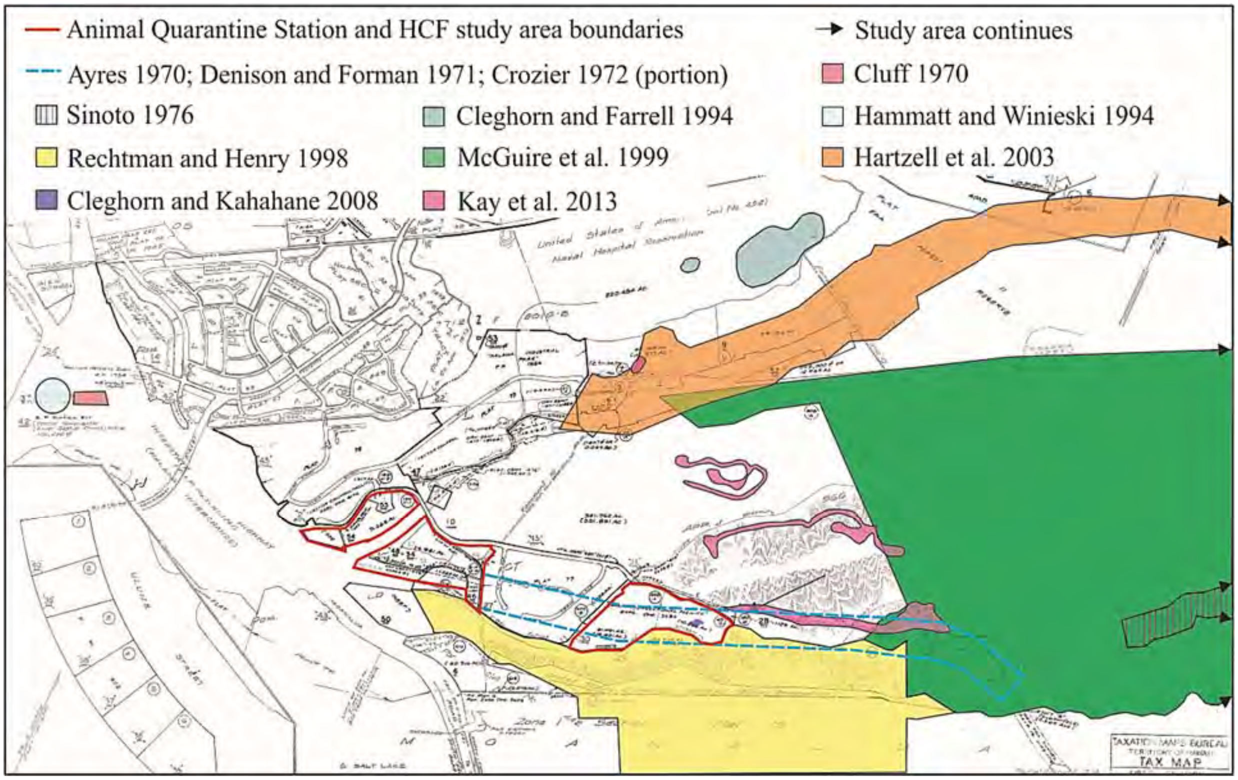

Figure 50. Locations of relevant previous archaeological studies conducted within the Animal Quarantine Station and HCF vicinity.

One year later, Bishop Museum personnel returned to the same study area and conducted part I of phase II archaeological investigations (Denison and Foreman 1971). They observed that sixteen of the forty-eight sites were concentrated in a small area bounded by Hālawa Stream and another side stream; located to the east of HCF. In 1972, Bishop Museum conducted part II of phase II (Crozier 1972), which focused on four sites that still needed intensive survey and restoration after the earlier studies: an enclosed stone wall complex (Bishop Museum Site 50-Oa-B1-30), two walled structures/*heiau* (B1-33 and B1-66), and a residential and agricultural site (B1-67). Site B1-30 was interpreted as the possible residence of *ali'i*. This site's features included a round-ended *hale noa* (family sleeping house), the first of its kind uncovered in Hawai'i, a *mua* (men's eating and gathering place), and a cooking area.

The site closest to the Hālawa subject area identified as a result of these investigations was Site B1-33, located roughly 470 meters to the northeast of the eastern boundary of HCF. Ayres (1970) initially described Site B1-33 as a walled house structure. Later, Denison and Forman (1971) reclassified Site B1-33 as a *heiau* with three associated features that include two terraces, two stone rings, and four stone mounds. No artifacts or midden were recovered from test excavation within the *heiau*; but some artifacts recovered in the walls and nearby rubble included "two adz blanks, one crude adz, two adz fragments, one core scraper, and one core" (Denison and Foreman 1970:31). Denison and Foreman reclassified this site based on the following reasons: "1) the distribution of sites in the survey area; 2) the size of the structure [9 meters by 10 meters—larger than typical house platforms]; 3) the presence of coral; and 4) the negative evidence of the test pits" (ibid.:33). Two years later, Crozier (1972) conducted further investigation and restoration of Site B1-33, as follows:

> A stabilization and restoration project was undertaken on this rectangular enclosure, which is believed to have served a religious function—perhaps as a family *heiau* or shrine. Fortunately, two of the enclosing walls had survived the hazards of time, and the data gathered from the observation of these walls enabled us to reconstruct accurately the remaining, partially disturbed structure.
>
> When the area surrounding the enclosure was thoroughly cleared of vegetation and rubble, we were able to uncover the base stones and corners of the steps and walls [Figure 51]. Again, careful study of the remaining, undisturbed areas guided us in assessing the height, size of stones, and width of the pavement.

> I believe that Denison's interpretation of this structure as a *heiau* has been strengthened by our recent investigation and restoration. The height of the walls, the overall size of the feature, and the stepped platform are all indicative of a religious structure rather than a house site. The unique architecture of site B1-33 can be appreciated when comparing it to the sketches and photographs of the many other known *heiau* in the Hawaiian Islands.
>
> The presence of a stepped, rounded platform is uncommon in precontact features found in Hawaii. It is now up to the interested and concerned parties to preserve this site and possibly provide an authentic display for visitors. (Crozier 1972:4)

Figure 51. "View of Heiau Site B1-33 after restoration, looking NE" (Crozier 1972:6).

In 2013, Cultural Surveys Hawaii (CSH) completed an AIS (Kay et al. 2013) for the Hālawa Valley Transmission Line Relocation Project, a discontinuous 21.49-acre area that lies intermittently to the north/northeast of HCF (see Figure 50). The southernmost portion of their study area fell largely within the Ayers (1970), Denison and Foreman (1971), and Crozier (1972) study corridor. No new archeological sites were identified as a result of the AIS; but twelve previously identified archaeological sites were relocated within and near their study areas, including Site B1-33 (SIHP Site 50-80-10-657), which was located immediately outside their study area. CSH made the following observations of SIHP Site 657 during their recent fieldwork:

> It is approx. 20 m south of the substation access road, near the intersection of the BWS [Board of Water Supply] road. . . The entire site is thickly overgrown by tall grasses. . . the condition of the site seems unchanged since the restoration work was completed. (Kay et al. 2013:82)

SIHP Site 657 is currently under the stewardship of the cultural organization Pā Ku'i A Lua, through a curatorship agreement with DLNR-SHPD (see consultation section below). CSH recommended no further archaeological work for the ridge-top pole locations or for all HECO (Hawaiian Electric Company) work conducted within the existing quarry. They also recommended that a combination of archaeological monitoring and temporary delineation measures should be employed within the areas of significant sites, should any work near the sites be necessary.

In 1976, Bishop Museum completed an archaeological reconnaissance survey (Sinoto 1976) for a three-mile portion of South Hālawa Valley that was slated as an alternate route for the H-3 freeway, located to the northeast of the Animal Quarantine Station and HCF (see Figure 50). Both Precontact and Historic sites were identified during this survey, with the majority of the sites found along streams and flood plain areas on the valley floor. Precontact sites consisted of a wall, a house platform, three circular walled enclosures, and agricultural terraces.

In 1994, CSH conducted a reconnaissance survey (Hammatt and Winieski 1994) of a proposed non-potable well site for irrigation, located to the northwest of the Animal Quarantine Station (see Figure 50). As a result of their fieldwork, CSH reported that any and all Precontact or Early historic cultural resources had been obliterated by extensive land modification associated with more recent historic commercial sugar cane cultivation.

Also in 1994, BioSystems Analysis, Inc. and Cultural Resource Management Services conducted an AIS (Cleghorn and Farrell 1994) of two study areas (60 acres) within the Hālawa Heights Headquarters Complex of the Military Reservation known as Camp Smith for the then-proposed construction of family housing units, located to the north of HCF (see Figure 50). As a result of their study, no Precontact or Historic cultural remains were identified. Cleghorn and Farrell reported that the entire study area had been modified by modern agriculture (grazing and commercial sugar cultivation) and/or military activities, such as recreation areas, a helicopter pad, and a former small arms range; in addition to ground disturbance caused by wild pigs and erosion associated with use of the parcel for horseback riding.

In 1998, PHRI conducted a phase I archaeological reconnaissance survey of the Red Hill Fuel Storage Area in south Hālawa Valley (Rechtman and Henry 1998), located immediately south of the Animal Quarantine and HCF study area (see Figure 50). The remains of six historic/modern features consisting of concrete slab foundations were recorded. But they were interpreted as being associated with WWII or later facility construction activities and none of the features retained their original integrity. Therefore, no significant historic properties were identified as a result of their study.

In 1999, CSH performed an archaeological assessment (McGuire et al. 1999) of a 1,728-acre portion of south Hālawa Valley to the north/northwest of HCF (see Figure 50). The areas that were most likely to be impacted by proposed activities were the low-lying flatlands surrounding the southern portion of Hālawa Stream. As a result of their study, six sites were newly identified: a burial cave (SIHP Site 50-80-13-5737), a terrace complex (SIHP Site 5738), a C-shaped enclosure that was most likely a permanent habitation site (SIHP Site 5739), a rectangular agricultural enclosure (SIHP Site 5740), a habitation and agricultural site complex (SIHP Site 5741), and a round enclosure (SIHP Site 5742). Due to the nature of the study, sites were identified, photographed and mapped but no test excavations were done.

In 2003, Bishop Museum staff prepared a comprehensive AIS report (Hartzell et al. 2003) for the North Hālawa Valley, which summarized the results of the archaeological fieldwork completed by Bishop Museum between 1987 and 1993 within the then-proposed H-3 corridor, located to the north and extending to the northeast of the Animal Quarantine Station and the HCF (see Figure 50). Over 2,000 features and 1,000 test units are documented in the report. Of these, seventy archaeological sites spanning the last 700 years were identified and documented along the H-3 lower, middle, and upper Hālawa Valley corridor. Hartzell et al. (2003:351-354) identified *ahupuaʻa*-wide patterning for Hālawa Valley, which was summarized by Kay et al. (2013) as follows:

- Use of the coastal region was well under way by A.D. 1200s or 1300s, but that it is likely that use of the upper valleys of North Hālawa and South Hālawa was relatively incidental in the period prior to A.D. 1200,
- Agricultural use and at least one early habitation in North Hālawa Valley was indicated in the A.D. 1200s or 1300s,
- After about A.D. 1500 archaeological data from North Hālawa Valley appear to document a considerable increase in the use of the upper valley for dryland agriculture and for habitation,
- Sometime prior to the late 1700s, two major *heiau* were constructed in the lower valley,
- By the mid-1800s North Hālawa Valley and likely, South Hālawa Valley as well, had few inhabitants and little emphasis on agricultural pursuits. "The exact timing of the virtual abandonment of the upper valleys of the ahupuaʻa is not known; it occurred either during the very late pre-Contact or very early post-Contact period." (Hartzell et al. 2003: 353). Settlement in the mid-1800s was almost exclusively in the lower (coastal) valley,

- Subsequently activities in the H-3 project area were largely focused on grazing, Chinese rice growing, and large scale commercial sugar cultivation. (2013:44)

In 2008, Pacific Legacy, Inc. conducted an archaeological assessment (Cleghorn and Kahahane 2008a) as part of an Environmental Assessment (EA) for the proposed construction of two prefabricated temporary structures with mobile restrooms and a storage unit within the HCF campus (see Figure 50). Their study area was located at roughly 240 feet above sea level, within the fenced-in graded area planted in grass at the western end of the extant Medium Security Facility. Pacific Legacy did not conduct a field survey; rather, they determined from a review of photographs that there was no potential for surface archaeological sites and that "the area has an extremely low likelihood of containing subsurface archaeological resources" (Cleghorn and Kahahane 2008b:5). Thus, the recommendation for the then-proposed construction project was no further archaeological work.

Previous Studies Near Mililani Tech Park

Since the 1980s, various archaeological investigations have been conducted in Waikele *ahupuaʻa*. The majority of the studies conducted in *mauka* Waikele pertain to storied Waikakalaua Gulch (Hommon and Ahlo 1983; Hammatt et al. 1988; Kennedy 1985; Sinoto 1990; Moore and Kennedy 1994 and 2003), which borders the Mililani Tech Park parcel to the south. While other studies focused on areas that were formerly planted in pineapple, which resulted in the absence of observable cultural resources not associated with historic sugar cultivation (Barrera 1985; Rosendahl 1987; Hammatt et al. 1996 and 2004). The results of previous archaeological studies conducted within closest proximity to the Mililani Tech Park study area (Table 4) are presented below, and their locations relative to the current subject area are depicted in Figure 52 below.

Table 4. Previous studies conducted in the Mililani Tech Park study area vicinity.

Year	***Author***	***Ahupuaʻa***	***Type of Study***
1983	Hommon and Ahlo	Waikele	Reconnaissance survey
1985	Kennedy	Waikele	Reconnaissance survey
1986	Hammatt	Waikele	Reconnaissance survey
1990	Sinoto	Waikele	Archaeological re-assessment
1993	Kennedy	Waikele	Burial Recovery
1994	Moore and Kennedy	Waikele	AIS
2002	Hammatt et al.	Waipio	Archaeological and cultural impact evaluation
2003	Moore and Kennedy	Waikele	Reconnaissance survey
2005	Jourdane and Dye	Waikele	Archaeological assessment
2006	Jourdane and Dye	Waikele	Archaeological assessment
2008a	Jourdane and Dye	Waikele	Historic properties assessment
2008b	Jourdane and Dye	Waikele	Historic properties assessment

As previously mentioned, several studies have been conducted within Waikakalaua Gulch. The first such study was an archaeological reconnaissance survey (Kennedy 1985) of roughly 70 acres conducted by Archaeological Consultants of Hawaii (ACH) in 1985. The Kennedy (1985) study area included a portion of the southernmost reaches of the Mililani Tech Park property and extended beyond (see Figure 52). A single archaeological site, an unirrigated terrace that was thought to be for dry land taro agriculture, was recorded during this survey (no SIHP Site number was assigned). A single, small *kukui* nut fragment was recovered from a test unit that was excavated adjacent to the terrace wall. No further work was recommended for the property.

In 1990, Bishop Museum Applied Research Group completed an archaeological reassessment (Sinoto 1990) of the same 70-acre portion of Waikakalaua Gulch. Sinoto found that large portions of the gulch had undergone extensive disturbance since the 1800s; particularly rechanneling and diversion of the stream between the mid-1950s and 1960s, which likely resulted in the obliteration of any Precontact cultural remains. Despite the alteration to the landscape, Sinoto recorded four areas of structural remains that included Historic habitation platforms, retaining walls, water catchments, and roadbeds with associated Historic surface artefactual remains. Although deemed significant, no SIHP Site numbers were assigned to any of the sites identified as a result of the Sinoto (1990) study.

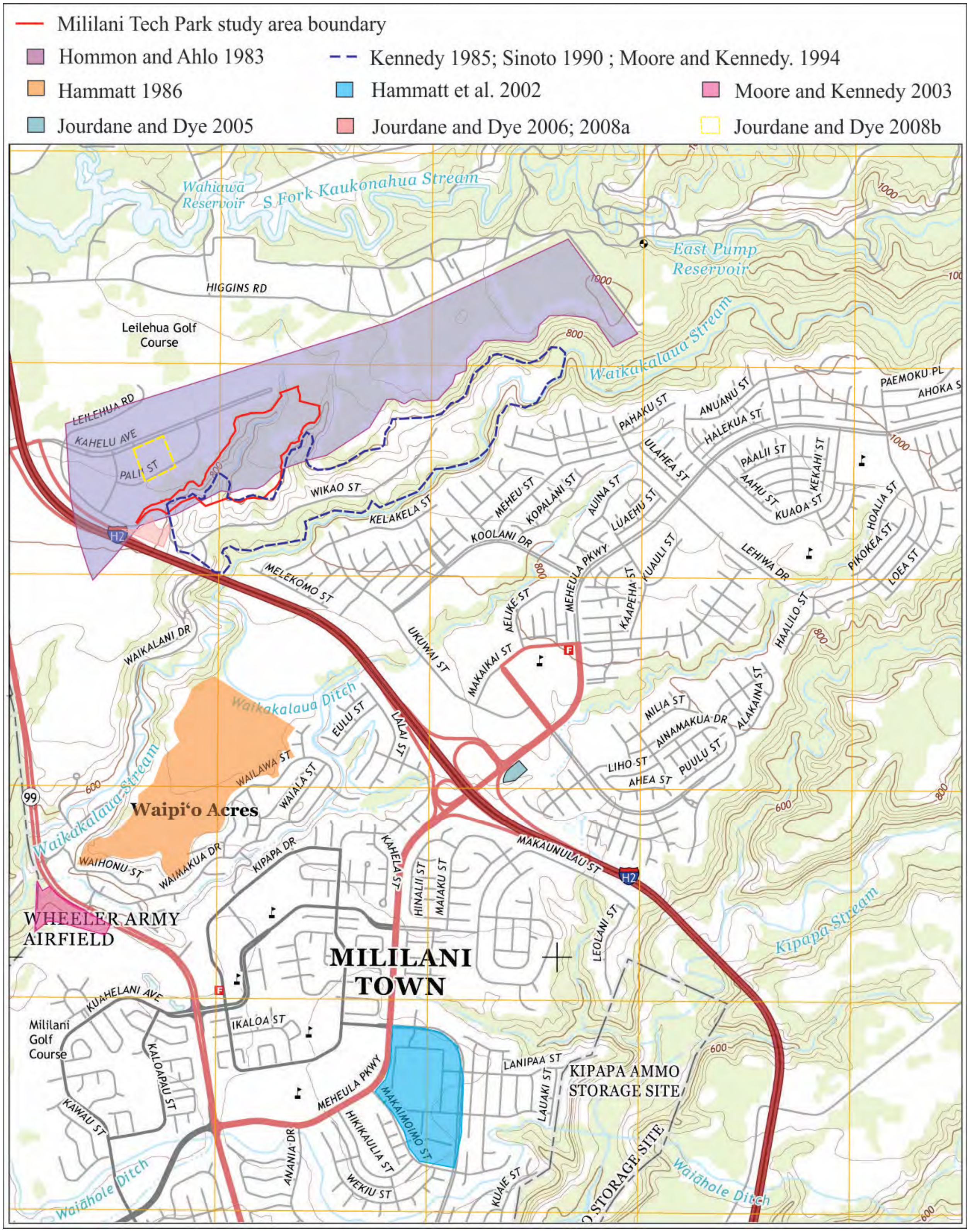

Figure 52. Locations of relevant prior studies in the Mililani Tech Park study area vicinity.

In 1993, ACH returned to the same project area to conduct a third investigation (Moore and Kennedy 1994) for the then-proposed Launani Valley Townhouse development project. ACH identified two archaeological sites located to the east of the Mililani Tech Park study area: a probable agricultural site (SIHP Site 50-80-09-4812) consisting of nineteen *ahu* features, a capped stone flume, and terrace; and a group of historic nursery structures including eight terraces, two stone pavements, and associated cisterns (SIHP Site 50-80-09-4813). The second site, Site 4813 includes the terrace originally identified during the Kennedy (1985) study. Excavations at these two sites revealed Historic cultural material from the twentieth century. ACH concluded that future construction activities would have no adverse effect on any significant historic properties. During construction activities for the development, a single set of human remains (SIHP Site 50-80-09-4730) was inadvertently identified within the same project area; to the south of the Mililani Tech Park study area (within TMk Parcel 006), and a burial recovery (Kennedy 1993) was conducted.

Most recently, in 2003, Archaeological Consultants of the Pacific completed an archaeological reconnaissance survey (Moore and Kennedy 2003) of a 7.49-acre parcel on the slopes of Waikakalaua Gulch, located *makai* of Kamehameha Highway to the southwest of the Mililani Tech park parcel (see Figure 52). No archaeological sites were identified as a result of their study.

In 1983, Science Management completed an archaeological literature search and reconnaissance survey (Hommon and Ahlo 1983) of approximately 300 acres for the then-proposed Hawaii High Technology Park, which encompasses most of the present-day Mililani Tech Park study area and extends beyond to the east and west (see Figure 52). As a result of the study, a single site was recorded, a terrace/stacked retaining wall (SIHP Site 50-80-09-3401) parallel to the Waikakalaua streambed. Site 3401 is located outside of the Mililani Tech Park study area on neighboring TMK Parcel 056. No further work was the recommended treatment for this small site.

In 1986, CSH completed an archaeological survey (Hammatt 1986) of a 150-acre property, located south of the Mililani Tech Park study area (see Figure 52). The parcel was previously used to cultivate pineapple and no historic properties were identified.

In 2002, CSH completed an archaeological and cultural impact evaluation (Hammatt et al 2002) for the then-proposed Mililani Community Transit Center, located to the southeast of the Mililani Tech Park study area (see Figure 52). CSH found that the current Kamehameha Highway corridor follows the same path as a former traditional trail that connected ‘Ewa and Waialua districts, located to the west of the Mililani tech park study area. CSH also suggested that a second trail described by John Papa ‘Ī‘ī was likely near their project area. ‘Ī‘ī described the trails as follows:

> There the trail met with the one from Kolekole and continued on to the stream of Waikakalaua, Piliamoo, the plain of Punaluu to the rise, then down to Kipapa and to Kehualele. A trail ran from this main trail to Halakoa, Oahunui, and other places much visited, such as Kukaniloko. From there it extended to the digging place of Kahalo then went below to Paupalai, thence to Lelepua and to Kahalepoai where the legendary characters Kalelealuaka and Keinohoomanawanui lived. (1959:99)

As previously mentioned, Kukaniloko was the site of sacred birthstones, significant to traditional Hawaiian royalty. Based on the location of Kukaniloko, the trail was likely north (*mauka*) of the Mililani Community Transit Center project area and west of the Mililani tech Park study area; but the precise location of the trail has since been lost due to pineapple cultivation and urbanization. CSH reported that there was no indication that the project area was formerly or currently utilized for traditional Hawaiian cultural practices such as pig hunting or plant resource gathering. Given the long history of pineapple cultivation followed by recent urban development, there were no records of cultural resources or burials in their project area vicinity. Thus, they concluded that construction of the proposed transit center would not have adverse effects on archaeological remains or cultural practices.

In 2005, T.S. Dye and Colleagues, Archaeologists, Inc. (Dye and Colleagues) conducted an archaeological assessment (Jourdane and Dye 2005) of a 1.472-acre property for a NEXTEL cellular site located to the southeast of the Mililani Tech Park study area (see Figure 52). Jourdane and Dye found that no historic properties would be directly or visually effected by the proposed cellular site.

In 2006, Dye and Colleagues conducted an archaeological assessment (Jourdane and Dye 2006) of the 2.42-acre Trinity Church parcel for a Coral Wireless/ MOBI PCS cellular site, located to the south of the westernmost portion of the Mililani Tech Park study area (see Figure 52). No historic properties would be directly or visually effected by the installation of the cellular site in the southwest corner of the parcel. Two years later, Dye and Colleagues conducted a historic properties assessment (Jourdane and Dye 2008a) for a Clearwire HI cell site in the southeast portion of the same parcel. Once again, they concluded no historic properties would be effected by the cellular site.

In 2008, Dye and Colleagues conducted a historic properties assessment (Jourdane and Dye 2008b) of a 5-acre property for a Verizon Wireless cellular site, located along Kahelu Street to the north of the westernmost portion of the Mililani Tech Park study area (see Figure 52). They determined no historic properties would be in direct or visual effect of the cellular site.

Previous Studies Near Current OCCC

Prior studies in close proximity to the current OCCC site in Kalihi Ahupuaʻa have been conducted in support of projects intended to improve infrastructure (O'Hare et al. 2007; Dey and Hammatt 2009) including the rail (Hammatt 2013). Many of them focused on fishponds formerly located around Keʻehi Lagoon in *makai* Kalihi (Kikuchi 1973; Athens and Ward 2002, 2007; Moore et al. 2004). The results of previous archaeological studies conducted within closest proximity to the current OCCC site (Table 5) are presented below, and their locations relative to the current OCCC site are depicted in Figure 53 below.

Table 5. Previous studies conducted in the current OCCC vicinity.

Year	*Author*	*Ahupuaʻa*	*Type of Study*
1991	Landrum and Klieger	Kalihi	Historic Literature search
1993	Folk et al.	Kalihi	AIS
1993	Folk and Hammatt	Kalihi	Mitigation plan
2002	Hammatt and Shideler	Kalihi	Archaeological Assessment
2004	Moore et al.	Kalihi	AIS
2005	Dega and Davis	Kalihi	AIS
2007	O'Hare et al	Kalihi and Kapālama	Field inspection
2008	Cleghorn and Kahahane	Kalihi	Archaeological Assessment
2009	Dey and Hammatt	Kalihi	Archaeological Monitoring
2012	Hunkin et al.	Kalihi, Kapālama, Nuʻuanu, Pauoa, and Makiki	Archaeological Monitoring
2013	Hammatt	Kalihi, Kapālama, Honolulu, and Waikīkī	AIS
2013	Tulchin and Hammatt	Kapālama	Preliminary testing
2017	Hammatt et al.	Moanalua and Kalihi	Field inspection

In 1991, Bishop Museum conducted a historic literature search for the then-proposed City and County of Honolulu Bus Unit Repair Facility (Landrum and Klieger 1991) of a roughly 4-acre parcel (711 Middle Street), located to the north of the current OCCC site (see Figure 53). No historic properties were identified within their project area but Landrum and Klieger did note that Loko Weli was formerly located near their project area. In 1992, CSH performed an AIS (Folk et al. 1993) of the same project area. As a result of the excavation of nineteen backhoe trenches, three Postcontact burials (two coffin burials and one direct burial) and a corresponding remnant cultural layer were identified beneath an extant asphalt parking lot and designated SIHP Site 50-80-14-4525; which necessitated the preparation of a burial treatment plan. The cultural layer consisted of a clay loam soil that contained marine shellfish, a few water-rounded cobbles, and charcoal. CSH did not identify any other archaeological material beyond the burial area. Thus, archaeological monitoring was not recommended. In 1993, CSH prepared a mitigation plan (Folk and Hammatt 1993) for the removal and subsequent reinternment of the burials at SIHP Site 4525 to a location decided upon in coordination with SHPD and the Oʻahu Island Burial Council. No further archaeological work was recommended after the burial relocation.

In 2002, CSH performed an archaeological assessment for the proposed Middle Street Transit Center (Hammatt and Shideler 2002) located north of the current OCCC site on the *mauka* side of Kamehameha Highway (see Figure 53). CSH reported that the entire property had been impacted by historic land use and that no significant historic properties were identified within their study area. However, Hammatt and Shideler did note one remnant of a concrete and basalt retaining wall located adjacent to Kalihi stream. This wall is depicted on Land Court Map number 748, dated 1929, and was therefore found to be a historic property; but it was not deemed a significant historic property, nor was it assigned a SIHP Site number because it did not retain its original significance. The Hammatt and Shideler (2002) study area had been identified during an archaeological and cultural resource assessment conducted by Davis and McGerty (2002) as the former site of a traditional Hawaiian fishpond.

Thus, in 2003, Scientific Consultant Services (SCS) conducted an AIS (Dega and Davis 2005) of the same property to mitigate any potential impact to Waikulu fishpond, which Hammatt and Shideler (2002) had failed to mention in their report although it is mentioned in Māhele documents and was listed as Site #157 by Kikuchi (1973). SCS collected numerous samples for pollen analysis to determine the approximate vertical depth of the fishpond sediment, which they were unable to ascertain; however, it was hypothesized that taro may have been planted along the edges of the fishpond based on the presence of taro (*Colocasia sp.*) pollen in limited quantities in two samples. As a result of their fieldwork, SCS assigned Waikulu Fishpond the following SIHP Site designation: 50-80-14-6683; in addition, SCS documented several late-nineteenth to early-twentieth century artifacts that were related to the property's former use as a meatpacking center, such as a meat hook and a sheaf for a butcher knife. Also of relevance to the current discussion is Dega and Davis' suggestion that the three burials identified in the nearby project area by CSH (Folk et al 1993) were likely associated with the former leprosarium, which was located in close proximity to where the burials were encountered.

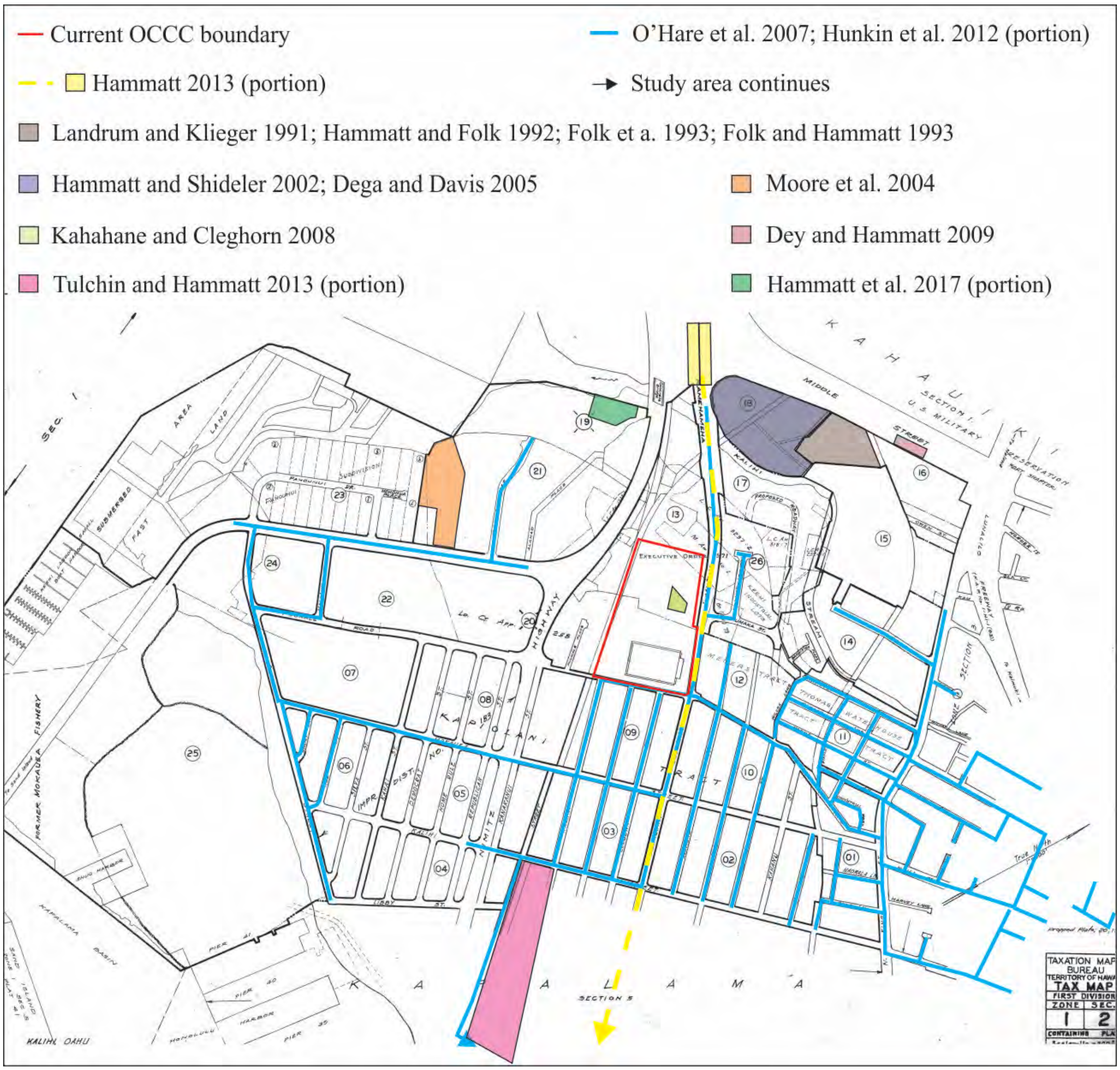

Figure 53. Locations of relevant previous studies conducted in the current OCCC vicinity.

In 2004, Archaeological Consultants of the Pacific completed a limited AIS (Moore et al. 2004) for a property along the eastern coastline of Keʻehi lagoon located to the southwest of the current OCCC site (see Figure 53). The AIS was performed to identify three adjoining fishponds, buried below fill deposits in conjunction with the collection of six sediment cores for a geophysical study. Pollen sample analysis indicated that the sediment most likely did not come from a man-made fishpond due to its low levels of pollen and absence of any charcoal within the sample. However, archival research indicated the former presence of named Hawaiian fishponds, Apili, Pahounui, and Pahouiki within their project area.

In 2007, CSH conducted a field inspection of multiple discontiguous areas (O'Hare et al. 2007) for Phase I of the Kalihi/Nuʻuanu Sewer Rehabilitation Project, extending to the south, east, and north of the current OCCC site; a portion of their project area extended along Kamehameha Highway, immediately adjacent (to the north) of the current OCCC site (see Figure 53). CSH identified four site types that could be encountered during the proposed construction: Traditional Hawaiian fishponds and salt beds, Precontact and Postcontact habitation and agricultural sites, Precontact and Postcontact burials, and Historic schools, churches, and hospitals. However, no archaeological resources were identified as a result of their study. In 2012, CSH conducted archaeological monitoring (Hunkin et al. 2012) for the same project. No features or intact cultural deposits were identified during monitoring, except for a single isolated human bone fragment, which was identified within fill material. No SIHP Site number was assigned, and custody of the fragment was transferred to SHPD.

In 2008, Pacific Legacy, Inc. performed an archaeological assessment (Cleghorn and Kahahane 2008b) as part of an EA for the proposed construction of one prefabricated temporary program structure and a storage unit within the current OCCC site (see Figure 53). Their study area was located at roughly 20 feet above sea level, within the fenced area at the northeast corner of the OCCC campus. Pacific Legacy did not conduct a field survey; rather, they determined from a review of photographs that there was no potential for surface archaeological sites and that "the area has an extremely low likelihood of containing subsurface archaeological resources" (Cleghorn and Kahahane 2008a:6). Thus, the recommendation for the proposed construction project was no further archaeological work.

In 2009, CSH performed archaeological monitoring for the Traffic Management System PH 1 Project at Middle Street (Dey and Hammatt 2009), located northwest of the current OCCC site (see Figure 53). As a result of the monitoring effort, no historic properties were identified.

In 2013, CSH performed an AIS (Hammatt 2013) for the Honolulu High-Capacity Transit Corridor project in numerous locations between Middle Street and Ala Moana Center across Kalihi, Kapālama, Honolulu, and Waikīkī *ahupuaʻa*; one portion of the corridor was located adjacent to the current OCCC site along Kamehameha Highway (see Figure 53). Testing identified multiple sites throughout the corridor, but only one site was recorded adjacent, to the north, of the parking lot of the current OCCC location, within Dillingham Boulevard; a subsurface fire feature remnant or hearth (SIHP Site 50-80-14-7425).

Also in 2013, CSH completed preliminary testing as part of an Archaeological Inventory Survey Plan (Tulchin and Hammatt 2013) for commercial lands owned by Kamehameha Schools, located southeast of the current OCCC location (see Figure 53). No historic properties were identified but the study did provide information on the stratigraphic profile of the vicinity, which consisted of fill deposits overlying natural alluvial deposits, over limestone bedrock.

In 2017, CSH conducted a field inspection (Hammatt et al. 2017) for the 6.6-acre Kamehameha Highway force main project, located west of the current OCCC site, primarily within the Keʻehi Lagoon Beach park (see Figure 53). CSH documented several surface structural features that appeared Historic in origin (concrete benches and a concrete slab) but they were not successfully dated and no site designations were made. Hammatt et al. reported that their project area was entirely comprised of post-1940 fills; thus, no AIS or monitoring was recommended.

Previous Studies near WCCC

Numerous archaeological studies have been conducted within Koʻolaupoko district and Kailua Ahupuaʻa beginning in the 1970s. As a result of these investigations, a variety of sites and features have been recorded including agricultural terraces, walls, platforms, temporary and permanent habitation sites, *heiau*, burials, and royal complexes, among others. Much of the knowledge about the archaeological record for Kailua is derived from studies which focused primarily on *mauka* locales such as locations within Maunawili Valley (Toenjes and Donham 1986; Brennan 1986; Allen 1988; Williams 1988; Hammatt and Shideler 1991) and Kawainui Marsh (Cordy 1977, 1978; Allen-Wheeler 1981; Neller 1982; Athens 1983; Hammatt et al. 1990; Athens and Ward 1991), located to the west of the WCCC facility. This is largely due to the development of coastal areas of Kailua predating the implementation of State and Federal historic preservation laws (Dye 1992; Hammatt 2011). Although the chronology for the first settlement of windward O‘ahu and Kailua is debatable, conservative interpretations of published data places this event at A.D. 800-900. One early radiocarbon date published by Clark (1980) suggests that this area may have been settled as early as A.D. 353-655, however, most published dates are from the 13th and 14th century, which correspond with expanding agricultural use for Ko‘olaupoko (Allen-Wheeler 1981; Williams et al. 1995). While many archaeological and historical studies have been conducted in Kailua Ahupua‘a, only six such investigations focused on the WCCC property or its immediate vicinity (Table 6), the locations of which are depicted in Figure 54.

Table 6. Previous studies conducted in the WCCC study area vicinity.

Year	*Author*	*Ahupua‘a*	*Type of Study*
1977	Clark	Kailua	Site survey
1989	Szabian & Cleghorn	Kailua	Reconnaissance survey
1992	Quebral et al.	Kailua	AIS
1999	Hammatt et al.	Kailua	AIS
2005	Morawski & Monahan	Kailua	AIS
2006	Parsons Brinckerhoff	Kailua	Cultural resource assessment

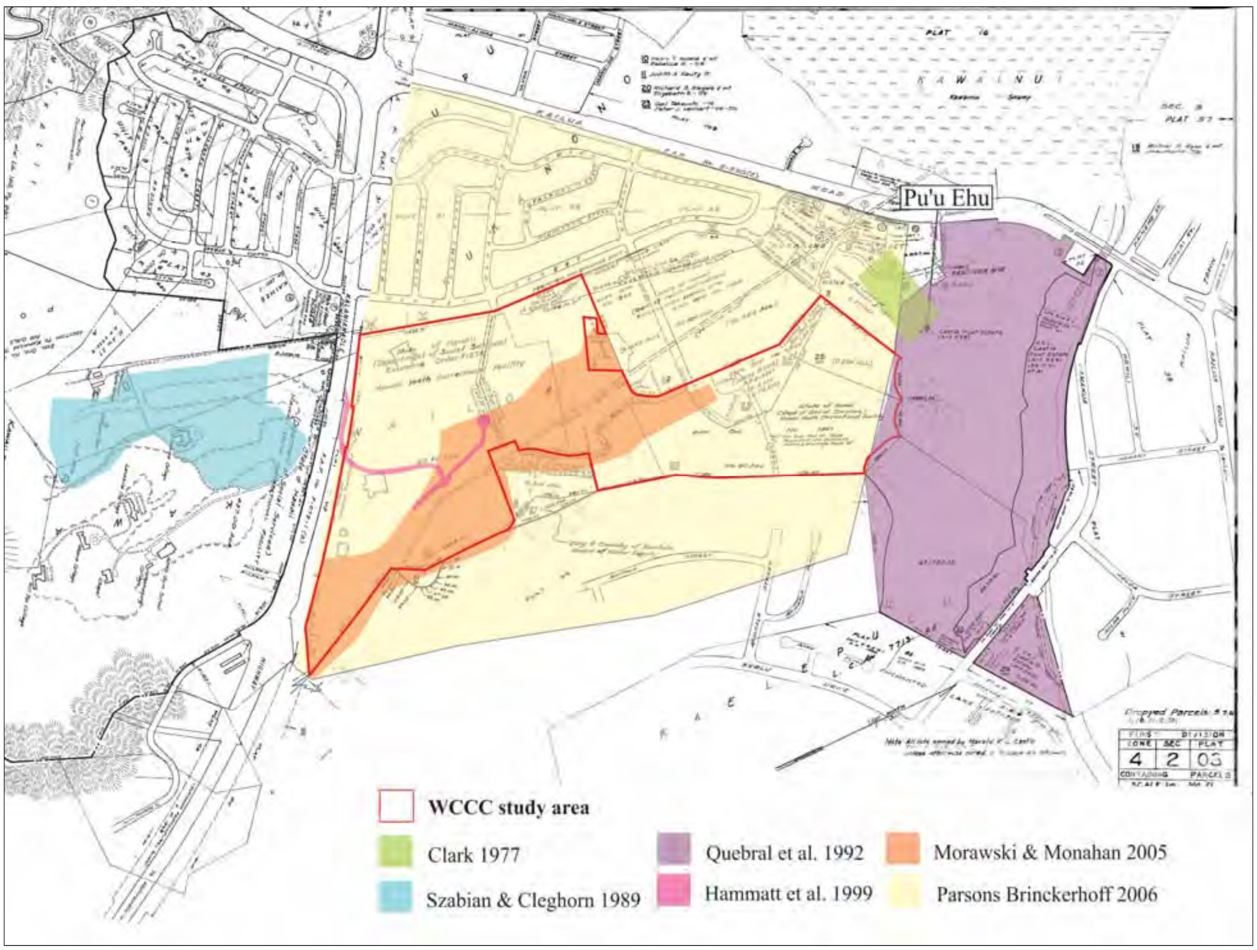

Figure 54. TMK map showing previous studies conducted within the WCCC study area vicinity.

In 1977, Kualoa archaeological staff conducted a pedestrian survey (Clark 1977) for the Department of Public Works of Honolulu for a proposed road corridor for the extension of Hamakua Drive located between Hahani Street and Akoakoa Street (see Figure 54). The survey resulted in the identification of possible agricultural, ceremonial, and habitation features, as well as an isolated human bone. Among these features, was a large earth mound (SIHP Site 50-80-11-4699), which may have been part of a traditional earthen agricultural structure or formed from recent bulldozing activities. Upon closer inspection, the crew identified a possible wall alignment located on the southwest side of the mound base. While on the northwest side of the mound, the crew identified a stone alignment oriented east-west, consisting of five basalt stones embedded in the ground. They concluded that these alignments may be the remains of traditional agricultural terrace walls. In the survey area located south of Ka‘elepulu Stream, the crew identified two possible agricultural plots and a potential habitation site, as well as an irrigation ditch. Additionally, on the southwest side of Ka‘elepulu Stream, the crew identified a possible *heiau* with associated platforms and stone alignments (SIHP Site 50-80-11-4428); however, this site would be reclassified in a 1991 study (Quebral et al. 1992), discussed in detail below. In addition, an isolated human mandible fragment was found on the surface at the end of Hamakua Drive. The bone was described as weathered and it was concluded that it was likely brought in with the fill used during the construction of the road.

Roughly fifteen years later, in 1991, International Archaeological Research Institute, Inc. (IARII) conducted an AIS (Quebral et al. 1992) of a 33-acre parcel located north of Kailua High School and WCCC, extending along Pu‘u Ehu ridge (see Figure 54). A portion of their study area was previously surveyed as part of the Clark (1977) study summarized above. IARII identified four sites during the survey and assigned them SIHP Site designations 50-80-11-4428 thru 4431. One of these sites (SIHP Site 4428) had been recorded by Clark (1977) as a possible *heiau* and was relocated and reclassified as a habitation site by Quebral et al. (1991). Two previously unrecorded lithic scatter concentrations (SIHP Sites 4429 and 4430) were recorded on Pu‘u Ehu ridge. And two rectangular features (SIHP Site 4431), which IARII concluded to be terraces were also newly identified. In addition, Quebral et al. (1992) relocated and reclassified a possible habitation site recorded by Clark (1977) as a bulldozer push pile. IARII recommended additional research and surveys be completed for SIHP Sites 4428-4430.

In 1989, Bishop Museum Applied Research Group conducted a reconnaissance survey (Szabian and Cleghorn 1989) for the proposed Olomana Women’s Community Correctional Complex, located to the south of WCCC (see Figure 54). They reported no surface archaeological sites within the study area; however, they noted that two cottages named Ho‘okipa and Maluhia were included in the Hawai‘i Register of Historic Places (SIHP Site 50-80-11/15-1362 d and e). Additionally, they investigated Kukuipilau, a *heiau* reported by Thrum and McAllister to be within the general WCCC vicinity (see Figure 48). Thrum’s informants referred to the *heiau* as Heinau; however, McAllister reports that his informant referred to the *heiau* as Kukuipilau and indicated that the *heiau* had been destroyed. Szabian and Cleghorn, with the help of Earl Neller, identified and recorded Kukuipilau Heiau in 1989 and determined that it was not located within their project area.

In 1999, CSH completed an AIS (Hammatt et al. 1999) of the then-proposed alternate site for the Kailua 272 Reservoir within the WCCC property (see Figure 54). Their study area consisted of a 0.65-acre proposed reservoir site and associated access road alignments, located along the ridge between WCCC and Ka‘elepulu Pond. The pedestrian survey yielded no surface archaeological sites; however, historical research revealed the existence of a single historic subsurface water tunnel (SIHP Site 50-80-15-4042). Additional research revealed that the water tunnel was constructed in 1923 as part of the Waimanalo Sugar Company’s irrigation system, and used to transport water from Kawainui marsh to the sugar cane fields in Waimānalo. No further preservation work was recommended for this site as the proposed construction did not have an adverse effect on the identified historic property.

In 2005, CSH completed an AIS (Morawski and Monahan 2005) for the proposed Kailua High School-Kalaniana‘ole access road, located within the WCCC property (see Figure 54). As a result of their fieldwork, they recorded two archaeological sites: Temporary Site (TS)-1 was interpreted as a Precontact lithic surface scatter with small amounts of crypto-crystalline silicate and volcanic glass debitage; TS-2 was interpreted as a Historic water-flow control structure consisting of two features. The main feature was described as a rectangular construction made from stacked basalt blocks joined with mortar/concrete, and the second feature was described as a concrete encased valve/pumping station located adjacent to the main structure. Both TS-1 and TS-2 were determined to be significant under Criterion d and subsequently assigned SIHP Site designations 50-80-11-6816 and 6817, respectively (Monahan and Morawski 2009). In addition to the two sites, two other features of interest, but of no historic significance were identified and noted within the project area. The first was a complex of horse stables dating to the 1960s or 1970s located at the northern end of the project area, and the second site was a parallel row of *kī* (tī) plants, likely planted during a cultural program implemented by the WCCC since 1991.

In 2006, Parsons Brinckerhoff prepared a Cultural Resource Assessment (CRA) as part of an Environmental Assessment for the Kailua High School access road project, which encompassed the WCCC (Parsons Brinckerhoff 2006). The CRA included the findings from the Morawski and Monahan (2005) AIS with the addition of a community consultation section. The CRA assessed the potential for all cultural practices, not just those associated with Native Hawaiian traditions. Six alternatives and a "no-build" option were developed for this project. The CRA identified and evaluated any potential cultural impact for each of the proposed alternatives; of which all, excluding Alternatives 1 and 2, were determined to have little to no impact. Alternatives 1 and 2 (described as the construction of the new roadway and parking lot connecting Kalaniana'ole Highway to the Kailua High School property) demonstrated the potential for impacts to two previously identified sites: the parallel row of *kī* (tī) plants and an irrigation feature. Through consultation efforts and field investigations, it was determined that both sites were part of the Hawaii Youth Correctional Facility cultural awareness program. No site-specific mitigative measures were addressed in this assessment.

3. CONSULTATION

As stated in the OEQC Guidelines for Assessing Cultural Impacts, the goal of consultation and the oral interview process is to identify potential cultural resources, practices, and beliefs that may be associated with a proposed action. In this case, the proposed action is the replacement of the existing OCCC facility; and the potential associated resources, practices, and beliefs might be related to the action itself or to the specific locations being considered in the environmental review process. To that end, consultation interviews were sought with individuals having general knowledge or interest in the conceptual OCCC replacement project as well as with individuals with specific knowledge of each of the potential new OCCC locations and the current WCCC location. As each of the proposed locations (and the WCCC) has a long institutional history of restricted public access, the present study gathered potential cultural use information from individuals within the respective institutions who have long-time associations with the respective locations.

It is the present authors' further contention that the oral interviews should also be used to augment the process of assessing the significance of any traditional cultural properties that may be identified. It is the researcher's responsibility, therefore, to use the gathered information to identify and describe potential cultural impacts and propose appropriate mitigation as necessary. In addition to gathering the interviewees project- or site-specific *mana'o*, a primary focus of the interviews was to elicit each interviewee's reaction to the proposed project.

ASM attempted publication of a public notice with the Office of Hawaiian Affairs (OHA) monthly newsletter (Ka Wai Ola O OHA). The following was electronically submitted to OHA in August 2017 (receipt acknowledged in August 2017), but to date has yet to appear in their publication; we are hopeful that it will appear in the November 2017 issue and any additional consultation can take place before publication of the Final EIS.

PUBLIC NOTICE

ASM Affiliates is preparing a Cultural Impact Assessment (CIA) in support of the proposed O'ahu Community Correctional Center (OCCC) Replacement Project, State of Hawai'i Department of Public Safety (PSD), Island of O'ahu. Four alternative locations on O'ahu have been identified for the replacement of the OCCC facility. In addition to the four sites being investigated for the OCCC replacement facility, PSD seeks to improve the current Women's Community Correctional Center (WCCC) located in Kailua and is therefore included in the current project plans as well as the CIA study. The five study areas are:

1. **Animal Quarantine Site** - TMKs: (1) 9-9-010:006 (por.), (1) 9-9-010:046 (por.), (1) 9-9-010:054, (1) 9-9-010:055, (1) 9-9-010:057, and (1) 9-9-010:058; Hālawa Ahupua'a, 'Ewa District; approximately 40 acres of buildable land (16% of site).
2. **Current OCCC Site** - TMK: (1) 1-2-013:002; Kalihi Ahupua'a, Kona District; approximately 8 acres of buildable land area (50% of site).
3. **Halawa Correctional Facility Site** - TMK: (1) 9-9-010:030; Hālawa Ahupua'a, 'Ewa District; approximately 5 acres of buildable land (16% of site).
4. **Mililani Lot 17 (Tech Park) Site** - TMKs: (1) 9-5-046:041 and (1) 9-5-046:042; Waikele Ahupua'a, 'Ewa District; approximately 19 acre of buildable land.
5. **WCCC Site** - TMKs (1) 4-2-003:004, (1) 4-2-003:024, (1) 4-2-003:025, and (1) 4-2-003:026; Kailua Ahupua'a, Ko'olaupoko District.

> We are seeking consultation with any community members that might have knowledge of traditional cultural uses of the proposed project areas; or who are involved in any ongoing cultural practices that may be occurring on or in the general vicinity of the subject properties, which may be impacted by the proposed project. If you have and can share any such information please contact Bob Rechtman brechtman@asmaffiliates.com, or Lokelani Brandt lbrandt@asmaffiliates.com, phone (808) 969-6066, mailing address ASM Affiliates 507A E. Lanikāula Street, Hilo, HI 96720.

Potential interviewees are organized into six categories; those with general knowledge or interest in the conceptual OCCC replacement project, those with specific knowledge about the existing OCCC location, those with specific knowledge about the Animal Quarantine Station location, those with specific knowledge about the HCF location, those with specific knowledge about the Mililani Tech Park location, and those with specific knowledge about the WCCC location. In all 17 persons or organizations were contacted of which 13 participated in the interview process. Some of these individuals are employees of the extant facilities at the proposed OCCC locations who were introduced to ASM staff during the site visits conducted as part of the current study. The other individuals are either experts who have conducted research and authored publications on the impact of the criminal justice system on Native Hawaiians or representatives of local community organizations.

GENERAL OCCC REPLACEMENT PROJECT

Four individuals were contacted with requests to be interviewed with respect to their thoughts on the cultural impacts associated with general OCCC replacement project, RaeDeen M. Keahiolalo, Ph.D., Michael Broderick, Mark Patterson, and Kamanaopono Crabbe, Ph.D. Only RaeDeen M. Keahiolalo, Ph.D. and Michael Broderick responded to our request for interview. A summary of their interviews is presented below.

RaeDeen M. Keahiolalo

On October 3, 2017, Lokelani Brandt conducted a phone interview with Dr. RaeDeen M. Keahiolalo to discuss the potential cultural and broader social impacts for the proposed OCCC replacement project. Dr. Keahiolalo is currently the Director of Education Research and Postsecondary Success at Kamehameha Schools and she is an adjunct faculty in Chaminade University's Criminal Justice Division. In 2008, Dr. Keahiolalo completed her dissertation titled 'The Colonial Carceral and Prison Politics in Hawai'i' where she examined Hawai'i's carceral system as a site of continued colonial conquest and neocolonial subjugation. Her experience and knowledge in this field have led her to serve in many community advocacy forums such as the Native Hawaiian Justice Taskforce Committee (governor-appointed), advocating at the legislature; and writing and teaching a political reintegration curriculum.

When asked about her thoughts on the proposed project, Dr. Keahiolalo identified several areas of concern. One of the most pressing concerns was the impact that replacement to Hālawa or Mililani may have on the inmates and their families, particularly regarding family visits. She noted that many of the families that come to visit their spouses, parents, or relatives at OCCC rely on the Honolulu bus service, which currently takes them directly to the facility. However, if OCCC is relocated to where the city bus might not provide access, such as Hālawa or Mililani, then it will severely impede the families' ability to visit their incarcerated relatives. She adds that traveling to these less accessible locations will require additional travel time, which will have an impact on childcare as parents and grandparents will need to arrange or pay for additional childcare time. She contends that children of incarcerated parents suffer the most when they are not able to maintain contact with their parents; and she specifically mentioned unsuccessful attempts on the part of PSD to implement an Ohana Conferencing Call program.

Additionally, she states that the Hālawa and Mililani locations will create an atmosphere of isolation for both the inmates and their families. In this same vein, she noted that there is a tendency to keep carceral facilities out of sight, and therefore out of mind. She stated that when these types of facilities are removed from the public eye, there is a greater degree of decreased accountability to the public, which has historically contributed to further trauma, and in some cases death. Dr. Keahiolalo related that studies have shown that inmates that lack family support and involvement during their incarceration have higher rates of recidivism. She stressed that if rehabilitation and reducing recidivism is the goal, then PSD should maintain the present OCCC location for families to have access to their incarcerated relatives as they play a key role in an inmate's rehabilitation and transition back to society. She related the idea of reducing recidivism to the ongoing rhetoric about the lack of space for inmates, and she openly believes that simply relocating OCCC will continue to feed into the rhetoric instead of addressing the problem. She suggested that PSD align their decision making with a detailed analysis of the population, including rehabilitation needs and custody level; and believes that space limitations can be reduced by placing community and low-custody level inmates on supervision such as work furlough, treatment, probation, and electronic monitoring—versus prison. Dr. Keahiolalo related that the types of supervision are proven to result in lower rates of recidivism and higher rates of rehabilitation.

Another area of concern that Dr. Keahiolalo highlighted was the relocation of the women from the OCCC facility to the WCCC in Kailua. She remarked that merely separating inmates based on their gender does not consider the specific needs or level of security within the women's population. She states that combining and relocating all women based solely on gender is cause for concern especially as it relates to inmate safety and rehabilitation needs. She cautioned that housing additional female inmates, potentially with unique needs, at WCCC, may impact the WCCC rehabilitative environment.

She emphasized the importance of looking at the context in which OCCC is currently situated. She indicated that there are some inmate support services like the Laumaka Work Furlough Center situated within the surrounding Kalihi community. She added that access to these support services are vital to the inmate's rehabilitation as these centers provide job training, placement, and more; all of which helps the inmates transition back into society. Therefore, if OCCC is relocated and taken out of its current location and context, there may be a shortage of support services for the inmates. She foresees an adverse impact to the inmates who are prepared to transition out of the system and into the community.

Dr. Keahiolalo also discussed the current lack of reliable and accurate data on which these kinds of impactful decisions are being made. She contends that there is a discrepancy between the actual data and what is being reported, especially as it concerns the Native Hawaiian inmate population. She believes that much of the decision to relocate OCCC is largely being driven by economics and politics. She argues that when there is no real assessment of the inmate population and their needs, *Kanaka Maoli* (Native Hawaiians) and their peer populations are not going to receive the treatment that they need to stop the cycle of imprisonment – and this impacts true public safety.

When asked specifically about how the potential to relocate OCCC could positively or negatively impact Native Hawaiians, Dr. Keahiolalo stated that the cycle of imprisonment of *Kanaka Maoli* has been proven for over two-hundred years. She asked, how would the status of our communities look like if indeed all native communities were flourishing? She insists the disparities are socially accepted and that although there is an array of rehabilitative services for Native Hawaiians in nearly every sector, the statistics do not reflect any improvement or public will for Native Hawaiians. She remarked that there are policies in place that prevent a flourishing culture from occurring. Instead our policies perpetuate social, cultural, economic, and political disparity, and she is concerned that relocating the prison without considering the broader context will continue to perpetuate this cycle of *Kanaka Maoli* imprisonment. She also reflected that the issue is not just about an individual, or an individuals' family, rather it's about communities and the impacts that are felt by communities. As Native Hawaiians make up the largest proportion of Hawaiʻi's inmate population, they are the most adversely impacted.

Michael Broderick

On October 11, 2017, Lokelani Brandt conducted a phone interview with Michael Broderick, current CEO of the YMCA of Honolulu and former Family Court Judge. In 2012, Mr. Broderick served as Chair for The Native Hawaiian Justice Task Force (governor appointed) and has been an advocate of reforming Hawaiʻi's criminal justice system. When asked about his thoughts on the proposed OCCC replacement project, Mr. Broderick stressed that Native Hawaiians have been and continue to be, disproportionately represented in Hawaiʻi's criminal justice system, and therefore any new jail facility *will* have an impact on Native Hawaiians. He stressed that the fundamental question is, *how* will Native Hawaiians be impacted? He added, *how* and to *what degree* Native Hawaiians are impacted is largely dependent on the type of facility that is built (i.e. the size of the facility, and the types of programs that will be offered).

Mr. Broderick identified several areas of concern, the first being what he called 'process'. He emphasized that the process used to plan and develop a new jail facility must be as inclusive and as comprehensive as possible, and that engagement with the varied constituents should be continuous. He recommends that PSD develop a commission or council that will take responsibility to engage with the proper stakeholders throughout this project. He cited New York City, Milwaukee, St. Louis and Ada County, Idaho as good models of ongoing engagement.

Mr. Broderick questioned what is the vision for this new jail facility? He believes that if a new facility is constructed, it is an opportunity to move away from the traditional custody-control type facility to one that emphasizes transitioning inmates back into society. Based on the information that he has gathered about the project, he worries that there is more concern about the location of the jail and not the vision of the facility. He cautioned against building a facility that emphasizes custody-control and contends that doing so will adversely impact Native Hawaiians. Mr. Broderick believes that the proposed project is an opportunity to address the racial disparities that currently exist in Hawaiʻi's jails as well as the criminal justice system as a whole. He referenced the current jail reform taking place in various parts of the nation, where there is a movement to address racial disparities as well as reduce the number of pretrial inmates. He cited Harris County, Texas and Connecticut as good models where racial disparities are being addressed. He stated that if a new facility is constructed, in-jail treatment programs must be made available to the inmates, the inmates must be linked to specific services, and that any mentally ill inmates must be placed in the appropriate facilities. He emphasized that if OCCC is relocated out of Kalihi, then PSD should ensure that the inmates have access to the proper support services, such as the Laumaka Work Furlough Center. He added that the physical environment of the jail should also be considered and he would like to see it reflect a rehabilitative environment. An example of this would be a "dormitory setting" instead of "hard cells." Mr. Broderick stressed that upon an inmate's release, there needs to be a continuity of care, especially for those inmates with mental health or addiction-related issues.

Ensuring family support through scheduled visitations was another area of concern for Mr. Broderick. He recalled speaking to inmates who stated that being visited by their family member while incarcerated was very important experiences. He was also informed by these inmates that there have been times when these scheduled family visits were canceled due to the lack of guards to monitor the visits. He would like to see PSD improve the family visitations process so that the inmates can consistently maintain contact with their family members. Mr. Broderick said that the smaller the jail, the less need for staff, and the greater chance visits will occur.

Mr. Broderick specified that if PSD is looking to replace the current OCCC facility, that they consider the ways in which the overall jail population can be reduced, resulting in a smaller jail facility. He estimated that roughly fifty percent of the current inmate population at OCCC are pretrial detainees, meaning that they have not been convicted. He believes that reducing the number of pretrial detainees will alleviate overcrowding at OCCC and help to reduce the number of Native Hawaiians in the system. To do this, Mr. Broderick stressed that Hawai‘i needs to reform the bail and pretrial systems. He asserted that this is a very crucial step that should not be overlooked.

When asked about specific cultural impacts this project may have on Native Hawaiians, Mr. Broderick reflected on his time as a family court judge and noted that after working on over ten thousand cases, he estimates that roughly ninety to ninety-five percent of the people he encountered in his courtroom had experienced some sort of trauma, whether that was sexual or physical abuse or neglect. During this time, he also noticed a cycle that was most evident amongst Native Hawaiian, which is an intergenerational perpetuation of trauma as well as historical trauma. He believes that the hurt resulting from historical losses (i.e. the loss of language, culture, and land) is passed on from one generation to the next. He believes that the cumulative impacts resulting from these historical losses compounded with personal trauma, leads to a loss of identity and sense of pride. He observed that when he was a Family Court Judge and gave Native Hawaiians the opportunity to engage with their culture, and learn about their history and cultural accomplishments, their outlook on life and self-esteem increased significantly. For these reasons, Mr. Broderick believes that offering cultural programs in jails, like Hawaiian cultural immersion programs, will be critical as they help to raise self-respect and dignity, all of which he believes can help break the cycle of imprisonment.

When asked about his thoughts on separating the female inmate population at OCCC, Mr. Broderick believes that relocating the female inmates is a wise decision. During his time on the Native Hawaiian Justice Task Force, he spent time with female inmates who expressed that female OCCC inmates have very different needs from the male population. He sees the relocation of the female inmates as a positive consideration, especially because he believes that currently, female inmates at OCCC do not get the programming they need, and WCCC will be a better environment and more human atmosphere.

Finally, Mr. Broderick emphasized that the Native Hawaiian Justice Task Force did a lot of work in preparing recommendations to improve Hawai‘i's criminal justice system and that the recommendations outlined in that report should be considered as part of the proposed OCCC replacement project. A full copy of The Native Hawaiian Justice Task Force report is reproduced in Appendix A.

OCCC LOCATION

On July 28, 2017, Robert B. Rechtman met at the current OCCC location with Reynaldo Gonzales, a seventeen year civilian employee with OCCC. The purpose of the meeting was to tour the facility and identify whether he was aware of any past or ongoing cultural practices that may be taking place in the vicinity of the proposed location for the new OCCC facility. Reynaldo explained that the proposed location for the new OCCC has been a parking lot for the facility for many years, and that he was unaware of any requests to access the facility for cultural practices. Several guards were encountered during the site visit and each was asked if they knew of any individuals (detainee population or outside public) that conducted cultural practices anywhere within the existing OCCC facility. No one was aware of any such individuals or activities.

HCF LOCATION

On July 25, 2017, Robert B. Rechtman met at the HCF location with Ben Dias (HCF Special Projects Coordinator) and Carrick Agbayani (HCF Facilities Superintendent). Both gentlemen were asked if they knew of any individuals (detainee population or outside public) that conducted cultural practices anywhere within the existing HCF facility; neither was aware of any such individuals or activities. As a lifelong hunter, Mr. Agbayani, a 21 year veteran of the facility, described the surrounding area as a pig hunting location that is actively accessed by member of the Pig Hunters Association of Oahu. While it is the current authors contention that pig hunting in Hawaiʻi is not a traditional cultural practice (cf. Maly et al. 2007), it is nonetheless a practice in Hawaiʻi with perhaps a 150 year history and tradition.

A phone conversation was conducted on October 10, 2017 with Mitchell Tynanes, President of the Pig Hunters Association of Oahu. The potential construction of a new OCCC facility within the recreation yard at HCF was identified to Mr. Tynanes. He expressed concerned that more activity in the area could affect the pig population, and indicated that, for most of their hunting activity in the area, they use an access road through the Hawaiian Cement property and not the Board of Water Supply road that would be used to provide access to a new OCCC. However, he did acknowledge that one hunting unit is accessed from that Board of Water Supply road, and as long as reasonable accommodations were made for continued access to that hunting unit, there should not be a significant impact on their hunting practices.

Mr. Agbayani also identified the Board of Water Supply road as the access for a *heiau* site located roughly 1 mile above HCF. This site was identified earlier in the current study as SIHP Site 50-80-10-657. Through an agreement with DLNR-SHPD, this *heiau* is currently being cared for by *Pā Kuʻi A Lua*, a Hawaiian cultural organization (Figure 55). Although several attempts, via phone calls and emails, were made to contact the leadership of *Pā Kuʻi A Lua*, but at the time of this writing no responses were received. The possible construction of the OCCC in the existing HCF recreation yard will likely not be visible from the *heiau* site; and; as long as access to this site by practitioners is not impeded, the OCCC replacement project should not have any effect on Site 657 and the cultural practices that currently take place there.

Figure 55. Sign placed along the Board of Water Supply road at the location of Site 657.

ANIMAL QUARANTINE STATION LOCATION

On July 24, 2017, Robert B. Rechtman, Ph.D. met with George Demesillo (building maintenance worker) at the Animal Quarantine Station to tour the facility. Mr. Demesillo was asked if he knew of any individuals that conducted cultural practices anywhere within the existing HCF facility. He did not, and he recommended speaking with two current Animal Quarantine Station employees, Penny Fernandez and Abraham Kahaʻi. Mrs. Fernandez has worked at the Animal Quarantine Station for 30 years, and when asked if she was aware of any cultural sites or practices associated with the area, she indicated that the only cultural item that she was aware of in the area was a cement pillar of religious (Shinto) significance located near the Maintenance Shop. George Demesillo explained that this cement pillar (Figure 56) was brought to its current location about 35 years ago after being relocated from a King Street cemetery to the Department of Agriculture offices in downtown Honolulu also on King Street. Mr. Demesillo referred us to Ronny Shimojo, who works in the Animal Industry section, as someone with knowledge of this item. Mr Shimojo was contacted and he explained that after the pillar was placed on site, it was cared for by members of a local temple, but no one has looked after the pillar for many years. He also explained that there are both Chinese and Japanese characters inscribed in opposite sides along with a dragon, and that the pillar was considered a “crossroads” shrine. According to Mary Tashiro of the Animal Quarantine Station, this shrine was inspected by DLNR-SHPD Historian Ross Stephenson, Ph.D. in 2012 and apparently determined to not be a significant historic property.

Figure 56. Cement pillar.

Upon review of the information pertaining to the concrete pillar provided by the interviewee and presented above, Dr. Isaac Maeda, DVM (Animal Quarantine Station Manager) provided the following information:

> The origin of the concrete pillar is unknown. The archaeologist from DLNR's Historic Preservation Division could not definitively identify the object in 2012. And said it could be a marker/sign from a Japanese temple as there were some located in the Makiki area historically.
>
> No employees at the HDOA main office knew the history of where/how the object was placed at the King street building, or could identify the object when questioned in 2012.
>
> Ron Shimojo's involvement with the object is from a priest he knew that examined it. To my knowledge there are no visible characters or dragon and that description was given by the female priest that "felt" them (spiritually and not tactile). (Maeda 2017)

A short interview was also conducted with Abraham Kahaʻi on July 24, 2017. Mr Kahaʻi has worked as a groundskeeper at the Animal Quarantine Station for the past 15 years, and has lived in the area since childhood (born in 1949). During the tour of the facility, several stacked stone monuments (*ahu*) and modern petroglyph stones (Figures 57 and 58) were observed, and when asked about these items, Mr. Kahaʻi explained that he was responsible for their manufacture and placement. When asked about their significance, he related that the area is full of "spirits" and the *ahu* were for spiritual protection. Mr. Kahaʻi suggested that the spirits of the many individuals that were buried in the area (he was referring to the WWII Naval Cemetery—see discussion above) still inhabit the place. He said that he learned of the former cemetery from Mr. Shimojo, who shared old photographs with him.

Figure 57. Stacked rock feature constructed by Mr. Kahaʻi.

Figure 58. Petroglyph rock feature made by Mr. Kaha‘i.

On October 11, 2017 Robert B. Rechtman, Ph.D. returned to the Animal Quarantine Station for a follow-up interview with Mr. Kaha‘i. Upon arrival, Dr. Rechtman met with Mary Tashiro (Quarantine Operations Supervisor) who suggested speaking with Harrison Hoe, who has been employed for 46 years with Animal Quarantine. Mr. Hoe, like Mr. Kaha‘i talked about the many spirits that inhabit the area and related them to more than just the former Naval cemetery, explaining that Halawa Valley has a lot of history and ancient Hawaiian villages. He also described that a “Menehune” trail crosses that Animal Quarantine Station property, and that “night marchers” are present on this trail. He placed the location of this spiritual trail leading out of the Hawaiian Cement property and into the Animal Quarantine Station property extending past the Pump House in the vicinity of the MWR kennels. When asked what he thought of the Animal Quarantine Station moving to make way for a new OCCC facility, He replied the proposed new location for the Animal Quarantine Station is actually its old location before it moved to where it is now in the 1990s; and that maybe the spiritual presence that he has experienced at the property could serve as a benefit to the rehabilitation of correctional facility inmates.

After talking with Mr. Hoe on October 11, 2017, Robert B. Rechtman, Ph.D. conducted a follow-up interview with Abraham Kaha‘i. The primary purpose of the follow-up discussion was to share ASM’s research about the former Naval cemetery, particularly its projected former location (see Figure 33) relative to the present-day Animal Quarantine Station property. Mr Kaha‘i reviewed our maps and aerial photographs, which sparked his childhood memories of walking from the Red Hill area (where he lived) to the Halawa Stream area. When shown images of the bridge (see Figures 29 and 30) that we used to secure the location of the former Naval cemetery, he recalled that as Bridge 2 that he walked across in his youth (in the late 1950s). Mr. Kaha‘i was also asked about the spiritual trail that Mr. Hoe described as traversing the upper portion of the Animal Quarantine Station, and he acknowledged that a night marchers trail does exist and described a few personal experiences he had with malevolent spirits.

MILILANI TECH PARK LOT 17 LOCATION

Robert B. Rechtman, Ph.D. had both a phone conversation and an email exchange with Mr. Christopher M. Lovvorn, the Castle & Cooke Hawaii Vice President-Commercial Development. Mr. Lovvorn was asked if any individuals have requested access to conduct cultural practices anywhere within the Mililani Tech Park, inclusive of Lot 17. He explained that he was not aware of any such requests or of any such activities that may have or are taking place anywhere within the Mililani Tech Park. This is not surprising as the non-gulch areas of the Mililani Tech Park Lot 17 were intensively cultivated with pineapples during most of the twentieth century.

WCCC LOCATION

On July 27, 2017, Robert B. Rechtman, Ph.D. met at the WCCC facility with Mark Gonzales (Sergeant and Maintenance Coordinator). Sgt. Gonzales has worked at WCCC for 20 years, and he was asked if any individuals conducted cultural practices anywhere within the existing HCF facility. He was unaware of any persons (outside public) requesting access to the WCCC property for traditional cultural activities. Mr. Gonzales did explain that one of the Hawaiian inmates was actively engaged in cultivation and that she constructed traditional Hawaiian monuments (Figure 59) at the cultivation site, which the current authors interpret as an expression of cultural identity.

Figure 59. Traditional monuments constructed by WCCC inmate at an agricultural planting area.

As a follow-up, ASM requested to conduct an interview with the WCCC inmate identified as having constructed the monuments and who is undertaking the agricultural activities, however at the time of this writing the interview has yet to take place. Given that the proposed location of the new facility at the WCCC to house the relocated OCCC women’s population is distant from the current planting area, there would likely be no direct impact on the expression of cultural identity that is reflected in the activities that take place there.

4. DISCUSSION AND ASSESSMENT OF CULTURAL IMPACTS

The OEQC guidelines identify several possible types of cultural practices and beliefs that are subject to assessment. These include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs. The guidelines also identify the types of potential cultural resources, associated with cultural practices and beliefs that are subject to assessment. Essentially these are natural features of the landscape and historic sites, including traditional cultural properties. A working definition of traditional cultural property is:

> “Traditional cultural property” means any historic property associated with the traditional practices and beliefs of an ethnic community or members of that community for more than fifty years. These traditions shall be founded in an ethnic community’s history and contribute to maintaining the ethnic community’s cultural identity. Traditional associations are those demonstrating a continuity of practice or belief until present or those documented in historical source materials, or both.

The origin of the concept of traditional cultural property is found in National Register Bulletin 38 published by the U.S. Department of Interior-National Park Service. “Traditional” as it is used, implies a time depth of at least 50 years, and a generalized mode of transmission of information from one generation to the next, either orally or by act. “Cultural” refers to the beliefs, practices, lifeways, and social institutions of a given community. The use of the term “Property” defines this category of resource as an identifiable place. Traditional cultural properties are not intangible, they must have some kind of boundary; and are subject to the same kind of evaluation as any other historic resource, with one very important exception. By definition, the significance of traditional cultural properties should be determined by the community that values them.

It is however, with the definition of “Property” wherein there lies an inherent contradiction, and corresponding difficulty in the process of identification and evaluation of potential Hawaiian traditional cultural properties, because it is precisely the concept of boundaries that runs counter to the traditional Hawaiian belief system. The sacredness of a particular landscape feature is often cosmologically tied to the rest of the landscape as well as to other features on it. To limit a property to a specifically defined area may actually partition it from what makes it significant in the first place. However contentious the concept of boundaries may be, it is nonetheless the regulatory benchmark for defining and assessing traditional cultural properties. As the OEQC guidelines do not contain criteria for assessing the significance of traditional cultural properties, the current study utilizes the state criteria for evaluating the significance of historic properties, of which traditional cultural properties are a subset. To be significant, the potential historic property or traditional cultural property must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

> a. Be associated with events that have made an important contribution to the broad patterns of our history;
>
> b. Be associated with the lives of persons important in our past;
>
> c. Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;
>
> d. Have yielded, or is likely to yield, information important for research on prehistory or history;
>
> e. Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s history and cultural identity.

While it is the practice of DLNR-SHPD to consider most historic properties significant under Criterion d at a minimum, it is clear that traditional cultural properties by definition would also be significant under Criterion e. A further analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities resulted from the *Ka Pa‘akai O Ka‘āina* v Land Use Commission court case. The court decision established a three-part process relative to evaluating such potential impacts: first, to identify whether any valued cultural, historical, or natural resources are present; and identify the extent to which any traditional and customary native Hawaiian rights are exercised; second, to identify the extent to which those resources and rights will be affected or impaired; and third, specify any mitigative actions to be taken to reasonably protect native Hawaiian rights if they are found to exist.

The discussion that follows summarizes the resources (archaeological and traditional cultural) and practices (ancient and modern) identified for each of the proposed OCCC replacement alternatives and the WCCC location; as well as potential impacts to any such resources and practices, and proposed mitigation. This summary derives from the background research and consultation presented above and the findings of the archaeological and architectural study (Louis Berger 2017) that was conducted in support of the EIS for the OCCC replacement project.

The current OCCC location in Kalihi Ahupuaʻa, Kona District, situated within an area of coastal flats replete with traditional Hawaiian fish ponds, overlaps with the northern portion of a former *kuleana* parcel (LCAw. 5044:5 to Kahaha). Although the current OCCC property appears to have not been used for commercial agriculture during historic times, it has undergone development for over a century and has hosted several iterations of the Oʻahu Prison, beginning as early as 1914. Other development includes ground disturbance associated with the former OR&L railway, a portion of which extended across the southern boundary of the property until around 1947. Aside from architectural features, there are no known historic or cultural properties identified within the current OCCC site; likewise, there were no past or ongoing cultural practices identified. The Louis Berger (2017) archaeological and architectural study found that:

> No new sites were identified during the reconnaissance survey, and as a whole the majority of the current OCCC facility is highly impacted by the built environment of the jail. The majority of the property is covered by housing modules, administration buildings, and paved parking areas. Several small grass lawns are interspersed with the structures. The recreation yard, located in the southwest quarter of the facility, is the only sizable open outdoor space remaining, and it has been disturbed by underground utilities and sprinkler lines. Given the extensive coverage of structures and disturbances across the facility, systematic or subsurface testing is not likely recover any additional information. Should the existing OCCC facility be selected for the proposed project, Louis Berger recommends archaeological monitoring during construction. (2017:133)

If the new OCCC facility is built within the existing OCCC property and the recommended archaeological mitigation (monitoring) is followed, then no site-specific cultural resources or practices will be impacted.

Three of the potential OCCC sites are located within the ʻEwa District, which has a storied past and many freshwater springs and mountain streams. For instance, the Mililani Tech Park Lot 17 location is situated between Kaukonahua and Waikakalua Streams. Despite the nearby fresh water source, traditional Hawaiian agricultural terraces did not extend as far *mauka* as Lot 17; nor did the rice paddies that supported the Waipahu Chinese community in the late 1800s and early 1900s; or the commercial sugarcane planted by Oahu Sugar Company. However, beginning in the early 1900s, commercial pineapple cultivation was carried out within Lot 17 of Mililani Tech Park, for roughly eighty years. Previous archaeological studies conducted in the vicinity of Lot 17 reveal scant evidence of Precontact sites, which is likely due to land alteration associated with nearly a century of pineapple cultivation. No known Historic properties are located within the proposed Mililani Tech Park Lot 17 OCCC site. According to the Louis Berger (2017) study:

> The field reconnaissance found no artifacts or evidence of buried soil horizons around the perimeter of the landform, although field conditions severely limited physical access and ground visibility . . . Given the low potential for intact archaeological deposits, systematic or subsurface testing is not likely to recover any additional information. Louis Berger recommends archaeological monitoring during construction should the Mililani Technology Park, Lot 17 site be selected for the proposed project. (2017: 134)

Our limited consultation indicated that there was no past or present cultural activity taking place on this property. Thus, if the Mililani Tech Park Lot 17 location is selected, and the recommended archaeological monitoring take place, there will likely be no site-specific cultural impacts at this location.

The more *makai* locations of the other ʻEwa District locales, the Animal Quarantine Station and HCF, in Hālawa Ahupuaʻa tell a different tale. Prior to and during the early years after Western explorers' arrival, the lower reaches of Hālawa Valley contained *loʻi* situated along Hālawa Stream. In addition, dry taro was planted four and five miles inland. A century later, both HCF and the Animal Quarantine Station were planted in sugarcane as part of Honolulu Plantation. By the mid-1950s, the Animal Quarantine Station property had become part of the nearby quarrying activities and host to other industrial buildings. The southwestern end of the Animal Quarantine Station property overlaps with a portion of the former Hālawa Naval Cemetery, which was in use within two days of the Pearl Harbor Attack in December of 1941 until early 1947. By September of 1947, all the burials had been exhumed and reburied elsewhere. During the consultation process, interviewees related that the area of the Animal Quarantine Station was frequented by spirits associated with the former Naval cemetery as well as by traditional Hawaiian spirits (night marchers) along a corridor through the upper part of the facility. No archaeological sites are known to currently exists with the Animal Quarantine Station property, and according to the Louis Berger (2017) study:

> Inspection of the ground surface in the open areas of the Animal Quarantine Station did not result in the identification of any new archaeological sites. Ground surface visibility in the small patches of grass between the kennels and pens varied between 40 to 50 percent in the active south portion of the facility and 0 to 15 percent in the north portion that is no longer used. The construction of the H-3 overpass through the center of the facility also appears to have resulted in the grading and disturbance of most of a large pasture, which constitutes the only appreciable area of open ground without structures to inhibit systematic subsurface archaeological survey.
>
> Given the absence of recorded sites and the low potential for surviving subsurface remains, Louis Berger recommends no further survey if the Animal Quarantine Station is selected as the site for the OCCC facility. However, the larger area of the lower Halawa Valley is culturally significant, containing numerous archaeological sites, and the possibility exists for unanticipated cultural remains to be discovered. This could even include human remains from the nearby World War II temporary cemetery as it is possible that not all the remains were removed by the Navy following the war. Therefore Louis Berger recommends archaeological monitoring during construction if the site is selected and the formulation of an unanticipated discovery plan that includes procedures should human remains be encountered. (2017 131-132)

If the Animal Quartine Station is the selected location, construction of the new OCCC facility and construction of a new facilities elsewhere on the property to support the Animal Quartine Station activities will likely have no impact on archaeological sites if the recommended moniting (Louis Berger 2017) takes place. With respect to traditional cultural resources, it is recommended that both Harrison Hoe and Abraham Kahaʻi be consulted with respect to situating the new OCCC facilites so as to mitigate any impacts that may arise due to the presence of a spiritual night marchers trail.

HCF remained planted in sugarcane until construction began on the facility buildings around 1962. There are no known archaeological or cultural sites within HCF. Cultural practices identified during this study that occur in the vicinity of HCF are pig hunting activities and the stewardship of a *heiau* site (SIHP Site 50-80-10-657). Both of these activities use the road (Board of Water Supply road) that would be used for a new OCCC if HCF was the selected location. As reported in the archaeological and architectural study conduted for the OCCC replacement project:

> Louis Berger observed no new sites during field reconnaissance, and documented evidence of disturbances throughout the entire property, suggesting that all the open ground was graded and/or filled for the construction of the current facility. . .
>
> Given the disturbed nature of the ground observed in and around the recreation yard, further systematic or subsurface testing is not likely to recover any additional information. Should the Halawa Correctional Facility be selected, Louis Berger recommends archaeological monitoring during construction and a more detailed assessment of the potential visual impacts of the project design on the complex of sites around Site SIHP 50-80-10-657. (Louis Berger 2017 132)

If HCF is the selected location for the new OCCC, the possible construction of the OCCC in the existing HCF recreation yard will likely not be visible from the *heiau* site; and; as long as access to this site by practitioners is not impeded, the OCCC replacement project should not have any effect on Site 657 and the cultural practices that currently take place there. The same is true for any potential impacts to pig hunting in the area; as long as reasonable accommodations were made for continued access, there should not be a significant impact on hunting practices

The WCCC in Kailua, Koʻolaupoko District, is situated near significant cultural resources such as Kaʻelepulupulu fishpond, Kawainui Marsh, and Kukuipilau and Ulupo Heiau. In addition, a portion of a *kuleana* award (LCAw. 6969:1 to Kuahine) is found within the central (eastern) part of the property. Despite its proximity to traditional Hawaiian cultural sites, there are no known historic properties that date from Precontact times within the WCCC property. A single archaeological site (SIHP Site 50-80-11-6817) is located within the WCCC property, a Historic Period water-flow control structure consisting of two features: a rectangular construction made from stacked basalt blocks joined with mortar/concrete, and a concrete encased valve/pumping station located adjacent to the main structure. This plantation-era irrigation feature was determined to be significant under Criterion d. There are also seven potential Historic properties of architectural significance within the WCCC property. None of these sites are considered significant for cultural reasons (Criterion e). As reported in the archaeological and architectural study conduted for the OCCC replacement project:

> Louis Berger's reconnaissance of the entire west half of the facility found that ground surface visibility varied between 0 and 15 percent across most of the project area. No artifacts or buried soil horizons were observed; however, a small concrete housing for a gauge or gate was identified in the north portion of the project area. This feature does not appear to be associated with the Waimanalo Ditch System complex . . . but rather the small intermittent drainage that runs through the WCCC grounds. Active garden terraces were documented that likely date to the beginning of the facility as the Koolau Boys Home in the 1950s, but they do not constitute an archaeological site. . . Given the low potential for subsurface remains in the area likely to be impacted by construction, further survey or subsurface testing is not likely to recover any additional information. Louis Berger recommends that any alterations or changes in the proposed project design avoid areas near the Waimanalo Ditch System complex (SIHP #50-80-11-6817) and that an archaeological monitoring program be implemented during construction. (2017:134)

If the Louis Berger (2017) mitigation recommendations are followed, construction of new facilities at WCCC will likely not result in impacts to cultural properties. The agricultural activities and associated monument construction promoted by a WCCC inmate could be considered cultural practices; however, given that the proposed location of the new facility at the WCCC to house the relocated OCCC women's population is distant from the current planting area, there would likely be no direct impact on these practices.

In the form of concluding remarks we offer the following:

A previously discussed, beginning with the founding of Hawai‘i's criminal justice system in the early nineteenth century, Native Hawaiians have and continue to be adversely impacted by this system in ways no other ethnic group has experienced. The 2010 study completed by OHA substantiated years of anecdotal claims regarding the disparate treatment of Native Hawaiians in the criminal justice system, with the most significant find revealing that Native Hawaiians are overrepresented in every stage in of Hawai‘i's criminal justice system, and the disproportionality increases as Native Hawaiians go further into the system (OHA 2010). Additionally, Native Hawaiian males and females make up the largest proportion of Hawai‘i's inmate population (ibid.). It is without a doubt that the construction of a new jail facility will impact Native Hawaiians. However, the ways in which this proposed project is implemented, will ultimately determine whether the subject ethnic group will be adversely or positively impacted (see below and the recommendations presented in the 2012 Native Hawaiian Task Force Report reproduced in Appendix A).

While typical Cultural Impact Assessments often emphasize identify and discuss site-specific impacts (as was done above), in reviewing Hawai‘i's current carceral system it is evident that distinguishing between social and cultural impacts is a difficult proposition at best, as many of the identified social impacts apply to a specific ethnic group (Native Hawaiians), thus transforming them into cultural impacts. The findings from OHA's (2010) study is cause for great concern especially for Native Hawaiians and should prompt actions and solutions that should be addressed or mitigated through the proposed OCCC replacement project. It is our hope that the social impacts are fully identified in the overall EIS process and addressed appropriately. Below we address a few of these sociocultural impacts.

Through the consultation process, several sociocultural impacts were identified. The disproportionality of Native Hawaiians in the criminal justice system is by far one of the greatest sociocultural impacts. As identified in the literature and through the consultation process, the authors recommend PSD expand their inmate support services and revise the bail process, which can help reduce the overall pretrial inmate population at OCCC. Furthermore, if the overall pretrial population is reduced, this will help address overcrowding and will likely reduce the number of Native Hawaiians in the system, possibly curtailing further contact.

While preventative measures can help limit initial contact with the system, provisions for intervention and support services for inmates who are currently moving through the system could be expanded. As discussed in the consultation section of this report, maintaining and improving the current family visitation process is a vital component of the inmates' rehabilitation process. Studies have shown that inmates who have regular family support in the form of visitations have lower recidivism rates. For many Native Hawaiians, the *‘ohana* (family unit) provides the motivation and the support needed to stay out of contact with the system. We, therefore, recommend PSD ensure adequate staffing and if applicable, technology, so that the inmates can maintain healthy contact with their families and received support that can facilitate their reintegration into society.

Drawing from the cultural-historical background and as expressed by consulted parties, we recommend that a concerted effort is made to transform a relocated OCCC facility to one that emphasizes inmate rehabilitation and reintegration. This philosophical shift may be actualized through tangible means (i.e., improving inmate processes, building design, increased access to support services, offering cultural programs, etc.); and we recommend that PSD implement and sustain a consultation process with the various stakeholders who can offer rational input on these topics.

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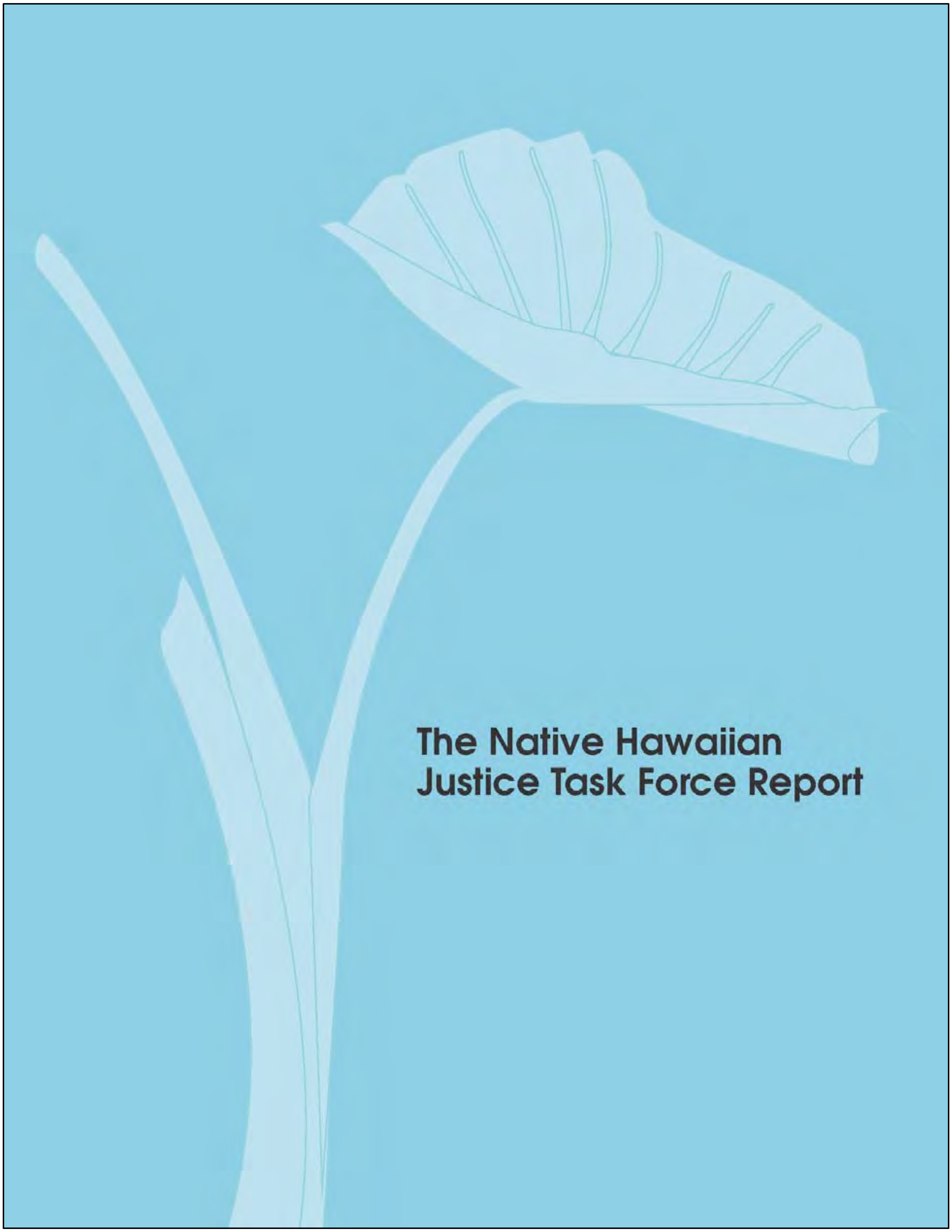
APPENDIX A:
THE NATIVE HAWAIIAN JUSTICE TASK FORCE REPORT



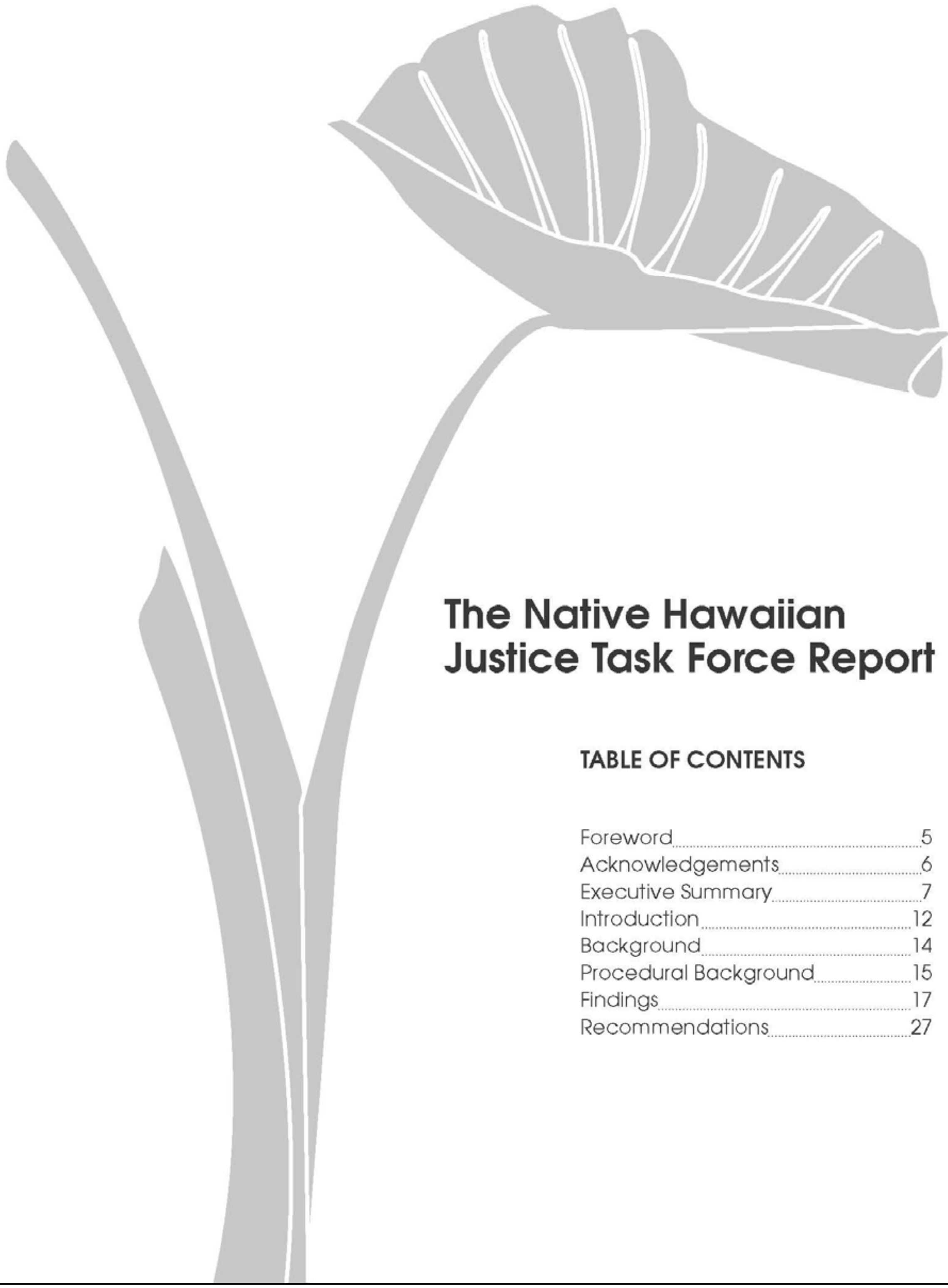
The Native Hawaiian Justice Task Force Report

E HOʻOKANAKA.

BE A PERSON OF WORTH.

These were the very last words of Kamehameha, the unifier of the Hawaiian islands, upon his deathbed. To his beloved attendants, the King uttered the famous, "E ʻoni wale nō ʻoukou i kuʻu pono (ʻaʻole i pau)." With these words, he instructed his attendants, "Continue to do what I have done." Then, turning to his grieving young son Liholiho, the dying King spoke these words, "E hoʻokanaka." These words continue to be spoken today as an encouragement to be brave and courageous as well as to assert one's Hawaiian identity.

E hoʻokanaka. Be a person of worth.



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FOREWORD

We are blessed to call Hawai'i home. There is no more special place. Yet, the root culture, Native Hawaiians, in their own homeland, are over-represented at every stage of the criminal justice system. Regardless of why, the reality cannot be denied. This state of affairs can only be considered a tragedy. To view it in any other way would be to insult and undervalue the most welcoming, giving people in the world.

Working on complex, emotional, and critically important matters is never easy. Certainly the work of the Task Force was not easy. If it was, the Task Force would not have done its job. I am confident the Task Force did its job, and I want to extend my gratitude to each Task Force member for giving so generously of their time and talents.

The Task Force took the issues and questions to the people, first and foremost to the Native Hawaiian people. As we traveled the State, from O'ahu to Kaua'i to Maui to Hilo to Kona to Moloka'i and Lāna'i (via video), Hawai'i's people taught us much about perseverance, about suffering, about courage and above all, about hope. It is the Task Force's hope that all of Hawai'i will take responsibility for reducing the number of Hawaiians in prison. As nine individuals, all the Task Force has done is lay the ground work for real change to occur. This Report, although a good start, is just that.

King Kamehameha's last dying words to his son were, "Be a person of worth." In the context of this Report, the same admonition should be applied to all of us—each and everyone.

Michael Broderick
Chair
Native Hawaiian Justice Task Force

Acknowledgements

The Native Hawaiian Justice Task Force Report ("Report") represents a significant amount of time, thought, and emotional investment on the part of numerous individuals, organizations, and communities. Pursuant to Act 170, the Native Hawaiian Justice Task Force ("Task Force") consists of nine members: designee of the attorney general, Paul Perrone; designee of the director of public safety, Martha Torney, M.A.; chief executive officer of the Office of Hawaiian Affairs, Dr. Kamana'opono Crabbe; administrator of the adult client services branch, Cheryl Marlow; circuit court judge, the Hon. Richard K. Perkins; criminologist, selected by the Governor, RaeDeen Keahiolalo-Karasuda, Ph.D.; representative from the prosecuting attorney for the City and County of Honolulu, Tricia Nakamatsu, Esq.; representative of the Office of the Public Defender, John M. Tonaki, Esq.; and member representing the public, selected by the Governor, the Hon. Michael Broderick (ret.). Pursuant to Act 170, at the selection of Task Force members, Michael Broderick serves as the Chair of the Task Force. Task Force members serve without compensation. Much work was done by Task Force members to produce this document, and by members' organizations in order to accommodate for the work in both time and resources.

The Task Force was assisted in the production of the Report by a dedicated staff. The Office of Hawaiian Affairs, Research and Advocacy divisions, already stretched to meet numerous demands, invested a significant amount of time and resources to the development of the Report. The staff at the Office of Hawaiian Affairs acted as community organizers, press liaisons, and organizers for six summits held throughout the state in the summer of 2012. After the summits, they diligently transcribed and developed the testimony that was used as the basis of the Report. Throughout the summer of 2012, independent research was also conducted by three students: Taryn Kaili, Morwenna Steinersen, and Megan Moniz. As a contracted writer, Sonny M. Ganaden, Esq. organized and compiled research, and led in the drafting of the Report.

The Task Force and the Office of Hawaiian Affairs extends their sincerest and utmost mahalo to all participants who shared their life experiences regarding the criminal justice system for this Report. Their leo (voice) and mana'o (thoughts) are crucial to understanding the human and social impact of the issues discussed in this document. As has been said in the Acknowledgments section of the 2010 Report, which subsequently led to the formation of the Task Force, "No words or phrase in English nor Hawaiian can convey the unsurpassed appreciation and deep gratitude for those participants for courageously sharing the depths of their lives with us and others."

To identify some individual testifiers and not others in this brief section would be a disservice to the efforts of all who testified. The Task Force wishes to honor all individuals' contributions. Readers are directed to engage with the compelling words which guided the Report at: www.oha.org/nativehawaiianjusticetaskforce

There were several individuals that allowed the Task Force direct access to Native Hawaiian prisoners who would be most directly affected by the Report. Warden Nolan Espinda of Hālawa Correctional Facility, Warden Mark Patterson at the Women's Community Correctional Center, and Lorraine Robinson, Director of TJ Mahoney and Associates, Ka Hale Hoʻāla Hou No Nā Wāhine. All allowed direct access to individuals in the facilities they direct, and those individual voices led directly to specific findings and recommendations.

Many who testified before the Task Force admonished those in leadership positions to acknowledge the personal and political histories that led to the overrepresentation of Hawaiians in the criminal justice system. The Task Force acknowledges the rich legacy of brave individuals within the criminal justice system and critics of that system who have endeavored to perform their duties justly. Throughout the summer of 2012, Task Force members received oral testimony before a display that recounted the last words of Kamehameha the Great, which read: E HO'OKANAKA, be a person of worth. It is this conception of duty, received through successive generations that the Task Force wishes to acknowledge and honor.

Executive Summary

In 2010, the Office of Hawaiian Affairs, in collaboration with the University of Hawai'i at Mānoa, Justice Policy Institute, and Georgetown University, produced a report entitled *The Disparate Treatment of Native Hawaiians in the Criminal Justice System* ("2010 Report"). Researchers found that "Native Hawaiians are overrepresented in every stage in the criminal justice system, and the disproportionality increases as Native Hawaiians go further into the system, also making it harder to leave and stay out of prison." ("2010 Report, at 17") The 2010 Report recommended the formation of a governing collaborative, which lead to the passage of Act 170 and the statutory creation of the Native Hawaiian Justice Task Force.

The disproportionate representation of Native Hawaiians in the criminal justice system has been previously reported upon and presented to the Hawai'i state Legislature. In addition to the findings of the 2010 Report, the Task Force acknowledges the studies "Crime and Justice Related to Hawaiians and Part Hawaiians in the State of Hawaii," ("1981 Study"), and "Criminal Justice and Hawaiians in the 1990's: Ethnic Differences in Imprisonment Rates in the State of Hawai'i," ("1994 Study"). The 1981 Study, the 1994 Study, and the 2010 Report independently concluded that Native Hawaiians are overrepresented in the criminal justice system. Those documents, and several others which discuss Native Hawaiians in the criminal justice system, are now available online at: www.oha.org/nativehawaiianjusticetaskforce

As a group, the Task Force and the Office of Hawaiian Affairs, which is attached to the Task Force as its administrator through Act 170, have devoted a significant amount of time and effort in engaging in a dialogue with the community. Through a series of summits held throughout the state during the summer of 2012, the Task Force received testimony regarding the disproportionate representation of Native Hawaiians in the criminal justice system directly from one hundred fifty nine individuals, and dozens of others through site visits at State correctional facilities and the receipt of written testimony and research.

Following the summits, site visits, and the receipt of testimony, the Task Force undertook a deliberate process to draft the Findings and Recommendations sections of the Report. The production of those sections was also influenced by the perspective of each Task Force member who brought forth from his or her role within the criminal justice system.

The headings of the Report are:

A. Data regarding Native Hawaiians in the criminal justice system;
B. The disproportionate representation of Native Hawaiians in the criminal justice system;
C. Early intervention programs for Native Hawaiians;
D. Impact of the State's contracting with non-state facilities on Native Hawaiians;
E. Issues in State-operated correctional facilities and their impact on Native Hawaiians;
F. Restorative justice practices and their application to Native Hawaiians;
G. Lack of services for Native Hawaiians who come into contact with the criminal justice system;
H. Continuing state efforts to ameliorate the over representation of Native Hawaiians in the criminal justice system.

The Task Force produced forty eight findings and thirty eight recommendations. This executive summary provides a short list of key findings and recommendations that the Task Force made. Throughout the production of the Report, the Task Force attempted to use direct and concise language; eschewing ambiguous phrasing and legal rhetoric.

The Task Force urges readers to engage with the full text of the Report. As the wording of the findings and recommendations has been deliberately vetted, the Executive Summary cannot supplant the full text. As criminal causality is debated by esteemed professionals across the world, so too are the options to address criminality. In the Report, no finding or recommendation is more important than another. From the perspective of the present, it is impossible to deduce which specific recommendation, if enacted into law, may proximately remedy the disproportionate representation of Native Hawaiians in the criminal justice system.

Key Findings

A. **Data regarding Native Hawaiians in the criminal justice system**

- In order to inform future policy decisions regarding the disproportionate representation of Native Hawaiians in the criminal justice system, the State of Hawaiʻi needs to identify what data is to be collected at different points within the criminal justice system, improve data integration, and improve data infrastructure amongst state agencies.
- The disproportionate representation of Native Hawaiians in the criminal justice system has been clearly and repeatedly established. Further study, including additional control variables, would provide a richer understanding of why Native Hawaiians remain disproportionately represented in the criminal justice system.

B. **The disproportionate representation of Native Hawaiians in the criminal justice system**

- The general perception in the Native Hawaiian community is that the criminal justice system is broken. There has been ongoing, tremendous frustration in the Native Hawaiian community regarding the disproportionate representation of Native Hawaiians in the criminal justice system.
- Proactive policy initiatives, including those promoting a rehabilitative model of incarceration, in the criminal justice system must be effectuated. It is possible, and even likely, that federal and/or state funding will continue to decrease in the near future. In that instance, Hawaiʻi may continue to face a crisis.
- Implicit, unconscious bias and disparate treatment on the part of workers at all stages of the criminal justice system may explain a portion of the disproportionate representation of Native Hawaiians in the criminal justice system.
- In the present economy, ex-offenders face barriers in securing employment, housing, and reintegration into the community based on their arrest and court record. These barriers may affect the recidivism rate for Native Hawaiians.
- The Hawaiʻi Paroling Authority has more discretion than its counterparts in other states or the federal government regarding inmates' length of stay, conditions of parole, and other conditions regarding incarceration. An inmate's program enrollment is a factor considered by the Hawaiʻi Paroling Authority. The expanded discretion of the Hawaiʻi Paroling Authority may have been used to unequal effect due to the lack of programs for inmates.

C. **Prevention and early intervention programs for Native Hawaiians**

- The children of incarcerated parents are at risk of having a higher rate of interaction with the criminal justice system.
- Preventative measures, such as adequate education and programs for at-risk youth, continue to be inadequately funded.

D. **Impact of the State's contracting with non-state facilities on Native Hawaiians**

- Prisoners, former prisoners, family members of prisoners, and Task Force members report that prisoners in non-state facilities receive more consistent and available programs and live in less crowded conditions than prisoners in state prisons. Prisoners in private correctional facilities report receiving more respect from staff. However, prisoners in private facilities are subject to drastic dislocation from their home, culture, family, job prospects, and community support.
- The criteria for sending and returning prisoners to and from non-state facilities remain unclear.
- In reaction to recent statements from the Governor, and the Justice Reinvestment Initiative of 2011, any planned return of prisoners to the community from non-state facilities should be accomplished in a planned and responsible manner, with public safety being the primary concern.
- Native Hawaiians who are sent to non-state facilities are effectively given an unequal burden in relation to non-Hawaiian prisoners. This burden includes a dislocation from his or her home, connection to the land, culture, family, job prospects, and community support.
- Due to their incarceration on the continental United States, many released offenders do not have effective transition plans regarding employment, housing, and reintegration into the community beyond compliance with parole.

E. **Issues in State-operated correctional facilities and their impact on Native Hawaiians**

- Inmates released from state correctional institutions often do not have any form of official identification. A form of identification is necessary to apply for employment, to find housing, and to comply with conditions of parole.

- If the state of Hawaiʻi had sufficient and appropriate community-based alternatives to incarceration for substance abuse, mental health treatment, and housing at all points within the criminal justice system, the state may reduce its reliance on incarceration.

- Prisoners and former prisoners in state facilities may be receiving inconsistent treatment from staff. This inconsistent treatment by staff leads to inefficient effectuation of programs and policies.

F. **Restorative justice practices and their application to Native Hawaiians**

- Indigenous cultural practices present appropriate models in ameliorating the disproportionate impact of the criminal justice system on indigenous communities. The Native Hawaiian community and nations such as Aotearoa, Australia, and Canada have had recent successes in adopting indigenous cultural practices.

- Restorative justice practices, such as sentencing circles, mediation, and community justice, are an option for certain defendants.

G. **Lack of services for Native Hawaiians who come into contact with the Criminal Justice System**

- Culturally based programs are effective, and should be expanded upon.

- Mental health services, such as psychopharmacological medication, counseling, and case management for those with mental health conditions are inadequate, and are an important component for the rehabilitation of Native Hawaiian prisoners ("paʻahao").

- There is no comprehensive directory of culturally-based programs and service providers for Native Hawaiians who come into contact with the criminal justice system. The Office of Hawaiian Affairs is presently working on a directory of Native Hawaiian organizations and community-based service providers.

- Pretrial detainees have limited access to community-based programs. This lack of access leads to pre-trial detainees remaining incarcerated.

H. **Continuing State efforts to ameliorate the disproportionate Representation of Native Hawaiians in the Criminal Justice System.**

- Effective change in the criminal justice system will require a sustained, continued cooperation amongst state agencies and private organizations, past the work of the Native Hawaiian Justice Task Force.

Key Recommendations

A. **Data regarding Native Hawaiians in the criminal justice system**

- State agencies that affect the criminal justice system are to collect and maintain data on all aspects protected by the state and federal constitutions. The state of Hawai'i is to identify what data is to be collected at different points within the criminal justice system, improve data integration, and improve data infrastructure amongst state agencies.

B. **The disproportionate representation of Native Hawaiians in the criminal justice system**

- The portions of the Justice Reinvestment Initiative which were not passed into law as Senate Bill 2776, Act 139 (2011) and House Bill 2515, Act 140 (2011), are to be reintroduced. As Native Hawaiians are over-represented in the criminal justice system, the Native Hawaiian community will be disproportionately affected by any inaction to reduce inmates or fix problems within the criminal justice system.
- The state of Hawai'i, including the executive and judicial branches, shall create and maintain an inventory of service providers, including, but not limited to, culturally based service providers that interact with inmates and former inmates. Such services may include services that address mental health, substance abuse, workforce development, and housing.
- Training regarding implicit, unconscious bias is to be mandatory and ongoing for all employees who have contact with individuals in the criminal justice system. The judiciary has recently held such a training for judges.
- In order for the Office of the Public Defender to deliver optimal services, the legislature must approve and fund more deputies, related support staff, and facilities.
- All efforts should be made to conduct hearings before the Hawai'i Paroling Authority with the inmate/defendant physically present.
- The legislature should develop guidelines for the Hawai'i Paroling Authority concerning the setting of the minimum term and factors to be considered for parole. One such consideration is access to programs.
- By law, inmates should be given credit for "earned time/good credit" before the Hawai'i Paroling Authority.

C. **Prevention and early intervention programs for Native Hawaiians**

- To reduce intergenerational incarceration, resources must be directed toward children of incarcerated parents. The legislature should consider a mandatory educational program for guardians of minors with a parent in prison, similar to the "Kids First" program currently in place throughout the Judiciary.

D. **Impact of the State's contracting with non-state facilities on Native Hawaiians**

- The Department of Public Safety should ensure that prisoners who are housed in non-state facilities and who are eligible by classification for pre-release programs, such as work furlough, are returned to Hawai'i with sufficient time to complete programs prior to their tentative parole date.
- The Department of Public Safety should ensure that all allegations of abuse of inmates are independently investigated and that appropriate corrective action is taken.
- The Department of Public Safety should ensure that inmates are allowed to follow their religious and Native Hawaiian cultural practices, and retain sacred cultural items that do not pose a danger to the security of the institution.
- Consistent with community testimony and the Governor's repeated statements, prisoners held out of state should be returned. The State should make the return of inmates a top priority, and inmates should be returned as soon as practicable, consistent with public safety.
- Once the inmates are returned from private out-of-state facilities, the State should consider passing legislation prohibiting future use of private, for-profit, correctional facilities.

E. **Issues in state-operated correctional facilities and their impact on Native Hawaiians**

- The Department of Public Safety should ensure that prior to work furlough and/or release, all inmates obtain official state identification and if needed, a social security card.
- The staff at all state operated correctional facilities shall receive annual, mandatory training regarding trauma informed care.
- Prisoners should be allowed consistent and regular visitation with immediate and extended family members. The Department of Public Safety should make every effort to ensure that adequate staffing is available for consistent and regular visitation.

F. **Restorative justice practices and their application to Native Hawaiians**

- The State should recognize and support community and grassroots efforts that promote indigenous cultural practice models demonstrated to be successful in Hawai'i or elsewhere.

G. **Lack of services for Native Hawaiians who come into contact with the criminal justice system**

- The state should ensure adequate funding and staffing to treat offenders with mental health conditions, including supporting psychopharmacological medication, counseling, and case management.
- The State should ensure adequate funding and staffing to create a comprehensive directory of culturally-based programs, indigenous models, and service providers for Native Hawaiians who come into contact with the criminal justice system.
- Neighbor island models such as Maui Economic Opportunity BEST, POHAKU, Kahua Ola Hou, and Wailuku Neighborhood Place should be supported, expanded upon, replicated, and/or reinstated.

H. **Continuing state efforts to ameliorate the disproportionate representation of Native Hawaiians in the criminal justice system**

- There should be permanent funding and full time staffing in the appropriate agency or independent body to oversee and implement recommendations of the Native Hawaiian Justice Task Force, and to continue to review this evolving issue.
- Future efforts to implement recommendations and review this evolving issue should include a wider breadth of community and agency representation than the current Native Hawaiian Justice Task Force.

Introduction

The Native Hawaiian Justice Task Force Report ("Report") is the result of the collective work of many individuals, communities, and organizations. By law, the Native Hawaiian Justice Task Force ("Task Force") was primarily comprised of individuals who represent what is generally referred to as the "criminal justice system." Members of the Task Force include representatives from the bar, the judiciary, and governmental agencies directly involved in the prosecution, defense, sentencing, incarceration, and supervision of those charged with criminal offenses. In addition, two members were appointed by the Governor to represent the community. This Report has also been deeply influenced by individuals from various and diverse sectors of the community, whose contribution further legitimized the findings and recommendations found herein.

In 2010, the Office of Hawaiian Affairs; in collaboration with the University of Hawai'i at Mānoa, Justice Policy Institute, and Georgetown University; produced a report titled *The Disparate Treatment of Native Hawaiians in the Criminal Justice System* (2010 Report). Researchers found that "Native Hawaiians are overrepresented in every stage of the Hawai'i's criminal justice system, and the disproportionality increases as Native Hawaiians go further into the system, also making it harder to leave and stay out of prison" (2010 Report, at 17). Consequently, the 2010 Report recommended the formation of a governing collaborative, which led to the passage of SB986 HD3 CD1 RELATING TO THE CRIMINAL JUSTICE SYSTEM, signed into law as Act 170(11) on June 27, 2011. Act 170 statutorily created the Native Hawaiian Justice Task Force, which has authored the present Report.

This Report fulfills the duties assigned to the Task Force under Act 170, to "...formulate policies and procedures to eliminate the disproportionate representation of Native Hawaiians in Hawaii's criminal justice system by looking for new strategies to reduce or avoid unnecessary involvement of these individuals with the criminal justice system," and to "...recommend cost-effective mechanism, legislation, and policies to reduce or prevent individuals' unnecessary involvement with the criminal justice system. The recommendations shall include estimates of cultural and fiscal impact." (Act 170, pg. 2-3).

In response to this charge, the Task Force and the Office of Hawaiian Affairs, attached to the Task Force as its administrator through Act 170, sought direct testimony from the public. In the summer of 2012, through a series of Pae 'Āina Summits held on O'ahu, Hawai'i Island, Maui, Kaua'i and Moloka'i, and Lāna'i (via video), the Task Force heard from one hundred and fifty nine members of the public. The Task Force also received numerous documents representing written testimony. Overall, members of the community directly testified to the statistical data presented in the 2010 Report, and discussed what those data means to Native Hawaiian individuals, Native Hawaiian families, and non-Native Hawaiians as members of an interconnected community. During the Pae 'Āina Summits, the Task Force asked those testifying to present his or her own recommendations. For many who testified, including members of the legislature, representatives of governmental and non-governmental entities, service providers, former prisoners (pa'ahao), and families of incarcerated men and women, testifying was not an impersonal event or an academic exercise. Rather, testimony represented a collective of personal experiences, many painful, and narrative underpinned by social, political, and historical memory.

The diverse, yet consistent perspectives offered at the Pae 'Āina Summits uniquely qualifies the present Report. The Task Force members made a concerted effort to listen to the Native Hawaiian community and the broader community, approaching each summit with an understanding of his or her position within the social structure of the criminal justice system, and how those respective positions make a qualitative difference in how the criminal justice system is perceived and experienced. Following the summits, the Task Force conducted site visits at Hālawa Correctional Facility and the Women's Community Correctional Center on O'ahu, and spoke directly with Native Hawaiian pa'ahao regarding their prison experiences.

The Findings section of this Report reflects the dialogue between the Task Force, the public, and prisoners. Where possible, individuals have been cited within the document and "plain language" has been used in favor of ambiguous phrasing or legal rhetoric. The Task Force produced forty eight findings.

The Recommendations section of this Report suggests cost-effective mechanisms, legislation, and policies pursuant to Act 170, and developed from the Findings section. The Task Force produced thirty eight recommendations. The recommendations in this Report make clear that the State must continue to invest in ameliorating the disproportionate representation of Native Hawaiians in the criminal justice system. The Task Force does not have the capacity to implement its recommendations. The findings and recommendations in this Report are presented as the beginning of an endeavor to address this evolving issue.

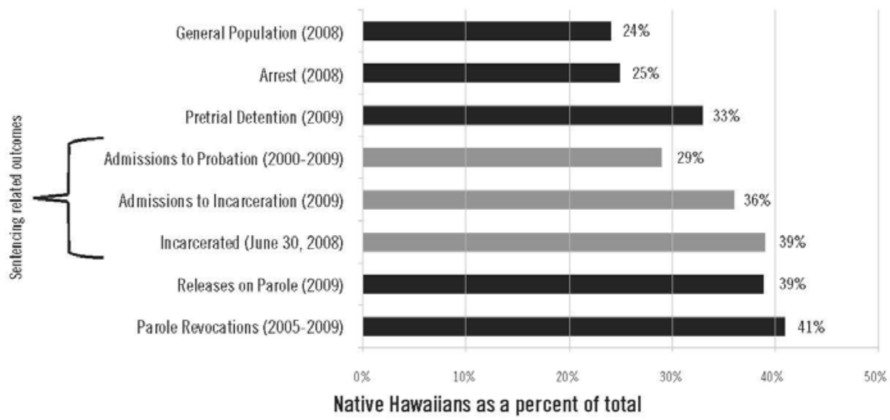
The Task Force is well aware that in order to solve the major problems elucidated in the Findings section of this Report, the state of Hawai'i must commit to do so. Without such commitment, the work of this Task Force, and the community that assisted in the development of this Report, will have been in vain. The Task Force has been emboldened in the development of its recommendations by the testimony of the community. In the words of one lawmaker who testified before the Task Force, "I think that we've had enough documents. We've had enough information that's been disseminated. We've got enough talk... We stand ready to support you with what you have to offer. And please be bold[.]"

The recommendations set forth are supported by research and a collective of public testimony. They point to the fact that the goals of rehabilitation and healing are not incongruent with the necessities of public safety and the protection of victims or potential victims of crime.

Background

The 2010 report The Disparate Treatment of Native Hawaiians in the Criminal Justice System, produced by the Office of Hawaiian Affairs, in collaboration with the University of Hawai'i at Mānoa, Justice Policy Institute and Georgetown University, ("2010 Report") effectively outlines the current statistical data regarding the disparate representation of Native Hawaiians in the criminal justice system. Portions of the 2010 Report regarding statistical data have been adopted by the Task Force.

The disproportionate impact of the criminal justice system on Native Hawaiians accumulates at each stage. Native Hawaiians are also more likely to receive a sentence of incarceration over probation.



Sources: Hawai'i State Department of Health, Office of Health Status Monitoring, special tabulation from the Hawai'i Health Survey, January 22, 2010. http://hawaii.gov/dbedt/info/economic/databook/2008-individual/01/; Hawai'i Criminal Justice Data Center; Lydia Seumanu Fuatagavi and Paul Perrone, *Crime in Hawai'i: A Review of Uniform Crime Reports* (Honolulu, HI: Attorney General, State of Hawai'i, 2009). http://hawaii.gov/ag/cpja/main/rs/Folder.2005-12-05.2910/copy_of_cih2007/Crime%20in%20Hawaii%202007.pdf ; Hawai'i Department of Public Safety, *2008 Annual Report* (Honolulu, Hawai'i, Department of Public Safety, 2008). http://hawaii.gov/psd/administration/publications/annual-reports/department-of-public-safety/PSD-AnnualReport2008.pdf

Note: Admissions to incarceration or probation are the result of sentencing. Admissions to probation do not include instances where a period of incarceration is a condition of probation.

The disproportionate representation of Native Hawaiians in the criminal justice system has been previously reported upon and presented to the Hawai'i state Legislature. The Task Force discussed and acknowledges the study "Crime and Justice Related to Hawaiians and Part Hawaiians in the State of Hawai'i," ("1981 Study") commissioned by Alu Like, Inc., produced by Gene Kassebaum, Ph.D., for use by the State of Hawai'i in 1981, and the study "Criminal Justice and Hawaiians in the 1990's: Ethnic Differences in Imprisonment Rates in the State of Hawai'i," ("1994 Study") commissioned by Alu Like, Inc. by Gene Kassebaum, Ph.D., for use by the State of Hawai'i in 1994.

The 1981 Study, the 1994 Study, and the 2010 Report independently concluded that Native Hawaiians are over represented in the criminal justice system. The 1981 Study, the 1994 Study, and the 2010 Report are available online at: www.oha.org/nativehawaiianjusticetaskforce

Procedural Background

United by the goal of fulfilling the duties elucidated in Act 170, the Task Force attempted to engage in a direct dialogue with the Native Hawaiian community, and the community at large. Firstly, the Task Force reviewed the document *The Disparate Treatment of Native Hawaiians in the Criminal Justice System* (2010 Report). At subsequent meetings, the Task Force chose a Chair, and worked with the staff of the Office of Hawaiian Affairs to coordinate the Pae ʻĀina Summits to be held on Oʻahu, Hawaiʻi, Maui, Molokaʻi, Lānaʻi (via video), and Kauaʻi.

The Task Force met on the following dates: 11/29/11, 02/07/12, 04/03/12, 05/01/12, 06/05/12, 07/10/12, 08/14/12, 09/04/12, 10/09/12, 10/22/12, 10/23/12, 11/04/12, and 12/12/12. Most Task Force meetings lasted two hours. The Task Force's final two meetings lasted four hours and eight hours respectively. The agendas and meeting minutes have been provided online for all of the above dates at: www.oha.org/nativehawaiianjusticetaskforce

The Pae ʻĀina Summits occurred on the following dates:

Honolulu, Oʻahu	June 7 and 8, 2012
Kailua-Kona, Hawaiʻi	July 7, 2012
Hilo, Hawaiʻi	July 14, 2012
Wailuku, Maui	July 21, 2012
Kaunakakai, Molokaʻi	August 1, 2012
And Lānaʻi (via video)	August 1, 2012
Līhuʻe, Kauaʻi	August 3, 2012

The Task Force also conducted site visits with Native Hawaiian paʻahao at Hālawa Correctional Facility on August 29, 2012, the Women's Community Correctional Center on August 30, 2012, and T.J. Mahoney and Associates, Ka Hale Hoʻāla Hou No Nā Wāhine on August 21, 2012.

Subsequent to the Pae ʻĀina Summits, the Advocacy and Research divisions of the Office of Hawaiian Affairs produced a research document for use by the Task Force. The research document organized the testimony and documents presented to the Task Force using an appropriate methodology, and analyzed the information using a standardized process and coding scheme. That document is available online at:
www.oha.org/nativehawaiianjusticetaskforce

Testimony presented at the summits was recorded by the staff of the Office of Hawaiian Affairs. One hundred forty nine testimonials were transcribed, and are presented online at: www.oha.org/nativehawaiianjusticetaskforce

In order to accommodate differing perspectives within the Task Force, a deliberate process was undertaken to draft the Findings and Recommendations sections of the Report. The production of those sections was influenced by the perspectives that each Task Force member brought forth from his or her role within the criminal justice system. Criminal causality and the appropriate models to address criminality are debated by esteemed professionals across the world. Stakeholders from differing fields tend to discuss criminality in specific ways and use alternative models from which to approach similar issues. In this way, discussions at Task Force meetings reflected these differing approaches and perspectives. At various points in the process of creating the present Report, Task Force members engaged in robust, and at times, heated discussions regarding appropriate findings and recommendations.

After review of the testimony, site visits, and in consultation with respective offices, individual Task Force members presented his or her own specific findings for review before the Task Force. These findings were discussed and presented through the contracted writer. Each finding was then grouped into headings organized from the major subjects the Task Force gleaned from testimony.

The headings of this Report are:

A. Data regarding Native Hawaiians in the criminal justice system;
B. The disproportionate representation of Native Hawaiians in the criminal justice system;
C. Early intervention programs for Native Hawaiians;

D. Impact of the state's contracting with non-state facilities on Native Hawaiians;
E. Issues in state-operated correctional facilities and their impact on Native Hawaiians;
F. Restorative justice practices and their application to Native Hawaiians;
G. Lack of services for Native Hawaiians who come into contact with the criminal justice system;
H. Continuing state efforts to ameliorate the over representation of Native Hawaiians in the criminal justice system.

With the collective prospective findings recorded, the Task Force then convened, and proceeded line by line through each prospective finding and recommendation. The Task Force discussed the possible impact, appropriate placement, and wording of each point. Most, but not all findings and recommendations were unanimously approved. Where there was not unanimity, a vote was taken. Those votes are reflected in the footnotes of the Report along with the comments of the dissenting or abstaining party. The process for drafting the Recommendations section followed the format of the Findings section. Though not all findings and recommendations are unanimous, none are mutually exclusive.

Findings

A. Data regarding Native Hawaiians in the criminal justice system

1. The 2010 Office of Hawaiian Affairs Report *The Disparate Treatment of Native Hawaiians in the Criminal Justice System* (2010 Report), recommended, among other things, the formation of a governing collaborative (2010 Report, at 76.). That specific recommendation led to the passage of SB986 HD3 CD1 RELATING TO THE CRIMINAL JUSTICE SYSTEM, signed into law as Act 170(11) on June 27, 2011. Act 170 statutorily created the Native Hawaiian Justice Task Force (hereinafter "Task Force"), which has authored the present Report.

2. The Task Force adopts the statistical data regarding the disproportionate representation of Native Hawaiians in the criminal justice system as discussed in the 2010 Report *The Disparate Treatment of Native Hawaiians in the Criminal Justice System*, pgs. 27-42. The Task Force acknowledges that there have been previous studies regarding the disproportionate representation of Native Hawaiians in the criminal justice system, and that these previous studies have found similar statistical information.[1]

3. The state of Hawai'i needs to identify what data is to be collected at different points within the criminal justice system, improve data integration, and improve data infrastructure amongst state agencies. Data collection will better inform future policy decisions regarding the disproportionate number of Native Hawaiians in the criminal justice system.[2]

4. While the disproportionate representation of Native Hawaiians in the criminal justice system has been clearly and repeatedly established, further study, however, including additional control variables, would provide a richer understanding of why Native Hawaiians remain disproportionately represented in the criminal justice system.

B. The disproportionate representation of Native Hawaiians in the criminal justice system

1. The general perception in the Native Hawaiian community is that the criminal justice system is broken. There has been ongoing, tremendous frustration in the Native Hawaiian community regarding the disproportionate representation of Native Hawaiians in the criminal justice system.[3]

2. Any conversation regarding Native Hawaiians within the criminal justice system must be cognizant of political and historical context.[4]

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1. *Vote taken. Two votes against the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "Decline to 'adopt' all or part of any prior reports." Department of the Attorney General, "The Department only acknowledges the 2010 Report's most basic measurements showing the statistical overrepresentation of Native Hawaiians in the justice system, but is unable to 'adopt' a report that lacks methodological soundness and analytical objectivity. Despite citing only a specific range of pages, the Department also feels that this Finding may mislead readers toward an erroneous impression that the Task Force broadly endorses the 2010 Report."*

   See, "Crime and Justice Related to Hawaiians and Part Hawaiians in the State of Hawaii," ("1981 Study") commissioned by Alu Like, Inc. for use by the State of Hawai'i in 1981, and the study "Criminal Justice and Hawaiians in the 1990's: Ethnic Differences in Imprisonment Rates in the State of Hawai'i," ("1994 Study") commissioned by Alu Like, Inc. for use by the State of Hawai'i in 1994.

   The 1981 Study, the 1994 Study, and the 2010 Report independently concluded that Native Hawaiians are over represented in the criminal justice system. The reports can be found online at: www.oha.org/nativehawaiianjusticetaskforce

   The Office of Hawaiian Affairs has provided further studies regarding Native Hawaiians in the criminal justice system online at: www.oha.org/nativehawaiianjusticetaskforce

2. *Vote taken. One vote against the finding: Department of the Attorney General, "Prior to crafting any sort of costly 'data infrastructure' or 'data integration' schemes, a single, statistically rigorous and analytically objective study should be conducted in order to identify factors that substantially explain the variance in Native Hawaiian overrepresentation in the justice system. The results of that effort would also provide excellent information on specific data-related needs for future efforts."*

3. *Vote taken. Two votes against the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "The phrase 'general perception' in the first sentence appears unfounded, though that is clearly the opinion of some Native Hawaiians. Department of the Attorney General, "While summit testifiers offered criticism and suggestions targeting a variety of specific justice functions, policies, and procedures, it does not seem accurate to portray this feedback as a wholesale indictment of the justice system."*

4. Numerous individuals testified regarding political and historical context.

   Task Force member RaeDeen Keahiolalo-Karasuda, Ph.D. has written extensively regarding the historical constructs which have lead to the present dis-

3. Native Hawaiians have suffered from severe intergenerational, historical, and political trauma from the loss of land, language, and culture. This collective trauma has negative economic, health, cultural, and educational impacts on individuals, and often manifests itself in criminal activity. Any effort to reduce the number of Native Hawaiians who come in contact with the criminal justice system must include a multi-pronged approach to addressing this trauma.[5]

4. There is a strong belief in the Native Hawaiian community that historically, the criminal justice system has been used as a political tool to subjugate Native Hawaiians.[6]

5. The effects of the Justice Reinvestment Initiative, passed into law as Senate Bill 2776, Act 139 (2011) and House Bill 2515, Act 140 (2011), and the pu'uhonua culturally-based substance abuse treatment and intervention program, passed

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proportionate representation of Native Hawaiians in the criminal justice system. "Scholarly studies about colonialism in Hawai'i demonstrate the methods by which power and dominance operate (Kaunui 2002; Osorio 2002; Liliuokalani 1990; Trask 1999; Silva 2004; Kame'eleihiwa 1992). Yet scholars and others have overlooked the role of the prison industrial complex in the illegal overthrow of the Hawaiian kingdom. Likewise, current attention to the study of drugs and crime generally concentrates on individuals or group determinants rather than institutional violence. This is misleading, [as] the colonization of Hawai'i is directly traceable to the 19th century war on Opium, and current practices of punishment. State and popularized efforts to eradicate "social problems" related to drugs in Hawai'i tend to target individual or group problems and rest on the proposition that Hawaiians are prone to addiction and crime. (Hishinuma 2005)." RaeDeen Keahiolalo-Karasuda, Carceral Landscape in Hawai'i: The Politics of Empire, the Commodification of Bodies, and a Way Home, at 123-124, Abolition Now!, CRIO Publications Collective, Oakland AK Press (2008).

"So much of the problem, of what you guys are talking about, is rooted in the psychological disenfranchisement resulting from our history." Joe Farias, Testimony before the N. Haw. Justice Task Force, Hilo Summit (2012).

5. Sharon Conroy, testimony before the N. Haw. Justice Task Force, Kaua'i Summit (2012).

Lorraine Robinson, Director of TJ Mahoney and Associates, Ka Hale Ho'āla Hou No Nā Wāhine, which is the "home of reawakening for women," offered a scientific analysis and optimism for trauma intervention and the work of service providers.

"There is a phenomenon called epigenesis, which is showing that not only does intergenerational trauma get passed on socially, but it actually gets passed on genetically. The good news about that is that brains have a capacity called neuro-plasticity, meaning that they can be rewired. And all of the good work that all the people in this room are doing are actually rewiring the brains of people who have patterns and habits that have been self-destructive or destructive towards others. And now the new brain research is validating this stuff that we, as practitioners, have been seeing and living. [T]he confluence of the research on trauma, on neurobiology, and on attachment theory, is really substantiating again the importance of how we connect with people, of how culture fits into that, of how in the case of my work, we are responsive to the fact that women are not men and that they have different needs. They have different pathways into the criminal justice system. So I do think this is a kākou thing." Lorraine Robinson (Director of TJ Mahoney and Associates, Ka Hale Ho'āla Hou No Nā Wāhine; "home of reawakening for women") Testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

Regarding the ways that trauma begets trauma through successive generations in terrifying and predictable ways, Earl Kawa'a offered a rebuttal to the argument that violence is inherent in the Hawaiian conceptions of love or justice. "We need to go deep. "[W]hen I talk about deep, deeper in knowledge and 'ike and understanding and in the heart. [A previous testifier] said [violence] was 'traditional Hawaiian,' but I challenge him now because that's not traditional.

And here's the mana'o today: when you hit someone, when you bang someone, we say it's okay. Someone will say it is Samoan love. A Hawaiian will say that is Hawaiian love. That's bullshit. It was never Hawaiian love and never will be. And we should get rid of it. Never, ever allow that to happen. Here's why. Here's the cultural baseline for that statement. When you hit someone, and where do we slap when we slap someone? We slap someone on the head. We slap someone, we pa'i on the head. Pa'i ka po'o. And we say that's the Hawaiian way. And I say, 'Fuck that bullshit, gang.' That shouldn't happen. And why it shouldn't it happen? Because the 'aumakua sits here on the head. Someone say, 'Why don't you pa'i the butt? When the 'aumakua sits on the head, the 'aumakua is the entire body. So any place you hit someone is sinful—every place. That's what we need to know." Earl Kawa'a (Kupuna and cultural practitioner) Testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

6. *Vote taken. Two votes against the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "The specific bases for this generalization are unclear." Department of the Attorney General, "[T]he Department believes that this Finding does not accurately portray the overall sentiments expressed at the summits."*

Kaniloa Kamaunu (Former Corrections Officer, State of Hawai'i), testimony before the N. Haw. Justice Task Force, Maui Summit (2012)

Malina Kaulukukui offered a reason that much of the testimony received by the Task Force took the form of narrative. "[W]e provide a gender specific, culturally informed, residential treatment program or substance abuse treatment program for pregnant and parenting women.

Why am I telling you these stories? Because naming and language are the two critical pieces of anyone's culture and these are the two significant factors significant factors that were diluted in the attempt to assimilate Hawaiians to a more Western paradigm." Malina Kaulukukui (Cultural Integration Coordinator for the Salvation Army Family Treatment Services), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

"How do you dignify, how do you justify the existence of a system that has stolen? You have the Apology Bill; you have the state legislature, who had admitted to the fact that the takeover was not justified. Yet there is no satisfactory resolution; there is no satisfactory answer. And so you are catching people in this grand hypocrisy that somehow they have violated the law, when the real question is: who are the real violators?" Pōkā Laenui aka Hayden Burgess, Esq., testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012) into law as House Bill No. 2848, Act 117 (2011), both passed into law on June 20, 2012, have yet to be felt.[7]

6. Proactive policy initiatives, including those promoting a rehabilitative model of incarceration, in the criminal justice system must be effectuated. It is possible, and even likely, that federal and / or state funding will continue to decrease in the near future. In that instance, Hawai'i may continue to face a crisis.[8]

7. Without proactive policy and oversight, there is no indication that the disproportionate representation of Native Hawaiians in the criminal justice system will abate.[9]

8. Implicit, unconscious bias and disparate treatment on the part of workers at all stages of the criminal justice system may explain a portion of the disproportionate representation of Native Hawaiians in the criminal justice system.[10]

9. There are clear connections between poverty, access to counsel in all courts, and criminality. The Task Force acknowledges that though it has been presented with adherence to American common law, there has been a disproportionate

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7. In 2011, in order to reduce dependence on out-of-state prisons and improve the functions of the criminal justice system, the State of Hawai'i sought assistance from the Bureau of Justice Assistance, a division of the U.S. Department of Justice, and the Pew Center on the States. The state leaders agreed to establish a bipartisan, inter-branch Justice Reinvestment Working Group comprising leading state and local officials which would receive intensive technical assistance from the Council of State Governments Justice Center, in partnership with the Pew Center on the States. The Justice Reinvestment Bill was signed into law by Governor Neil Abercrombie on June 27, 2012. Several of the Justice Reinvestment Initiative's recommendations were not passed into law. Please see the bill in its original form. For an overview of the Justice Reinvestment Working Group's recommendations, see http://justicereinvestment.org/states/hawaii

   Pu'uhonua was introduced to the Hawai'i State legislature as House Bill 2848 (2011), and passed into law as Act 117, Session Laws of Hawai'i (2012).

8. *Vote taken. Two votes to abstain from the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "It is unclear what 'crisis' is being referenced in the last sentence." Department of the Attorney General, "It is unclear what 'crisis' is being referenced, or how the crisis relates to a 'rehabilitative model of incarceration.' In addition, this Finding does not seem directly or clearly related to reducing the overrepresentation of Native Hawaiians in the justice system relative to other ethnic groups."*

   "We have over felonized. Things in Hawai'i that are felonies are misdemeanors or petty misdemeanors in other states. They call them wobblers. Jack Tonaki (speaking to Task Force member) knows that. A burglary second in California, a UEMV, unauthorized entry into a motor vehicle can be treated with prosecutorial discretion. I have great respect for our prosecutors... By over felonizing, you trigger repeat offender sentencing which leads to overly incarcerating people in prison. Prison is for felonies, not misdemeanors." Hon. Michael Town (Cir. and Fam. Ct. Judge (ret.), Board Member, Hawai'i Paroling Authority) testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

   Toni Bissen, J.D., Director of the Pū`a Foundation, brought a cohort of service providers to testify before the Task Force. "We're here to talk about the concept of systemic change. Looking at trying to eliminate the disparate treatment of Native Hawaiians [by] taking a very broad perspective, what we call 'from twinkle to wrinkle.' It's an approach that affects all of us. I think that some of the comments that have been shared today show the need for this continuum of services.

   [T]o affect systemic change is to form public-private, individual, and family partnerships for community healing and well-being; using a mind, body, spirit, place, perspective and incorporating trauma informed systems of care approach[es] and a frameworks work towards community healing and well-being." Toni Bissen, J.D. (Director, Pū'ā Foundation), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012)

9. Refer to Supra note 1 for a link to statistical information regarding the persistence of Native Hawaiian disproportionate representation in the criminal justice system. Senator Brickwood Galuteria testified to his readiness for substantive action. "I have absolutely nothing more to offer you, except my encouragement... to move towards a document that we will receive in the next legislative session, as indicated in the law that trips the switch for action. I think that we've had enough documents. We've had enough information that's been disseminated. We've got enough talk. I think that the legislature is poised to receive something that we can advance into policy, which is where we sit, and into funding, where we sit as well.

   So thank you for convening [the] 2012 Native Hawaiian Justice Task Force. We stand ready to support you with what you have to offer. And please be bold in what you do because we're gonna need boldness, courage, and we're gonna need also an extension, not only into the prison system, but into our communities." Brickwood Galuteria (Hawai'i State Senator, Dist. 12), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012)

10. *Vote taken. Two votes against the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "The specific bases for this statement are unclear." Department of the Attorney General, "We are concerned about the use of a "may" statement to the exclusion of considering other possibilities as to the reason for disparate representation of Native Hawaiians in the criminal justice system. For example, national research demonstrates that the nature and extent of an arrestee's criminal history; the specific offense(s) resulting in the current arrest; and whether or not an arrestee was already on parole or probation at the time of his/her current arrest are factors that on average may vary by ethnicity, and are certain to have dramatic impact on case processing/handling and outcomes (e.g., the likelihood of being sentenced to incarceration). These likelihoods were not examined in prior local research, and may play a major explanatory role in this issue."*

    See *Implicit Racial Bias Across the Law*, Justin D. Levinson & Robert J. Smith, editors, Cambridge University Press (2012). This finding is further bolstered by the decades-long work of legal scholars and faculty at the William S. Richardson School of Law. The Judiciary has recently held a series of trainings for judges regarding implicit bias.

impact upon Native Hawaiians.[11]

10. Many members of the public testified that the Office of the Public Defender is inadequately funded.[12]

11. In the present economy, ex-offenders face barriers in securing employment, housing, and reintegration into the community based on their arrest and court record. These barriers may affect the recidivism rate for Native Hawaiians.[13]

12. Historically, there has been a conflict between American law and Native Hawaiian values. This conflict may explain some of the disproportionate representation of Native Hawaiians in the criminal justice system.[14]

13. The Hawai'i Paroling Authority has more discretion than its counterparts in other states or the federal government regarding inmates' length of stay, conditions of parole, and other conditions regarding incarceration. An inmate's

11. *Vote taken. Two votes to abstain from the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "The strength of connection between poverty and criminality is unclear, as many Native Hawaiians and non-Native Hawaiians living in poverty do not resort to criminality." Department of the Attorney General, "[I]t is unclear how the Finding was derived and whether there is information to validate the cause and effect described."*

The funding of indigent legal service providers has fallen significantly in recent years. The most recent study of indigent legal services, conducted by the Access to Justice Hui in 2007, indicated that 1 in 5 low and moderate-income Hawai'i residents have their legal needs met, and legal service providers are able to help only 1 in 3 of those who contact them for assistance. In 2008, the Supreme Court formally adopted Rule 21 of the Rules of the Supreme Court of the State of Hawai'i, which established the Access to Justice Commission. See www.hawaiijustice.org/hawaii-access-to-justice-commission

12. Lucy Feinberg (Maui Director, Parents and Children Together (PACT)) testimony before the N. Haw. Justice Task Force, Maui Summit (2012).

Shari Lynn (Director, Ka Hale Pomaika'i), testimony before the N. Haw. Justice Task Force, Moloka'i and Lāna'i Summit (2012).

Discussion with Native Hawaiian pa'ahao at Hālawa Correctional Facility, August 29, 2012.

13 *Vote taken. Two votes against the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "It is unclear how Native Hawaiians are affected by these factors differently than other ethnicities." Department of the Attorney General, "This Finding relates to all former felony offenders across the country. Therefore, how former criminal offenders of Native Hawaiian descent might be disproportionately impacted by this reality relative to ex-offenders from other ethnic groups is unclear."*

Despite employment discrimination being illegal pursuant to Hawai'i Revised Statutes Chapter 378, many who testified before the Task Force discussed prevalent discrimination in hiring practices. See, Hawai'i Civil Rights Commission at: http://hawaii.gov/labor/hcrc

Discussion with Native Hawaiian pa'ahao at Hālawa Correctional Facility, August 29, 2012.

"[O]ur clients really have a loss of identity, and I think we've all heard today just how powerful the connection to culture is in re-establishing that identity. Ongoing identity creation really develops through how they're going to continue on their care with us into their everyday work life and career. And that's my job is to bring the two worlds together—to embrace the Hawaiian culture and the values that they learned and create a long-term career plan. These things go together.

Because what has been shown statistically, the biggest contributor to not re-offending and against recidivism is long-term employment, not just job acquisition, but job retention. So there is a challenge in the Native Hawaiian culture of career planning with them because a lot of them come from a place that's very consistent that they've never had a role model, they've never had a sense of worth and achievement prior to, which is where a lot of the drugs and crime have come from." John Unari (Workforce Development Specialist, Ho'omau Ke Ola), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012)

Six states provide state income tax credits to employers who hire individuals with criminal records: California, Illinois, Iowa, Louisiana, Maryland, and Texas. See, CAL. REV. & TAX CODE § 17053.34; LA. REV. STAT. ANN. § 47:287.752; MD. CODE ANN., LABOR AND EMPLOYMENT § 11-702 (2002); TEX. TAX CODE ANN. § 171.654; IOWA CODE § 422.35 (2003).

14 The discussion of a conflict between American law and Native Hawaiian values was a constant refrain throughout the testimony. Pastor Greg DeLa Cruz of Maui analogized the experience of Native Hawaiians in the criminal justice system with a parable. "The original ...Brothers Grimm version of Cinderella; it's bloodier than the Disney version. In the old version, when one of the daughters' feet won't fit into Cinderella's glass slipper, the mother cuts off the toes of her eldest daughter to make it fit. So this is what the western system has done to Hawaiians; cut off a toe to make the foot fit into a shoe that's not made for it." Greg DeLa Cruz (Family Success Coach, Neighborhood Place Wailuku; Pastor, Living Way Church), testimony before the N. Haw. Justice Task Force, Maui Summit (2012).

Senator Clayton Hee offered a remembrance of the first Native Hawaiian Chief Justice of the State of Hawai'i, and his inclusion of Native Hawaiian values into his jurisprudence and leadership. "Many of you knew Chief Justice Richardson and had the privilege to sit and hear him [remember,] as a young child going to Waikīkī and looking over the hedge at how the rich people were having a party at the Royal Hawaiian hotel and how some burley Hawaiian came to the hedge and said 'get out of here, this is not for you,' and how that imprint of not being worthy never left him.

And who could know that history would be such, that as Chief Justice, the decisions [to extend] the public land to the high water mark [were] decisions born out of discrimination, and who he was. That's what we need, leadership. But we also need a firm belief in who we are. And we need to know that the kupuna; and I don't mean this flippantly as might be mentioned on the Senate floor from time to time; have our back." Clayton Hee (Senator, 23rd District, State of Hawai'i), Testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

program enrollment is a factor considered by the Hawai'i Paroling Authority. The expanded discretion of the Hawai'i Paroling Authority may have been used to unequal effect due to the lack of programs for inmates.[15]

C. **Prevention and early intervention programs for Native Hawaiians**

1. This Task Force is aware that an individual's contact with the criminal justice system, regardless of race, often begins at youth. This Report has emphasized the impact of the criminal justice system on Native Hawaiian adults in order to comply with what the Task Force understood to be the focus of Act 170. The study Disproportionate Minority Contact in the Hawai'i Juvenile Justice System, prepared for the Juvenile Justice State Advisory Council and the State of Hawai'i, Office of Youth Services (May, 2012) provides guidance regarding effective prospective policy directives regarding juveniles.
2. Research shows that the children of incarcerated parents are at risk of having a higher rate of interaction with the justice system.[16]
3. Preventative measures, such as adequate education and programs for at-risk youth, continue to be inadequately funded.[17]

D. **Impact of the state's contracting with non-state facilities on Native Hawaiians**

1. Prisoners, former prisoners, family members of prisoners, and Task Force members report that prisoners in non-state facilities receive more consistent and available programs and live in less crowded conditions than prisoners in state prisons. Prisoners in private correctional facilities report receiving more respect from staff. However, prisoners in private facilities are subject to drastic dislocation from their home, culture, family, job prospects, and community support.[18]

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15 *Vote taken. Two votes against the finding: Department of the Prosecuting Attorney, City and County of Honolulu. Department of the Attorney General, "We are again concerned about the leading use of a 'may' statement. There is no footnote identifying the source(s) of information indicating that Native Hawaiian detainees are kept longer as a direct result of HPA discretion and the suggested unequal effect in releasing parolees. This Finding does not seem directly or clearly related to reducing the overrepresentation of Native Hawaiians in the justice system relative to other ethnic groups."*

Discussion with Native Hawaiian pa'ahao at Hālawa Correctional Facility, August 29, 2012.

Discussion with Native Hawaiian pa'ahao at Women's Community Correctional Center, August 30, 2012.

16 Refer to Finding C.1. Discussion with Native Hawaiian pa'ahao at Women's Community Correctional Center, August 30, 2012.

Also, see *Incarcerated Parents and their Children; Trends 1991-2007*, The Sentencing Project, Washington D.C. (2007), at: www.sentencingproject.org

17 Refer to Finding C.1. The Task Force is well aware that criminal prevention requires addressing the issues facing "at risk" youth. The Task Force heard numerous persuasive narratives regarding this necessity.

"I currently live in Big Island now, and I'm 20 years old. I am a UH Hilo student and a full time maile farmer. Both my parents were in and out of prison when I was younger. I grew up with those struggles. I am the oldest of three kids. I have two younger brothers and my mom actually had my youngest one when she was in prison. And she ended up in Woman's Way cause she saw how hard everyone was having trouble. They end up going back in prison, in and out and again, and she didn't want to go through that.

Lot of the programs that you guys are talking about now days, it wasn't around back then for kids like me and my brother. It would have nice to have them, but we made it through somehow, and my father unfortunately he did not seek help or anything.

The kids, it's not just about educating them. But getting them to understand, understand how it is. Lot of them don't know what to do about it and don't know how to deal with it. And no disrespect to any psychology majors or anything in here, but those steps and everything, some of 'em they'll do it in that room when you are talking to them, they'll write that paper down or whatever you want them to write, and as soon as they walk out that door, it's in one ear and out the other.

[T]hese kids wanted to learn. When it came to learning the chants and the olis indoors, they were so like, not there. But when it came to outdoors, hand-on everything, they were there. They wanted to. It was all about, like, getting them the motivation to do it. It seems like, to me, that they want to do Hawaiian, they want to know all about the Hawaiian culture. They want to. And that was the way that we got through to a lot of kids. And it's sad, cause we couldn't do it again this year and a lot of the kids wanted to." Jessica DeCosta (Student, University of Hawai'i at Hilo, farmer), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

18 In both state and non-state facilities, the Task Force has been apprised of individuals being reclassified while at non-state facilities, and having his or her stay extended due to minor infractions. The Task Force has also been apprised of individuals being reclassified while at non-state facilities, and such reclassification leading to a longer stay in a non-state facility. Varna Nakihei, who developed the program Ka Hale Pomaika'i on Moloka'i, reflected on

2. The criteria for sending and returning prisoners to and from non-state facilities remains unclear.[19]

3. The recidivism rate for prisoners who are incarcerated at non-state facilities on the continental United States is slightly lower than the rate for prisoners who are incarcerated in Hawai'i, however that difference has been shown not to be statistically significant.[20]

4. In reaction to recent statements from the Governor, and the Justice Reinvestment Initiative of 2011, any planned return of prisoners to the community from non-state facilities should be accomplished in a planned and responsible manner, with public safety being the primary concern.[21]

5. Prisoners in non-state facilities may be at a disadvantage in parole hearings as hearings are currently conducted remotely.[22]

6. Native Hawaiians who are sent to non-state facilities are effectively given an unequal burden in relation to non-Hawaiian prisoners. This burden includes a dislocation from his or her home, connection to the land, culture, family, job prospects, and community support.[23]

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numerous systemic issues within the criminal justice system. "I think we need to make pono internal with our state facilities first before even thinking of bringing our people home, the power and control, things that go on inside the facilities. I've seen firsthand in Maui Community Correctional Center one cousin getting one more year on top of that for sharing saimin with his cousin who came in. Stupid little things like that. Uncle them talk about ho'oponopono, the restorative justice. The restorative justice model works for today because it focuses on the issue of today." Varna Nakihei, (Maui Economic Opportunity B.E.S.T. Reintegration program), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

19 Concern has been expressed from several individuals and organizations regarding the Corrections Corporation of America's capacity to choose whom it will house in non-state facilities.

The Department of the Attorney General made a similar finding in 2011. "Hawai'i prison officials sometimes say that the most expensive inmates- those with serious health problems, mental illness, disciplinary issues, and the like- do not get transferred to private prisons on the mainland.... [W]e support efforts in the state House and Senate to pass legislation that would authorize and fund an audit of the Department of Public Safety's contract with the Corrections Corporation of America." *Hawai'i's Imprisonment Policy and Performance of Parolees Who Were Incarcerated In-State and on the Mainland*, Department of Sociology, University of Hawai'i at Mānoa & Department of the Attorney General, State of Hawai'i (2011)

20 See Id. for full discussion.

21 Governor of the State of Hawai'i, Neil Abercrombie, articulated a desire to return inmates housed in non-state facilities during the passage of the Justice Reinvestment Initiative. "The measures before us today — HB 2515 and Senate Bill 2776 — reflect that collaborative effort… With the enactment of these bills, I believe we are taking the next step forward in our commitment for control of our criminal justice system, to exercising resources in a sensible and clear-sighted, clear-headed manner in Hawai'i, and strengthening the capacity for people to return to society who have been separated from it.

From my first day on the job as Governor, I said we will bring our inmates housed in mainland facilities back home and keep our taxpayer dollars in the state. With the enactment of these bills, we are taking the next step forward in our commitment to taking control of our criminal justice system, bringing back vital resources to Hawai'i and strengthening communities for people to return to." Neil Abercrombie, Governor, state of Hawai'i, June 12, 2012.

22 The Department of the Attorney General made a similar finding in 2011. "[T]he impression of both authors is that, on the whole, it seemed more difficult for inmates on the mainland to obtain parole (via video conferencing) than it was for inmates who met face-to-face with the HPA in Hawai'i. This possibility was acknowledged by members of the HPA, who suggested that a 'live,' face-to-face connection with candidates for parole facilitates interpersonal communication and thus may raise the likelihood of release." Department of the Attorney General, supra note 18, pg. 34, Fn. 23.

23 *Vote taken. One vote to abstain from the Finding: Department of the Prosecuting Attorney, City and County of Honolulu. One vote against the Finding: Department of the Attorney General, "The listed conditions generally apply to all convicted felons who are sentenced to terms of incarceration, and it would be discriminatory and unlawful to treat one group of prisoners differently from others based on broad assumptions about their race or ethnicity."*

The Task Force found the words of Justice Thurgood Marshall's dissenting opinion in Olim v. Wakinekona, 461 U.S. 238 (1983) particularly relevant: There can be little doubt that the transfer of Wakinekona from a Hawaii prison to a prison in California represents a substantial qualitative change in the conditions of his confinement. In addition to being incarcerated, which is the ordinary consequence of a criminal conviction and sentence, Wakinekona has in effect been banished from his home, a punishment historically considered to be "among the severest." For an indeterminate period of time, possibly the rest of his life, nearly 2,500 miles of ocean will separate him from his family and friends. As a practical matter, Wakinekona may be entirely cut off from his only contacts with the outside world, just as if he had been imprisoned in an institution which prohibited visits by outsiders. Surely the isolation imposed on him by the transfer is far more drastic than that which normally accompanies imprisonment. Id. at 253.

Delbert Wakinekona, for whom the above-cited case is named, testified before the Task Force through his attorney, Robert Merce, Esq. Mr. Wakinekona was granted a compassionate release by the Hawai'i Paroling Authority on October 28, 2011, after forty one years of imprisonment at various non-state facilities.

"[W]hat has happened is that Native Hawaiian men have been ripped away from their families, their communities, and from the 'aina. You've heard in detail about what 'aina means to Native Hawaiians. The psychic and spiritual impact of this removal; of being alienated from their 'āina; is devastating. How are they to heal? How are they to atone? This is what our work is addressing: protecting their rights to engage in their religious practices." Sharla Manley, Esq. (Attorney, Native Hawaiian Legal Corporation), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

7. There are economic costs associated with inaction. The increase in the state's contract with non-state facilities has increased exponentially since its inception in December, 1995, and now costs over $60 million dollars per year.[24] The costs of the state's contract with private prisons may increase without action.[25]

8. Due to their incarceration on the continental United States, many paroled offenders do not have adequate transition plans regarding employment, housing, and reintegration into the community beyond compliance with parole.[26]

9. There has been concern expressed regarding inmates being lost in the system at the completion of their maximum sentence ("maxing out") without adequate transitional programming, follow up services, or housing. As a result, these individuals have a more difficult time reintegrating into the community.[27]

10. The state, and particularly the Department of Public Safety, may modify and/or renegotiate its contract with non-state facilities regarding Native Hawaiian religious and cultural practices. Concern was expressed regarding classification of offenders and placement in special holding units.

11. Concern was expressed regarding the reclassification of offenders in non-state facilities and his or her placement in special holding units.

E. **Issues in state-operated correctional facilities and their impact on Native Hawaiians**

1. Inmates released from state correctional institutions often do not have any form of official identification. Official identification is necessary to apply for employment, find housing, and comply with conditions of parole.[28]

2. Prisoners and former prisoners in state facilities report that they received inconsistent treatment from staff, which leads to inefficient effectuation of programs and policies.[29]

3. The trauma informed care model has been instituted at the Women's Community Correctional Center on O'ahu. This rehabilitative model is based on being informed by the trauma that the majority of inmates have experienced, and at-

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24 As of 2010, it costs approximately $139 per day to incarcerate an inmate in Hawai'i, and at least $77 per day to incarcerate him or her in a non-State prison on the mainland. Note, however, that unlike the in-state per day cost, the private prison cost estimate is not all-inclusive. See, *Management Audit of the Department of Public Safety's Contracting for Prison Beds and Services*, Marion M. Higa, State Auditor. 2010. at pg. 21.

25 "We found no policies and procedures aligned with Hawai'i Public Procurement Code, no objective evaluation to measure CCA's performance, and no plan for contracting for private prison beds to reasonably ensure fiscal responsibility in obtaining the best value at prices the State can afford." Id. at 24.

The Department of the Attorney General has warned against the trend of approaching questions about criminal risk and rehabilitation through the sole prism of cost. "In Hawai'i and elsewhere, problems such as these suggest the shortsightedness of relying on a perspective that stresses short-term savings at the expense of policies and programs aimed at improving the prospects for offenders' rehabilitation and the satisfaction of their basic needs and rights. States and their leaders have a responsibility to care not only about crime control and the costs of incarceration but also about the present welfare and future well-being of criminal offenders and the communities from which they come." Supra note 18, pg. 35

26 Discussion with Native Hawaiian pa'ahao at Hālawa Correctional Facility, August 29, 2012.

27 *Vote taken. One vote to abstain from the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "The specific bases for the second sentence are unclear; not all 'maxed out' individuals have such difficulty. One vote against the Finding: Department of the Attorney General, "The Department has not arrived at a formal position on the "maxing out" issue and would need to study it from several legal standpoints in order to do so. This finding also posits an unstudied causal link by stating that the maxing-out issue 'leads to' (i.e., causes) other problems, when in fact the relationship may be correlational. In addition, this Finding does not seem directly or clearly related to reducing the overrepresentation of Native Hawaiians in the justice system relative to other ethnic groups."*

See Supra notes 11, 13.

28 Discussion with Native Hawaiian pa'ahao at Hālawa Correctional Facility, August 29, 2012.

29 *Vote taken. Two votes against the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "It is unclear how Native Hawaiians are affected by these factors differently than other ethnicities." Department of the Attorney General, "This Finding does not seem directly or clearly related to reducing the overrepresentation of Native Hawaiians in the justice system relative to other ethnic groups."*

Discussion with Native Hawaiian pa'ahao at Hālawa Correctional Facility on August 29, 2012, and at the Women's Community Correctional Center on August 30, 2012.

Varna Nakihei, (Maui Economic Opportunity B.E.S.T. Reintegration program), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012) tempts to mitigate future traumatic experiences while incarcerated.[30]

4. Prisoners do not get regular and consistent visitation with family members, including extended family members. It is important for an inmate's rehabilitation that he or she is allowed regular visits with family members and extended family members.

5. Services to prisoners with mental health issues and the chronically homeless will continue to be a major challenge for the Department of Public Safety. The Department of Public Safety is in a settlement with the federal Department of Justice regarding mental health treatment at O'ahu Community Correctional Center. There continues to be a concern about meeting the mental health needs of inmates.

F. **Restorative justice practices and their application to Native Hawaiians**

1. Indigenous cultural practices present appropriate models in ameliorating the disproportionate impact of the criminal justice system on indigenous communities. The Native Hawaiian community and nations such as Aotearoa, Australia, and Canada have had recent successes in adopting indigenous cultural practices.[31]

2. Restorative justice practices, such as sentencing circles, mediation, and community justice, are an option for certain defendants.[32]

3. Incarceration and recidivism among the Native Hawaiian population will likely decrease as various contributing factors such as poverty, unemployment, healthcare, housing, and education are improved.[33]

G. **Lack of services for Native Hawaiians who come into contact with the criminal justice system**

1. Culturally-based programs are effective, and should be expanded upon.[34]

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30 Toni Bissen, J.D., Executive Director, Pū'a Foundation, has done extensive training in the application of the trauma informed care model. See http://pua-foundation.org/Welcome.html

31 "Every time we've travelled the world [as a Hawaiian delegation,] other indigenous groups all seem to always come back and gravitate to the fact that 'you folks had your own country. You had your own set of rules.' And one thing seems to be stark: when the overthrow took place, new management was in place." Keali'i Makekau (Cultural practitioner, Advocate), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

Carmen Heteraka, a Maori cultural practitioner and prisoner advocate, traveled from Aotearoa to Honolulu specifically to testify before the Task Force regarding the Maori experience in New Zealand's criminal justice system.

"Indigenous people are disproportionately represented in the justice system all over the world[,] [Y]et the programmes that are designed for inmates and offenders often overlook cultural identity as a significant factor. In Aotearoa (New Zealand), culturally specific programmes, such as the Maori Focus Unites, designed for Maori (indigenous people of Aotearoa) inmates, have been implemented since 1992.

During the past 20 years, indigenous communities have met to address poor health, housing, education and employment statistics. These gatherings provide opportunities for indigenous solutions to address indigenous problems. O'Rongo/O'Longo is a Maori cultural programme for offenders and their families that has been presented and piloted in Hawai'i, as a result of these gatherings.

The significance of this programme is its authenticity and cultural relevance as a genuine empowerment tool. This holistic model is designed to restructure inmates' meaning of life and self worth by drawing parallels between indigenous law and contemporary law. By reconnecting people to their ancestral knowledge and responsibilities, drawing on the legacies and great examples left by their ancestors, this programme guides the participants through a clear pathway of understanding their noble birthright that 'no action' is a violation of their sacredness." Carmen Heteraka and Michelle Brenner, *Conscious Connectivity, Creating Diversity in Conversation, Chap. 9 Holistic law approach to indigenous incarceration*, at 207 (2011).

32 *Vote taken. One vote to abstain from the Finding: Department of the Prosecuting Attorney, City and County of Honolulu.*

"I have personally been to Aotearoa and visited on both in the standard New Zealand system and also the Maori system. They have their own sentencing circles. That's restorative justice. First Nations in Canada have sentencing circles. That is restorative justice. The Mapuchi Indians, the people in Chile have that. And we have our own ho'oponopono. In each of those, anybody can enter. You don't have to have a card or a blood quantum, they self identify. You want to use that system you can do it, they don't discriminate for or against anyone. So restorative justice is my first recommendation as a lens, telescope and a microscope." Michael Town (Cir. and Fam. Ct. Judge (ret.), Board Member, Hawai'i Paroling Authority) testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

33 Numerous individuals testified regarding the value of employment for ex-offenders in reducing recidivism. See Supra note 13.

34 *Vote taken. Two votes to abstain from the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "All programs, including culturally-based programs, must be evaluated on their individual merits." Department of the Attorney General, "Culturally-based programs are inherently*

2. Mental health services, such as psychopharmacological medication, counseling, and case management for those with mental health conditions are inadequate, and are an important component for the rehabilitation of Native Hawaiian pa'ahao.[35]

3. If the state of Hawai'i had sufficient and appropriate community-based alternatives to incarceration for substance abuse, mental health treatment, and housing at all points within the criminal justice system, the state may reduce its reliance on incarceration.

4. There is no comprehensive directory of culturally-based programs and service providers for Native Hawaiians who come into the contact with the criminal justice system. The Office of Hawaiian Affairs is presently working on a directory of Native Hawaiian organizations and community-based service providers.[36]

5. Pre-trial detainees have limited access to community-based programs. This lack of access leads to pre-trial detainees remaining incarcerated.

6. There are residential transition programs that have had problems with zoning regulations. In order to effectuate ser-

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neither effective nor ineffective; that question depends on the quality and appropriateness of individual programs. Among other important considerations, effective programs target specific criminogenic factors and utilize evidence-based practices, and the manner of doing so can be culturally-based when appropriate."

Maui County Councilwoman and lifetime Maui resident Gladys Baisa reflected on the history of the highly successful Maui Economic Opportunity B.E.S.T. program that she and other community members have developed over several decades. "I went to a Head Start meeting in San Francisco decades ago now. It's chicken skin, how I read about DeLancey Street on my last day there. [See: www.delanceystreetfoundation.org] It's a wonderful program, and I came home and thought 'this is it, we need to have this.' We got our community together, wrote a grant through the state, and hired some fabulous people.

It was a reentry program back then, before we realized we needed more comprehensive services. I wanted to call it 'best' because that's what it was going to be, later on we came up with [the acronym] Being Empowered and Safe Together. At that time, we weren't thinking Hawaiian/cultural... it took us some time to learn how to integrate the cultural aspects. And our success rate has really proven how successful that is.

You cannot pull people out of jail and throw them back on the street. We have facilities, we have a program, and we have the knowledge for how to do this proper reintegration programming and services. We could do this at an intense level. Last year, the legislature provided a good amount of money that the Governor did not release. We are doing as much as we can with our services on a very limited budget.

You must believe that people can be reintegrated and improve their own lives. They will rise to meet that expectation." Gladys Baisa (Maui County Councilwoman, advocate), testimony before the N. Haw. Justice Task Force, Maui Summit (2012).

Regarding gender specific Hawaiian cultural programming, see *Native Men Remade,* Ty P. Kawika Tengan, Duke University Press Books, (2008).

Regarding advocacy for specific types of courts, "[t]here is a good reason that the major development of therapeutic courts and problem solving courts have been sweeping the country: they work." Hon. Michael Town (Cir. and Fam. Ct. Judge (ret.), Board Member, Hawai'i Paroling Authority) testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

"[W]e have to find diversionary programs [in which] we can actually take our people out of the prison track and into a program. I talk about diversionary programs because on Kaua'i, and you'll hear about this from our prosecutors here, and she'll be talking about the POHAKU program. She created a diversionary restorative justice program where you put that offender in the community they offended. [I]magine that offender going into the community that they injured and performing community service, but also include an element of cultural education…teaching the Hawaiian values." Mel Rapozo (Kaua'i County Councilman), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

35 "Today, it is estimated that about half of state and federal prisoners meet criteria for drug abuse and/or dependence, yet fewer than 20% actually receive treatment. Longitudinal studies show that treatment begun in the criminal justice system and then continued in the community garners more lasting reduction in criminal activity and drug abuse." Lorraine Burgess (Ho'omau Ke Ola) testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

36 The Task Force was cautioned to be respectful of the ways in which culturally based programs differ from other programs that are designed from non-cultural models. Wayde Lee formerly established a culture-based substance abuse residential program on Moloka'i for youth, Kahua Ola Hou, and produced a curriculum for his program. He shared his conception of best practice.

"[W]e all kalua pig different. We no kalua pig the same way. So each place gotta be one different thing. No can be the same in each community. We gotta go back to the community and kāhea. Where is the uncles and aunties for help them? The family gets hard time. You know what is one Hawaiian family? The whole community! That's all 'ohana! We gotta go back over there and ask them, eh what you think? They get them in place. That is best practice." Wayde Lee (Chair of the Hawai'i Juvenile Justice State Advisory Committee), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

Francis Malani (Cultural practitioner), Testimony before the N. Haw. Justice Task Force, Hilo Summit (2012).

vices, these programs must be supported by the state and counties with appropriate zoning.[37]

7. Neighbor island programs which present effective community-based models such as: Maui Economic Opportunity BEST and Neighborhood Place, Wailuku on Maui; POHAKU on Kaua'i; Ka Hui o Mo'omomi on Moloka'i; and others should be expanded upon.[38]

8. The Department of Public Safety, in conjunction with the Office of Hawaiian Affairs, is working on the expansion of appropriate models to utilize the work of culturally-based service providers, such as the pu'uhonua model.[39]

H. **Continuing State efforts to ameliorate the disproportionate representation of Native Hawaiians in the criminal justice system.**

1. Effecting change in the criminal justice system will require a sustained, continued cooperation among state agencies and private organizations, past the work of the Native Hawaiian Justice Task Force.

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37 *Vote taken. Two votes to abstain from the Finding: Department of the Prosecuting Attorney, City and County of Honolulu; Department of the Attorney General, "There are legitimate concerns on both sides of this issue. This Finding does not seem directly or clearly related to reducing the overrepresentation of Native Hawaiians in the justice system relative to other ethnic groups."*

See Clean and Sober Task Force, vetoed by the Governor on July 10, 2012. as S.B. 2536 H.D.2; Senate Concurrent Resolution 102.

38 *Vote taken. Two votes to abstain from the Finding: Department of the Prosecuting Attorney, City and County of Honolulu, "More information is needed to evaluate these particular programs on their individual merits." Department of the Attorney General, "While the Department strongly supports the intent behind this Finding, we do not have sufficient information to endorse or attest to the effectiveness of these specific programs."*

See, Supra note 35.

"I often say, if you wanna see the most novel innovative models, look to the rural communities of Hawai`i. They've had to do more with less for a really long time, and as a result, they figured out how to integrate, collaborate, and provide the best quality care with the fewest resources and providers. And as a result, the models they've come up with are truly innovative and positive, and they are strengths based." Aukahi Austin (Executive Director, I Ola Lāhui Rural Hawai`i Behavioral Health Program), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

"In a nutshell, everybody is talking about we need best practice, which is tied to culture. We got that concept, we got it. Nobody in this hall can tell me that you never hear that. We've been telling you guys a long time ago about that.Ho'oponopono process, Kūkulu Kumuhna, Hala, Mihi, Kala, Pā'ina is all part of the ho'oponopono process. The thing that really grabbed me as a Hawaiian [is this:] you can't put me in a small office and do individual counseling, because I feel smothered, I feel cluttered in a small little room. I had my individual counseling in the lo'i, pulling taro with my counselor. I had my individual counseling bouncing in the water at Pōka'ī Bay. They took me outside the building because universe, Hawai'i, 'ha.' Language; oli, kāhea, stories, legends all of that. In a group setting, like I said ho'oponopono style. Going out to paddle. Taking the things out while practicing my culture at the same time. My house on the non-profit that I started on Moloka'i, Hale Pōmaika'i, what we do is we bring in the kupuna and we teach them about Lapa'au." Varna Nakihei, (Maui Economic Opportunity BEST Reintegration program), testimony before the N. Haw. Justice Task Force, O'ahu Summit (2012).

39 The Office of Hawaiian Affairs, in conjunction with the Department of Public Safety, held a summit regarding pu'uhonua and its prospective effects on November 2-3, 2012. See House Bill 2848 (2011), and passed into law as Act 117, Session Laws of Hawai'i (2012).

Recommendations

A. **Data regarding Native Hawaiians in the criminal justice system**

1. In order to inform future policy decisions regarding the disproportionate representation of Native Hawaiians in the criminal justice system, the state of Hawaiʻi needs to identify what data is to be collected at different points within the criminal justice system, improve data integration, and improve data infrastructure amongst state agencies.[40]

2. In order to provide a richer understanding of why Native Hawaiians are disproportionately represented in the criminal justice system, the legislature should provide sufficient resources to the Department of the Attorney General for a study that includes additional control variables.[41]

B. **The disproportionate representation of Native Hawaiians in the criminal justice system**

1. The portions of the 2011 Justice Reinvestment Initiative which were not passed into law as Senate Bill 2776, Act 139 (2011) and House Bill 2515, Act 140 (2011), are to be reintroduced. As Native Hawaiians are disproportionately represented in the criminal justice system, the Native Hawaiian community will be disproportionately affected by any inaction to reduce inmates or fix problems within the criminal justice system.[42]

2. The State of Hawaiʻi, including the executive and judicial branches, shall create and maintain an inventory of service providers, including, but not limited to, culturally based service providers that interact with inmates and former inmates. Such services may include services that address mental health, substance abuse, workforce development, and housing.

3. Training regarding implicit, unconscious bias is to be mandatory and ongoing for all employees who have contact with individuals in the criminal justice system. The Judiciary has recently held such a training for judges.[43]

4. As funding for indigent legal services has fallen, the State of Hawaiʻi legislature, through the grants-in-aid program, must adequately fund and maintain services for indigent clients.

5. While progress has been made, the Department of Public Safety must continue to bring mental health services in all state correctional facilities to constitutionally required levels.

6. In order for the Office of the Public Defender to deliver optimal services, the legislature must approve and fund more deputies, related support staff, and facilities.

7. The Office of Hawaiian Affairs and Native Hawaiian community stakeholders should collaborate with State agencies for the further development of culturally-based standards and evaluations that may be applied to Native Hawaiians who come into contact with the criminal justice system. The legislature should assist in funding this effort.

8. To enhance employment opportunities and thereby reduce recidivism, businesses that hire ex-offenders should be given a tax credit incentive.

9. All efforts should be made to conduct hearings before the Hawaiʻi Paroling Authority with the inmate/defendant

40 *Vote taken. One vote against the Recommendation: Department of the Prosecuting Attorney, City and County of Honolulu, "This language appears to over-simplify the proposed mandate." Department of the Attorney General, "Prior to initiating any large and costly data integration scheme, a single study should be conducted that includes critical control variables that may vary by race/ethnicity and are known to dramatically impact case processing and outcomes (e.g., criminal history; current offense; parole/probation status)."*

41 The Task Force is cognizant of socio-economic variables and their effect on criminal behavior.

42 *Vote taken. Two votes against the Recommendation: Department of the Prosecuting Attorney, City and County of Honolulu, "For further information, see the Department's testimony pertaining to Senate Bill 2776 (2011), House Bill 2514 (2011), Senate Bill 2777 (2011), and House Bill 2525 (2011)." One vote to abstain from the Recommendation: Department of the Attorney General, "The report should identify the areas that were removed from these bills. Otherwise, the public will need to sort through SB 2776 and HB 2515 and determine which pieces were not enacted."*

43 *Vote taken. One vote against the Recommendation: Department of the Prosecuting Attorney for the City and County of Honolulu, "The specific bases for this recommendation are unclear."*

physically present.[44]

10. The legislature should develop guidelines for the Hawai'i Paroling Authority concerning the setting of the minimum term and factors to be considered for parole. One such consideration is access to programs.[45]

11. Legislation should be passed that establishes "earned time/good time" credit for inmates' behavior, including program participation, while incarcerated.[46]

C. Prevention and early intervention programs for Native Hawaiians

1. The Task Force recognizes the importance of addressing disproportionate contact of juveniles with the justice system, and recommends the legislature consider the linkage between early prevention and/or intervention with adult incarceration.

2. To reduce intergenerational incarceration, resources must be directed towards children of incarcerated parents. The legislature should consider a mandatory educational program for guardians of minors with a parent in prison, similar to the "Kids First" program currently in place throughout the Judiciary.

D. Impact of the state's contracting with non-state facilities on Native Hawaiians

1. The State of Hawai'i should the increase oversight of non-state facilities pursuant to best practices.

2. The Department of Public Safety should develop criteria regarding the transfer of inmates between facilities that promote the access and completion of programs prior to an inmate's minimum sentence date.

3. The Department of Public Safety should ensure that inmates are placed in facilities that are consistent with their classification as determined by the Hawai'i classification system.

4. The Department of Public Safety should ensure that inmates scored classification is not overridden for the purposes of placing him or her in specific programs or facilities.

5. The Department of Public Safety should determine the number of prisoners placed in private facilities who have been reclassified after out-of-state transfer, the basis for reclassification, including infractions, and the amount of time added to his or her sentence as a result of such reclassification.

6. The Department of Public Safety should ensure that prisoners who are housed in non-state facilities, and who are eligible by classification for pre-release transitional programs such as work furlough, are returned to Hawai'i with sufficient time to complete programs prior to their tentative parole date.

7. The Department of Public Safety should ensure that all allegations of abuse of inmates are independently investigated and that appropriate corrective action is taken.

8. The Department of Public Safety should ensure that inmates are allowed to follow his or her religious and Native Hawaiian cultural practices, and retain sacred cultural items that do not pose a danger to the security of the institution.

9. Consistent with community testimony and the Governor's repeated statements, prisoners held out of state should

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44 *Vote taken. Two votes against the Recommendation: Department of the Prosecuting Attorney, City and County of Honolulu, "All reasonable efforts should be made." Department of the Attorney General, "The Department would support this Recommendation if the first sentence read, 'All reasonable efforts…' Face-to-face hearings should be conducted whenever feasible. There is no information indicating that this Recommendation is expected to reduce the overrepresentation of Native Hawaiians in the justice system relative to other ethnic groups."*

45 *Vote taken. Two votes against the Recommendation: Department of the Prosecuting Attorney, City and County of Honolulu, "The specific bases and parameters for this recommendation are unclear." Department of the Attorney General, "Additional time is needed to review this issue due to the breadth of the recommendation. In addition, completing this Recommendation could not be expected to reduce the overrepresentation of Native Hawaiians in the justice system relative to other ethnic groups."*

46 *Vote taken. Two votes against the Recommendation: Department of the Prosecuting Attorney, City and County of Honolulu, "For further information, see the Department's testimony pertaining to House Bill 218 (2011)." Department of the Attorney General, "Like the previous Recommendation, additional time is needed to review this issue due to the breadth of the recommendation. Completion of this Recommendation is not expected to reduce the overrepresentation of Native Hawaiians in the justice system relative to other ethnic groups."*

be returned. The State should make the return of inmates a top priority, and inmates should be returned as soon as practicable, consistent with public safety.[47]

10. Once the inmates are returned from private, out of state facilities, the State should consider passing legislation prohibiting future use of private for-profit correctional facilities.[48]

E. **Issues in state-operated correctional facilities and their impact on Native Hawaiians**

1. The Department of Public Safety should ensure that prior to work furlough and/or release, all inmates obtain official state identification and if needed, a social security card.

2. The staff at all state operated correctional facilities should receive annual, mandatory training regarding trauma informed care.[49]

3. Prisoners should be allowed consistent and regular visitation with immediate and extended family members. The Department of Public Safety should make every effort to ensure that adequate staffing is available for consistent and regular visitation.

4. All staff should treat inmates with respect.

5. All staff should enforce the Department of Public Safety's operating rules and policies consistently

F. **Restorative justice practices and their application to Native Hawaiians**

1. The State should recognize and support community and grassroots efforts that promote indigenous cultural practice models demonstrated to be successful in Hawai'i or elsewhere.

2. Through funding and resources, the legislature should support the Office of Hawaiian Affairs' efforts to increase community resilience and address poverty, unemployment, healthcare, and housing as part of addressing the systemic cycle of the incarceration of Native Hawaiians.

G. **Lack of services for Native Hawaiians who come into contact with the criminal justice system**

1. The State should ensure adequate funding and staffing to treat offenders with mental health conditions, including the support of mental health services such as psychopharmacological medication, counseling, and case management.

2. The State should ensure adequate funding and staffing to create a comprehensive directory of culturally based programs, indigenous models, and service providers for Native Hawaiians who come into contact with the criminal justice system.[50]

3. In order to reduce its reliance on incarceration, the state of Hawai'i should assist in the development of sufficient and

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47 *Vote taken. One vote against the Recommendation: Department of the Prosecuting Attorney, City and County of Honolulu, "While the Department is not generally opposed to the return of prisoners held out-of-state, public safety must be the top priority at all times." One vote to abstain from the Recommendation: Department of the Attorney General, "It would be preferable for all Hawai'i inmates to be housed in State facilities within state boundaries, and for those housed on the mainland to be returned as soon as practicable, consistent with public safety."*

48 *Vote taken. Two votes against the Recommendation: Department of the Prosecuting Attorney, City and County of Honolulu, "As circumstances change and evolve, the State should be permitted to consider all options; a prohibition of this type would bar the State from considering even in-state private correctional facilities that present a cost-saving to the State." Department of the Attorney General, "The State should retain the ability to manage its correctional facilities in accordance with changing fiscal realities. In addition, completing this Recommendation could not be expected to reduce the overrepresentation of Native Hawaiians in the justice system relative to other ethnic groups."*

49 *Vote taken. One vote against the Recommendation: Department of the Attorney General, "While such training is important and should be supported, the specification of annual training (to presumably include retraining all employees every 12 months) was arbitrarily suggested and not properly researched in terms of need, value, and costs. In addition, completing this Recommendation could not be expected to reduce the overrepresentation of Native Hawaiians in the justice system relative to other ethnic groups."*

50 *Vote taken. Two votes against the Recommendation: Department of the Prosecuting Attorney, City and County of Honolulu, "OHA should continue its work on a comprehensive directory, as indicated in Finding G.4." Department of the Attorney General, "Finding G.4. notes that the Office of Hawaiian Affairs is already working on creating such a directory. This will be a valuable resource."*

appropriate community-based alternatives to incarceration for substance abuse, mental health treatment, and housing at all points within the criminal justice system.[51]

4. Neighbor island models such as such as: MEO BEST, Wailuku Neighborhood Place on Maui; POHAKU on Kaua'i; Ka Hui o Mo'omomi on Moloka'i; and others are effective models that should be supported, expanded upon, replicated and/or reinstated.[52]

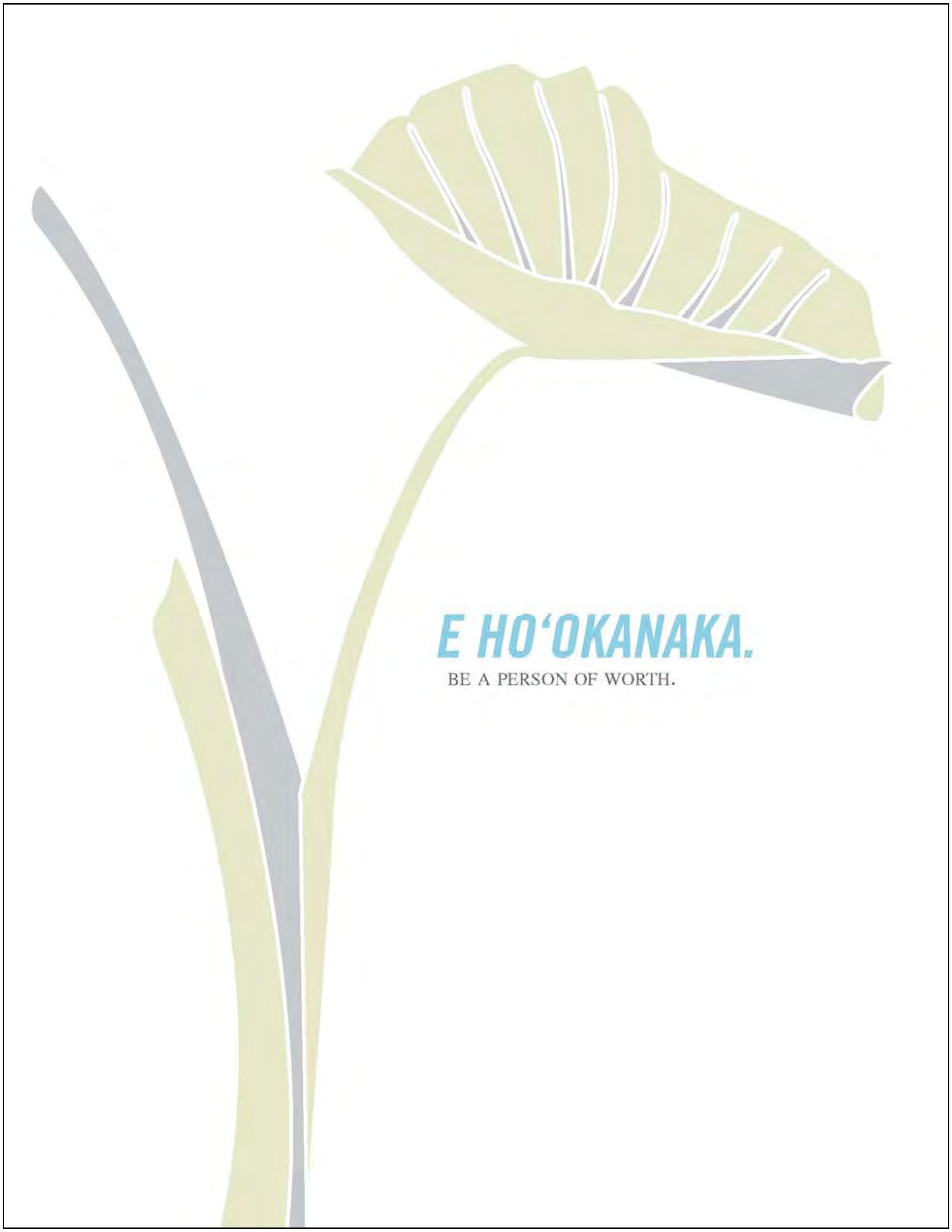
H. Continuing state efforts to ameliorate the disproportionate representation of Native Hawaiians in the criminal justice system

1. There should be permanent funding and full time staffing in the appropriate agency or independent body to oversee and implement recommendations of the Native Hawaiian Justice Task Force, and to continue to review this issue.[53]

2. Future efforts to implement recommendations and review this issue should include a wider breadth of community and agency representation than the current Native Hawaiian Justice Task Force.

51 *Department of the Prosecuting Attorney, City and County of Honolulu, "One suggestion, was for OHA to fund and/or collaborate with private organizations to create a residential substance abuse treatment facility designed specifically to treat Native Hawaiians."*

52 *Vote taken. Two votes to abstain from the Recommendation: Department of the Prosecuting Attorney, City and County of Honolulu, "More information is needed to evaluate these particular programs on their individual merits." Department of the Attorney General, "While the Department strongly supports the intent behind this Finding, we do not have sufficient information to endorse or attest to the effectiveness of these specific programs."*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Appendix N: Noise Impact Assessment

Oahu Community Correctional Center

October 27, 2017

Prepared for:

State of Hawaii
Department of Accounting and General Services
Department of Public Safety

Prepared by:

Louis Berger

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NOISE IMPACT ASSESSMENT

1.0 BACKGROUND

The Hawaii Department of Public Safety (PSD) operates the Oahu Community Correctional Center (OCCC), which acts as the local detention center for the First Circuit Court. Located at 2199 Kamehameha Highway in Honolulu, the OCCC is currently the largest jail facility in the state of Hawaii. With increasingly aged and obsolete correctional facilities, PSD is proposing to improve its corrections infrastructure through modernization of existing facilities when possible and construction of new institutions to replace others when necessary. Among its priority projects is the replacement of OCCC.

Four sites located on the island of Oahu have been identified as potential locations for the proposed OCCC facility: the Animal Quarantine Station in Halawa; the Halawa Correctional Facility in Halawa; the current site of the OCCC in Kalihi; and the Mililani Technology Park, Lot 17, in Mililani. The project also involves upgrades and expansions to the housing and supporting infrastructure at the Women's Community Correctional Center (WCCC) in Kailua to accommodate the relocation of female inmates from OCCC to that facility. The purpose of the proposed project is to provide a safe, secure, and humane environment for the care and custody of adult male and female offenders originating from the County of Oahu.

Development of the proposed OCCC and improvements to WCCC will generate noise during the periods of construction and following activation of the facilities. This report assesses the current noise environment in and around the alternative OCCC sites and WCCC and the potential for direct and indirect noise impacts to occur during facility development and operation. In addition, measures to mitigation potential noise impacts are also addressed.

2.0 INTRODUCTION

2.1 Noise Definitions

According to Hawaii Administrative Rules (HAR), Title 11 Chapter 46, Community Noise Control, "noise" means any sound that may produce adverse physiological effects or interfere with individual or group activities, including, but not limited to, communication, work, rest, recreation, or sleep. "Noise pollution" means noise emitted from any excessive noise source in excess of the maximum permissible sound levels. The accepted unit of measure for noise levels is the decibel (dB) because it reflects the way humans perceive changes in sound amplitude. Sound levels are easily measured, but human response and perception of the wide variability in sound amplitude is subjective.

Sound may be described in terms of intensity or amplitude (measured in decibels), frequency or pitch (measured in Hertz or cycles per second), and duration (measured in seconds or minutes). The standard unit of measurement of the intensity of sound is the decibel (dB). Since the human ear is not equally sensitive to sound at all frequencies, a special frequency-dependent rating scale is used to relate noise to human sensitivity. The A-weighted decibel scale (dBA) is most commonly used for community noise measurements, as it most closely resembles human perception of noise by weighting the most audible frequencies more heavily. The dBA scale is logarithmic; in other words, a noise difference of 3 dBA is barely perceptible to the human ear, while a difference of 10 dBA is perceived as twice as loud. Time duration also affects the perception of noise; that is, whether the noise is sudden, intermittent, occasional, or continuous.

Noise is emitted from many sources including aircraft, industrial facilities, railroads, power generating stations, and motor vehicles. Among the most common, motor vehicle noise is usually a composite of noises from engine, exhaust and tire-roadway interaction. Noise is known to have adverse health effects on people, including hearing loss, speech interference, sleep interference, physiological responses, and annoyance. Most individuals in urbanized areas are exposed to fairly high noise levels from many sources as they go about their daily activities. The degree of disturbance or annoyance of unwanted sound depends upon several key factors: the amount and nature of the intruding noise; the relationship between background noise and the intruding noise; and the type of activity occurring where the noise is heard. In considering the first of these factors (the amount and nature of the intruding noise), it is important to note that individuals have different sensitivities to noise. Loud noises bother some individuals more than others and some patterns of noise also enter into an individual's judgment of whether or not a noise is offensive. For example, noises occurring during sleeping hours are usually considered to be more of a nuisance than the same noises during daytime hours.

With regard to the second factor (the relationship between background noise and the intruding noise), individuals tend to judge the annoyance of an unwanted noise in terms of its relationship to noise from other sources (background noise). For instance, the use of a car horn at night when background noise levels are typically about 45 dBA, would generally be more objectionable than the use of a car horn in the afternoon when background noises are likely to be 60 dBA or higher.

The third factor (the type of activity occurring where the noise is heard) is related to the interference of noises with the activities of individuals. In a 60 dBA environment, normal work activities requiring high levels of concentration may be interrupted by loud noises, while activities requiring manual effort may not be interrupted to the same degree.

Several descriptors exist to help predict average community perceptions of noise. A noise descriptor, which provides a common basis to characterize the variability of noise, is the equivalent noise level (Leq). The Leq is a sound energy level averaged over a specified time period (usually 1 hour). Leq is a single numerical value that represents the amount of variable sound energy received by a receptor during the time interval. The Day-Night Equivalent Sound Level (Ldn) is the Leq measured over a 24-hour period. However, a 10-dB penalty is added to the noise levels recorded between 10:00 p.m. and 7:00 a.m. to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The Ldn is a commonly used noise descriptor in assessing land use compatibility and is widely used by federal, state, and local agencies and standards organizations.

2.2 Noise Standards

Various federal, state and local agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use. In this case, the most important and applicable guidelines are the State of Hawaii Community Noise Control Rule (HAR Chapter11-46). The Community Noise Control Rule defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to stationary noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, among others. The Community Noise Control Rule does not address most moving sources, such as vehicular traffic noise, aircraft noise, or rail transit noise which are regulated by the Hawaii Department of

Transportation (HDOT). However, the Community Noise Control Rule does regulate noise related to agricultural, construction, and industrial activities, which may not be stationary.

The maximum permissible noise levels for stationary mechanical equipment are enforced by the Hawaii Department of Health (DOH) for any location at or beyond the property line and shall not be exceeded for more than 10 percent of the time during any 20-minute period. The specified noise limits that apply are a function of the zoning and time of day as shown in Table 1. With respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. In determining the maximum permissible sound level, the background noise level is taken into account by Hawaii DOH.

Table 1: Maximum Permissible Sound Levels

Zoning District	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 7:00 a.m.)
Class A	55 dBA	45 dBA
Class B	60 dBA	50 dBA
Class C	70 dBA	70 dBA

HAR, Department of Health, Chapter 46, Community Noise Control.

Note: Class A zoning districts include all areas equivalent to lands zoned residential, conservation, preservation, public space, Open space, or similar type. Class B zoning districts include all areas equivalent to lands zoned for multi-family dwellings, apartment, business, commercial, hotel, resort, or similar type. Class C zoning districts include all areas equivalent to lands zoned agriculture, country, industrial, or similar type.

2.2.1 Construction Noise Standards

According to the Hawaii DOH Noise Reference Manual, an approved Community Noise Permit is required for construction projects exceeding 78 dBA or that have a total cost of more than $250,000. Construction is allowed from 7:00 a.m. to 6:00 p.m., Monday through Friday and 9:00 a.m. to 6:00 p.m. on Saturdays. The use of certain demolition and construction equipment (such as pile drivers, hydraulic hammers, and jackhammers) shall be limited to 9:00 a.m. to 5:30 p.m., Monday through Friday. Construction activities exceeding the maximum permissible sound levels before 7:00 a.m. and after 6:00 p.m., Monday through Friday, or before 9:00 a.m. and after 6:00 p.m. on Saturdays, or at any time on Sundays and holidays are only allowed with an approve Community Noise Variance.

2.2.2 Community Response to Changes in Noise Levels

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, the average ability of individuals to perceive changes in noise levels is well documented and has been summarized in Table 2. These guidelines permit direct estimation of an individual's probable perception of changes in noise levels.

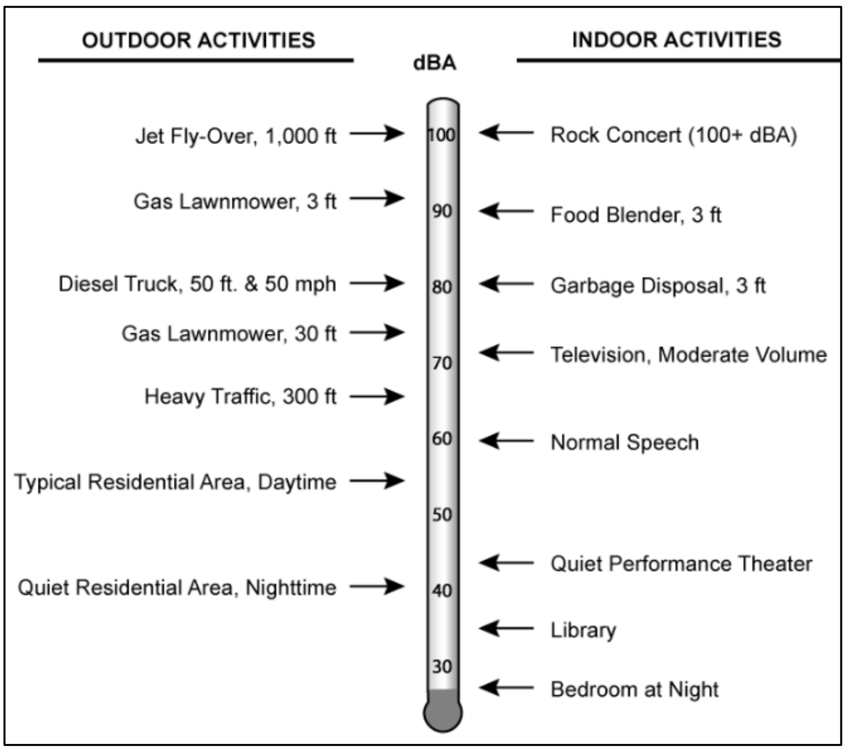
Table 2: Average Ability to Perceive Changes in Noise Level

Sound Level Change (dB)	Human Perception of Sound

0	Imperceptible
3	Barely Perceptible
6	Clearly Noticeable
10	Two Times (or one-half) as Loud
20	Four Times (or one-quarter) as Loud

Source: D.L. Adams Associates, Ltd., 2015.

Noise in a community can come from man-made sources, such as automobiles, trucks, buses, aircraft, and construction equipment, and from industrial, commercial, transportation, and manufacturing facilities. Exhibit 1 presents typical activities, noise levels, and effects that they have on humans. Noise levels, which are measured in units called decibels (dB), relate the magnitude of the sound pressure to a standard reference value. Although the noise values of certain activities can approach 135 dB, sounds typically encountered in the environment range from 50 to 100 dB.



Sources: FTA, 1995, ATS Consulting, 2005.

Exhibit 1: Common Indoor and Outdoor Noise Levels

3.0 EXISTING NOISE CONDITIONS

A survey of the existing noise environment and noise-sensitive receptors was conducted via field visits to each of the alternative OCCC sites and WCCC and review of adjacent and nearby land uses. Existing noise sources (highways, aircraft, etc.) affecting the acoustic environment in the vicinity of each site are described below.

3.1 Existing OCCC Site

The existing OCCC site is located in the Kalihi Ahupua'a, Kona District on approximately 16 acres of land within which the proposed OCCC development site would encompass approximately 8 acres of the overall property. The site, situated in a dense urban environment surrounded by roadways and ranging in elevation from 7 and 21 feet above mean sea level (amsl), is also located approximately one mile to the east of the Daniel K. Inouye International Airport (formerly Honolulu International Airport) and the flight path of Runway 8L extends over the site.

The acoustic environment is dominated by noise from truck and automobile traffic and aircraft fly-overs. Industrial and commercial activity also contribute to existing sound levels. A new elevated rail transit system is planned along the northern border of the site and once construction begins, an additional, temporary noise source will be added to the current environment.

Land uses in the vicinity of the OCCC site largely includes storage facilities, commercial properties, and light industrial uses. Light industrial, commercial and the Pu'uhale Elementary School occupy lands southeast of the site, across Pu'uhale Road. Noise-sensitive receptors in the vicinity include the Pu'uhale Elementary School, located approximately 200 feet south of the site, and residential uses located approximately 300 feet northeast of the site.

3.2 Animal Quarantine Station Site

The Animal Quarantine Station site is located in Halawa Ahupua'a, 'Ewa District on approximately 30 acres of land bisected by H-3. The site, ranging in elevation between 80 and 140 feet amsl, is situated in the Halawa Valley between the North Halawa Stream branch and intermittent South Halawa Stream branch ridge and valley juncture. The proposed OCCC development site would encompass approximately 20 acres located within the eastern portion of the overall property with the remaining acreage located west of H-3 to be used for development of a new Animal Quarantine Station to replace that lost to OCCC development (a requirement to developing a new OCCC at this site).

Land uses in the vicinity of the Animal Quarantine Station site include industrial areas to the east and west, the Halawa Correctional Facility to the east, undeveloped forest land and the Red Hill Naval Reservation to the south, and the Hawaiian Cement Co. and open pit Halawa Quarry operation located to the north. The acoustic environment is dominated by noise from truck and automobile traffic traveling along the elevated portion of H-3 that crosses over the site and by the network of roads and highways which border on or are located in proximity to the site. Industrial and commercial activity contribute to existing sound levels. Sensitive noise receptors (residences) are located approximately 800 feet south of the site and approximately 100 feet higher in elevation.

3.3 Halawa Correctional Facility Site

The Halawa Correctional Facility site is also located in the Halawa Ahupua'a, 'Ewa District. The entire Halawa Correctional Facility encompasses approximately 31 acres of land, of which approximately 5 acres in the northwestern portion of the property would be developed for the new OCCC facility. The project area is situated in a valley between two branches of the South Halawa Stream with elevations ranging between 180 and 310 feet amsl.

Areas to the west of the existing correctional facility consist of a large concentration of warehouses and similar industrial uses. The large open pit Halawa Quarry is located adjacent to the proposed OCCC site to the north. Residential uses are located to the south and southwest, however, there is a high, densely forested ridge situated between the residences and the Halawa Correctional Facility site. Ambient sounds in the vicinity are generally low in volume and originate from motor vehicle traffic arriving and departing the correctional facility and from operation of the nearby mine and its equipment.

The nearest sensitive receptors are the residences located to the south and southwest. Due to the distance and intervening topography and land cover, it is unlikely that noise currently generated at the Halawa Correctional Facility site would be perceptible at the residences. There are no other sensitive noise receptors identified near the Halawa Correctional Facility site.

3.4 Mililani Technology Park Site

The Mililani Technology Park (Lot 17) site is located in the Waikele Ahupua'a, 'Ewa District on approximately 40 acres of undisturbed land, of which approximately 19 acres is suitable for OCCC development. The developable portion of the site occupies a geographic landform that is bordered by the Waikakalaua and Kipapa gulches, in an area surrounded by a built environment featuring the Mililani Technology Park and suburban housing. The project area ranges in elevation between 656 and 854 feet amsl.

Veterans Memorial Freeway (H-2) is located approximately 0.25 miles to the southwest. Kahelu Avenue is located adjacent to the site on the north, and Wikao Street is located south of the site. Kahelu Avenue, the main access road serving the Mililani Technology Park and the proposed development site, is not a through roadway and carries a low volume of traffic. Wikao Street, providing access to the residential neighborhood located south of the site, also carries a relatively low volume of traffic. Ambient sounds include truck and automobile traffic traveling on the H-2 freeway and Kahelu Avenue and occasional wildlife calls. Noise levels in the area of the Mililani Technology Park site are generally very low owing to the nature and density of present nearby development.

Sensitive receptors in the vicinity of the Mililani Technology Park site include residences to the south, and commercial and light industrial facilities to the north and west. A day care center is located along Palii Street approximately 500 feet west of the site and a golf course is located approximately 550 feet to the north of the site. A house of worship is located approximately 150 feet to the west of the site and the concentration of residences are located along Wikao Street approximately 400 feet to the south. It should be noted that there is a substantial change in elevation downward of 100 feet or more between the site entrance on Kahelu Street and the residences and other uses which line Wikao Street.

3.5 Women's Community Correctional Center

As noted earlier, plans are to relocate female inmates from OCCC to WCCC located in Kailua in order to provide female inmates greater access to rehabilitation programs and improved family visitation. To accommodate the additional female population to be relocated from OCCC, plans are being developed for improving inmate housing and supporting infrastructure at WCCC. Improvements under consideration include development of a new housing unit comprising approximately 180 dormitory-style beds (Pods A and B), 14 segregation unit cells and 14 mental health unit cells (Pod C), intake control and intake services, medical and mental health units, a central control station, non-contact visiting room, outdoor recreation area, laundry department, a maintenance/warehouse building, and other ancillary facilities.

WCCC is located adjacent to and northeast of the Kalanianaole Highway. Land uses in the vicinity include undeveloped forested land along a steeply sloping ridge to the east beyond which lies residential development less than 0.5 miles from the property boundary. Areas to the north comprises undeveloped wooded land followed by recreational fields and a running track associated with Kailua High School. To the west of the facility is found residential development with commercial/utility uses along the highway and to the south, across the highway, are lands associated with the Youth Correctional Facility. The Maunawili Elementary School is located adjacent and to the southwest of the highway, approximately 200 feet from WCCC. Ambient sounds at WCCC are almost entirely the result of truck and automobile traffic on Kalanianaole Highway along with occasional wildlife calls.

Sensitive receptors include the residents located west of WCCC, Maunawili Elementary School located approximately 200 feet to the southwest, and Kailua High School located to the north.

4.0 POTENTIAL NOISE IMPACTS AND MITIGATION

Potential noise impacts resulting from the proposed OCCC development and WCCC improvements will occur from construction activities, routine facility operations, and motor vehicle traffic associated with facility operations. These potential impacts and recommendations for mitigation, if necessary, are discussed below.

4.1 Short-Term Construction Noise Impacts

For construction of facilities similar in size and scope to the proposed OCCC and WCCC, the worst-case condition for noise impacts occurs typically during the early stages of construction, when heavy-duty construction equipment is required for site preparation, foundation work, and construction of the structures. The magnitude of the potential impact depends upon the specific types of equipment to be used, the construction methods employed, the locations within the respective project sites where construction is active, and the scheduling and duration of the construction work. Many of these details are not specified in contract documents, but are at the discretion of the construction contractor. This allows the contractor flexibility in using equipment and personnel in order to accomplish the work, maintain the schedule and control construction costs. However, general conclusions can be drawn based on the nature of the construction work anticipated, the types of equipment involved in construction, and their associated range of noise levels. The construction process for OCCC and WCCC would be similar although the scale of the construction activities involving OCCC would be considerably greater and of longer duration than for the proposed WCCC improvements.

Equipment expected for the site preparation stage of construction may include bulldozers, graders, backhoes, front-end loaders and dump trucks. During construction of the foundations and structures, construction equipment expected in use may include excavators, pile drivers, backhoes and front-end loaders, generators, compactors, concrete mixing trucks and concrete pumpers, mobile cranes among other smaller equipment. Later stages of construction would involve interior and exterior fit-out, landscaping, installation of access roads and parking areas, and other elements where fewer heavy-duty construction equipment is required.

The various noise-generating activities that would take place during construction include site preparation and grading (including demolition of any standing structures), excavations for foundations, construction of structures, access roadway and parking area paving, utility installations, etc. Construction-related noise will occur only for the duration of the construction period and is typically limited to daylight hours. It is generally intermittent and depends on the type of operation, location and function of the equipment, and the equipment usage cycle.

Construction noise also attenuates quickly as the distance from the source increases. For example, noise levels resulting from use of an excavator during site clearing and grubbing yield a Leq of approximately 80 dBA at 50 feet and 74 dBA at approximately 100 feet. Furthermore, these noise levels would continue to decrease by approximately three or four dBA with every doubling of distance and would drop to approximately 62 to 65 dBA at approximately 800 feet. Typical noise levels generated by construction equipment that may occur at sensitive off-site receptors during various phases of construction are presented in Table 3. Construction noise impacts are a function of the distance between the source and the receptor, the topography and land cover in the intervening area, and the duration of the noise.

Table 3: Average Maximum Noise Levels at 50 Feet from Common Construction Equipment

Equipment Description	Impact Device (Yes/No)	Actual Measured Average Lmaxb at 50 Feet
Auger drill rig	No	84
Backhoe	No	78
Boring jack power unit	No	83
Chain saw	No	84
Compactor (ground)	No	83
Compressor (air)	No	78
Concrete mixer truck	No	79
Concrete pump truck	No	81
Crane	No	81
Bulldozer	No	82
Drill rig truck	No	79
Dump truck	No	76
Excavator	No	81
Flat bed truck	No	74
Front end loader	No	79
Generator	No	81
Grader	No	89
Impact pile driver	Yes	110
Jackhammer	Yes	89
Man lift	No	75
Mounted impact hammer	Yes	90
Paver	No	77
Pickup truck	No	75
Pumps	No	81

Equipment Description	Impact Device (Yes/No)	Actual Measured Average Lmaxb at 50 Feet
Rock drill	No	81
Roller	No	80
Scraper	No	84
Tractor	No	84
Vacuum street sweeper	No	82
Vibratory pile driver	No	101
Warning horn	No	83
Welder/torch	No	74

Source: FHWA Roadway Construction Noise Model.

Typical noise emission levels from construction equipment were derived from the FHWA Roadway Construction Noise Model (RCNM), and construction noise levels were modeled with the RCNM. The model calculates noise by using empirical data for noise generated by construction equipment, mathematical formulae relating noise attenuation with distance and information regarding the percentage of time that a certain piece of equipment is expected to be operated at maximum power while on site during construction – the Acoustical Usage Factor. The results of the noise model were used as a basis to evaluate potential construction-related noise impacts at receptor locations in the vicinity of each of the proposed OCCC development sites and WCCC and are provided in the sections which follow.

4.1.1 Existing OCCC Site

Construction activity associated with OCCC development at the existing OCCC site would occur at the northwestern portion of the property while the existing facility continues to operate along the southeastern portion of the property. The site and surrounding area lies within the Industrial, Class C zoning district. Sensitive noise receptors are located approximately 675 feet south of that portion of the OCCC site where construction is planned (Pu'uhale Elementary School) and approximately 650 feet to the northeast (residences).

To evaluate construction noise in these locations, the RCNM was populated with equipment expected to be used during the stage of construction with the greatest potential for noise impacts: site preparation (including demolition) using graders, bulldozers, front-end loaders and dump trucks, and foundation work using pile drivers, concrete mixing trucks, concrete pumper trucks, a crane(s), and other equipment. The equipment was dispersed to various locations around the development portion of the site, ranging from 650 feet to approximately 1,100 feet from the receptors. It was assumed that all equipment would be operating concurrently. Additionally, although intervening structures, such as the existing OCCC, would reduce noise levels at the receptors, no credit for the noise-reducing effect was incorporated into the model. The results of the model indicate that during periods of construction, noise levels could reach 72.3 Leq and 79 Lmax.

4.1.2 Animal Quarantine Station Site

Construction activity associated with OCCC development at the Animal Quarantine Station site would occur in the central portion of the property located east of H-3 while development of a new Animal Quarantine Station would occur in the western portion of the site, west of H-3. The site and surrounding area lies within the

Industrial, Class C zoning district. Sensitive noise receptors (residences) are located approximately 800 feet south of the site and approximately 100 feet higher in elevation.

To evaluate OCCC-related construction noise in these locations, the RCNM was populated with equipment which can reasonably be expected to be engaged during the stage of construction with the greatest potential for noise impacts: site preparation (including demolition) using graders, bulldozers, front-end loaders and dump trucks, and foundation work using pile drivers, concrete mixing trucks, concrete pumper trucks, a crane(s), and other equipment. The equipment was dispersed to various locations around the development portion of the site, ranging from 800 feet to approximately 1,500 feet from the receptors. It was assumed that all equipment would be operating concurrently. Additionally, although intervening vegetation and topography would reduce noise levels at the receptors, no credit for the noise-reducing effect was incorporated into the model. The results of the model indicate that during periods of OCCC construction, noise levels could reach 70.1 Leq and 76.7 Lmax.

Construction noise associated with development of a new Animal Quarantine Station to replace that displaced by OCCC development would involve a much smaller structure and a much shorter construction duration. Therefore, potential adverse construction noise impacts are expected to be substantially less than OCCC-related noise impacts.

4.1.3 Halawa Correctional Facility Site

Construction activity associated with OCCC development at the Halawa Correctional Facility site would occur within the 5-acre area located to the northeast of the main institution. The nearest sensitive receptors are residences located more than 1,800 feet to the south and southwest. Due to the distance and the substantial hillside located between the development site and the residences, noise generated during construction at the Halawa Correctional Facility site would not impact the residences. There are no other sensitive noise receptors identified near the Halawa Correctional Facility site that would be affected by construction activities.

4.1.4 Mililani Technology Park Site

Construction activity associated with OCCC development at the Mililani Technology Park site would occur largely within the central portion of the property. Zoning for the site and surrounding area is Industrial, Class C zoning district. Sensitive noise receptors are located approximately 400 feet south (residences along Wikao Street), 550 feet west (the house of worship) and approximately 850 feet to the west (the daycare center).

To evaluate construction noise in these locations, the RCNM was populated with equipment expected to be used during the stage of construction with the greatest potential for noise impacts, site preparation, using graders, bulldozers, front-end loaders and dump trucks, and foundation work, using pile drivers, concrete mixing trucks, concrete pumper trucks, a crane, and other equipment. The equipment was disbursed to various locations around the development portion of the site, ranging from 400 feet to approximately 1,250 feet from the receptors. It was assumed that all equipment would be operating concurrently. Additionally, although intervening vegetation and topography would reduce noise levels at the receptors, no credit for the noise-reducing effect was incorporated into the model. The results of the model indicate that during periods of construction noise levels could reach 70.7 Leq and 76.7 Lmax.

4.1.5 Women's Community Correctional Center

Construction activity associated with WCCC expansion would occur in the south-central portion of the property. The WCCC and surrounding area lies within Agricultural land, Class C zoning district, while the area to the west is identified as Residential, Class A zoning district. Sensitive noise receptors include the residential community located immediately west of the potential development area, the Maunawili Elementary School located approximately 650 feet to the south, and the Kailua High School located approximately 1,300 feet to the north.

To evaluate construction noise in these locations, the RCNM was populated with equipment expected to be used during the stage of construction with the greatest potential for noise impacts: site preparation using graders, bulldozers, front-end loaders and dump trucks, and foundation work using concrete mixing trucks, concrete pumper trucks, a crane, and other equipment. The nature and scale of the proposed WCCC improvements are significantly smaller than for the proposed OCCC facility and, as such, fewer pieces of construction equipment are anticipated to be employed and for a far shorter duration. The equipment was dispersed to various locations around the planned WCCC development area, ranging from 50 feet to approximately 400 feet from the residential receptors. It was assumed that all equipment would be operating concurrently. Additionally, although intervening vegetation may slightly reduce noise levels at the receptors, no credit for the noise-reducing effect was incorporated into the model. The results of the model indicate that during periods of construction noise levels could reach 79.7 Leq and 80.1 Lmax.

4.1.6 Conclusion

Noise resulting from construction of the proposed OCCC and WCCC improvements is not anticipated to have a significant adverse effect on land uses surrounding any of the alternative OCCC development sites or WCCC. The relatively isolated locations of the Animal Quarantine Station, Halawa Correctional Facility and Mililani Technology Park sites, the distances to homes, businesses, schools, and other sensitive land uses and noise receptors in the vicinity of the sites, background noise from neighboring high-volume roadways, wildlife calls, and aircraft overflights, and short construction duration, should allow construction to proceed while avoiding significant adverse impacts to adjoining properties. Following completion of construction, noise levels would return to their pre-construction levels.

4.2 Recommended Mitigation for Construction Activities

Potential noise impacts during the OCCC and WCCC construction phases would be mitigated by confining construction to normal working hours and employing noise-controlled construction equipment to the extent feasible. Measures to mitigate potential construction noise impacts may also include the following provisions:

- Source Control
  - Construction equipment would be equipped with appropriate noise attenuation devices, such as mufflers and engine housings.
  - Exhaust systems would be maintained in good working order. Properly designed engine enclosures and intake silencers would be employed.
  - Regular equipment maintenance would be undertaken.
- Site Control
  - Stationary equipment would be placed as far away from sensitive receptors as possible (e.g., aggregate crushers, operators, if employed).
  - Construction debris disposal sites and haul routes would be selected to minimize objectionable noise impacts.

- Time and Activity Constraints
  - Operations would be scheduled to coincide with periods when people would least likely be adversely affected. Periods of work and workdays would be largely confined to daytime hours.
- Community Awareness
  - Public notification of construction operations would incorporate noise considerations and methods to handle complaints would be specified.

If noise levels during construction at any of the proposed OCCC development sites and WCCC are anticipated to exceed allowable limits, a permit must be obtained from the Hawaii DOH in compliance with Title 11, HAR, DOH, Chapter 46, Community Noise Control. The Hawaii DOH may grant permits to operate vehicles, construction equipment, and power tools that emit noise levels in excess of allowable limits. In addition, topographic conditions, the locations of existing structures, distance, and vegetation located between the construction noise source and the receptors will aid in buffering noise nuisance to potential receivers in the community. Intermittent elevated noise levels from certain types of construction activities are inevitable; however, they are expected to be short-term and minor.

4.3 Long-Term Facility Operation Noise Impacts

4.3.1 Direct Impacts

The new OCCC facility and the proposed WCCC improvements are not expected to include any stationary noise sources requiring detailed analysis and the absence of noise-producing equipment and activities should result in post-construction noise conditions similar to pre-construction conditions at the selected OCCC site and WCCC. In addition, the proposed OCCC facility will incorporate indoor recreational facilities so any noise associated with outdoor recreation activities at the existing OCCC will be eliminated. Any change in noise levels resulting from the operation of the proposed OCCC is expected to be slight and virtually imperceptible. Furthermore, the distances between the proposed facility and residences, commercial uses and other land uses adjoining the alternative OCCC sites should go far to attenuate any potential noise impacts. OCCC operation is not expected to result in a significant adverse noise impact.

Any change in noise levels resulting from the operation of WCCC following construction of the proposed improvements is also expected to be slight and virtually imperceptible. Furthermore, the distances between the proposed improvements and residences and schools which adjoin WCCC should go far to attenuate any potential noise impacts. WCCC operation is not expected to result in a significant adverse noise impact.

4.3.2 Indirect Impacts

Indirect impacts could occur due to increased vehicle traffic to and from the new OCCC facility and expanded WCCC. With all other factors held constant, a doubling of existing traffic volumes is necessary to result in a 3 dBA increase in traffic noise. Future traffic volumes with and without the projects were compared for the roadways served by each OCCC site and WCCC with the highest incremental traffic generation. According to the Traffic Impact Report prepared the proposed project, traffic is not expected to double for any of the alternatives and would not double at WCCC. No significant adverse indirect noise impacts are anticipated.

4.4 Recommended Mitigation – Facility Operation

Given the lack of significant adverse noise impacts during OCCC and WCCC operation, the distance to sensitive receptors, and the background noise levels generated by adjoining roadways, aircraft overflights and wildlife calls, no mitigation measures to control noise resulting from operation of the proposed OCCC and WCCC would be warranted.

5.0 REFERENCES

Federal Highway Administration, Office of Environment and Planning, Noise and Air Quality Branch, 2010. *Analysis and Abatement Guidance*.

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Appendix O:
Air Quality Impact Assessment

Oahu Community Correctional Center

October 27, 2017

Prepared for:

State of Hawaii
Department of Accounting and General Services
Department of Public Safety

Prepared by:

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AIR QUALITY IMPACT ASSESSMENT

1.0 BACKGROUND

The Hawaii Department of Public Safety (PSD) operates the Oahu Community Correctional Center (OCCC), which acts as the local detention center for the First Circuit Court. Located at 2199 Kamehameha Highway in Honolulu, the OCCC is currently the largest jail facility in the state of Hawaii. With increasingly aged and obsolete correctional facilities, PSD is proposing to improve its corrections infrastructure through modernization of existing facilities when possible and construction of new institutions to replace others when necessary. Among its priority projects is the replacement of OCCC.

Four sites located on the island of Oahu have been identified as potential locations for the proposed OCCC facility: the Animal Quarantine Station in Halawa; the Halawa Correctional Facility in Halawa; the current site of the OCCC in Kalihi; and the Mililani Technology Park, Lot 17, in Mililani. The project also involves upgrades and expansions to the housing and supporting infrastructure at the Women's Community Correctional Center (WCCC) in Kailua to accommodate the relocation of female inmates from OCCC to that facility. The purpose of the proposed project is to provide a safe, secure, and humane environment for the care and custody of adult male and female offenders originating from the County of Oahu.

Development of the proposed OCCC and improvements to WCCC will generate air emissions during the periods of construction and following activation of the facilities. This report assesses the current air quality environment on Oahu and the potential for direct and indirect air quality impacts to occur during facility development and operation. In addition, measures to mitigation potential air quality impacts are also addressed.

2.0 INTRODUCTION

Air quality is defined by ambient air concentrations of specific pollutants of concern with respect to the health and welfare of the general public. Air pollution is the presence in the outdoor atmosphere of one or more contaminants that are injurious to humans, plants, or animals, or that interfere with the enjoyment of life and property. Air quality can be affected by air pollutants produced by mobile sources, such as vehicular traffic, aircraft, or non-road equipment used for construction activities; and by fixed or immobile facilities, referred to as "stationary sources." Stationary sources can include combustion and industrial stacks and exhaust vents.

Air quality as a resource incorporates several components describing the levels of overall air pollution in a region, and sources of and regulations governing air emissions. A discussion of the affected environment as it relates to air quality, including State of Hawaii and National Ambient Air Quality Standards (NAAQS), local ambient air quality, and regional climate, follows.

2.1 Regulatory Setting

2.1.1 Air Quality Standards

The U.S. Environmental Protection Agency (EPA) defines ambient air in 40 CFR § 50.1(e) as: "that portion of the atmosphere, external to buildings, to which the general public has access." The Clean Air Act (42 USC 7401-

7671q), as amended, gives EPA the responsibility to establish the primary and secondary NAAQS (40 CFR 50) that set acceptable concentration levels for seven criteria pollutants: particulate matter less than 10 microns in diameter (PM_{10}); particulate matter less than 2.5 microns in diameter ($PM_{2.5}$); sulfur dioxide (SO_2); carbon monoxide (CO); nitrogen dioxide (NO_2); ozone (O_3); and lead (Pb). The State of Hawaii has established ambient air quality standards in Chapter ii-59 of the Hawaii Administrative Rules. Together, EPA and the Hawaii Department of Health (DOH) regulate air quality in Hawaii.

Short-term standards for 1-, 8-, and 24-hour periods have been established for pollutants contributing to acute health effects, while long-term standards (based on annual averages) have been established for pollutants contributing to chronic health effects. The State of Hawaii has adopted State Ambient Air Quality Standards (SAAQS) in addition to those established under federal regulations.

Federal regulations designate Air Quality Control Regions (AQCRs) that have concentrations of one or more of the criteria pollutants that exceed the NAAQS as nonattainment areas. Federal regulations designate AQCRs with levels below the NAAQS as attainment areas. Honolulu County (and, therefore, all project locations associated with the proposed OCCC replacement facility and the proposed WCCC improvements) are located in the State of Hawaii AQCR (AQCR 246) (40 CFR 81.76). EPA designated Honolulu County as in attainment or unclassifiable/attainment for all criteria pollutants for which designations have been issued (EPA 2017).[1]

EPA monitors levels of criteria pollutants at representative sites in each region throughout Hawaii. Table 1 provides a description of NAAQS criteria pollutants, while Table 2 lists both federal and state air quality standards.

2.1.2 Fugitive Dust

In addition to ambient air quality standards for particulate matter in general, fugitive dust is regulated by the Hawaii DOH, Clean Air Branch (Hawaii DOH, 2014). HAR §11-60.1-33, Fugitive Dust states, in part:

- §11-60.1-33(a): No person shall cause or permit visible fugitive dust to become airborne without taking reasonable precautions.
- §11-60.1-33(b): ...no person shall cause or permit the discharge of visible fugitive dust beyond the property lot line on which the fugitive dust originates.

[1] https://www.epa.gov/green-book/green-book-national-area-and-county-level-multi-pollutant-information

Table 1: Description of NAAQS Criteria Pollutants

NAAQS Criteria Pollutant	Description
Sulfur dioxide (SO_2)	A toxic, colorless gas with a distinctly detectable odor and taste. Oxides of sulfur in the presence of water vapor, such as fog, may result in the formation of sulfuric acid mist. Human exposure to SO_2 can result in irritation to the respiratory system, which can cause both temporary and permanent damage. SO_2 exposure can cause leaf injury to plants and suppress plant growth and yield. SO_2 can also cause corrosive damage to many types of manmade materials.
Particulates ($PM_{2.5}$), (PM_{10})	Particulates originate from a variety of natural and anthropogenic sources. Some predominant anthropogenic sources of particulates include combustion products (wood, coal and fossil fuels), automotive exhaust (particularly diesels), and windborne dust (fugitive dust) from construction activities, roadways and soil erosion. Smaller particulates that are smaller than or equal to 10 and 2.5 microns in size (PM_{10} and $PM_{2.5}$) are of particular health concern because they can get deep into the lungs and affect respiratory and heart function. Small particulates affect visibility by scattering visible light and when combined with water vapor can create haze and smog. Micron and submicron particles are those that assume characteristics of a gas and remain suspended in the atmosphere for long periods of time.
Carbon monoxide (CO)	A colorless, odorless, tasteless and toxic gas formed through incomplete combustion of crude oil, fuel oil, natural gas, wood waste, gasoline, and diesel fuel. Most combustion processes produce at least a small quantity of this gas, while motor vehicles constitute the largest single source. Human exposure to CO can cause serious health effects before exposure is ever detected by the human senses. The most serious health effect of CO results when inhaled CO enters the bloodstream and prevents oxygen from combining with hemoglobin, impeding the distribution of oxygen throughout the bloodstream.
Nitrogen dioxide (NO_2)	A reddish-brown gas with a highly detectable odor, which is highly corrosive and a strong oxidizing agent. NO_2 is one of a group of reactive gases called nitrogen oxides or NOx. NO_2 forms small particles that penetrate deep in the lungs and can cause or worsen existing respiratory system problems such as asthma, emphysema, or bronchitis. NOx are a precursor to the formation of ozone and $PM_{2.5}$.
Ozone (O_3)	An oxidant that is a major component of urban smog. O_3 is a gas that is formed naturally at higher altitudes and protects the earth from harmful ultraviolet rays. At ground level, O_3 is a pollutant created by a combination of VOC, NO_x and sunlight, through photochemistry. Ground-level O_3 is odorless and colorless, and is the predominant constituent of photochemical smog. Human exposure to O_3 can cause eye irritation at low concentration and respiratory irritation and inflammation at higher concentrations. Respiratory effects are most pronounced during strenuous activities. O_3 exposure will deteriorate manmade materials and reduce plant growth and yield.

NAAQS Criteria Pollutant	Description
Lead (Pb)	Lead is a toxic heavy metal that can have numerous adverse health impacts, including neurological damage to children and cardiovascular effects in adults. Lead emissions can contribute to exposure through the air directly or indirectly by causing soil/water contamination. Prior to the phase out of leaded gasoline, automobiles were a source of lead emissions. According to EPA, the major sources of lead emissions to the air today are ore and metals processing and piston-engine aircraft operating on leaded aviation gasoline.[a]

Source: Louis Berger U.S., 2017.

[a] https://www.epa.gov/lead-air-pollution.

Table 2: State and Federal Air Quality Standards

Pollutant	Hawaii Air Quality Standards	Federal Primary Air Quality Standards
Carbon Monoxide (CO)		
1-hour maximum	9 ppm	35 ppm
8-hour maximum	4.4 ppm	9 ppm
Lead (Pb)		
3-month average	1.5 µg/m3	0.15 µg/m3
Nitrogen Dioxide (NO_2)		
1-hour	Not Established	100 ppb
Annual average	0.04 ppb	53 ppb
Particulate Matter ($PM_{2.5}$)		
24-hour average	None	35 µg/m3
Annual average	None	12 µg/m3
Particulate Matter (PM_{10})		
24-hour average	150 µg/m3	150 µg/m3
Annual average	50 µg/m3	None
Ozone (O_3)		
8-hour maximum	0.08 ppm	0.070 ppm
Sulfur Dioxide (SO_2)		
1-hour average	None	75 ppb
3-hour block average	0.5 ppm	-
24-hour block average	0.14 ppm	None
Annual average	0.03 ppm	None
Hydrogen Sulfide (HS)		

Pollutant	Hawaii Air Quality Standards	Federal Primary Air Quality Standards
1-hour average	25 ppb	None

Sources: Hawaii DOH 2015.

Notes: NE = not established; ppm = parts per million; ppb = parts per billion; µg/m3 = micrograms per cubic meter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter.

3.0 CURRENT CONDITIONS

3.1 Air Quality Monitoring Stations

Fourteen air quality monitoring stations are located in the state: one on Kauai, two on Maui, four on Oahu, and seven on Hawaii Island (Hawaii DOH, 2016). The locations of the four monitoring stations on Oahu, illustrated in Figure 1, are described below in relationship to the alternative OCCC sites and WCCC.

- The Honolulu Monitoring Station is located at 1250 Punchbowl Street in downtown Honolulu on the roof of the Hawaii DOH building at Kinau Hale, across from the Queen's Medical Center, in a busy commercial, business, and government district. This station is located approximately 2.3 miles from the OCCC site, 5.2 miles from the Halawa Correctional Facility site, 5.5 miles from the Animal Quarantine Station site, 15.5 miles from the Mililani Technology Park Lot 17 site, and 8.4 miles from WCCC.
- The Sand Island Monitoring Station is located at 1039 Sand Island Parkway in a light industrial, commercial, and recreational area approximately 2 miles downwind of downtown Honolulu near the entrance to the Sand Island State Recreation Area. The station is located approximately 2.0 miles from the OCCC site, 5.1 miles from the Halawa Correctional Facility site, 5.3 miles from the Animal Quarantine Station site, 15.2 miles from the Mililani Technology Park Lot 17 site, and 9.5 miles from WCCC.
- The Pearl City Monitoring Station is located at 860 4th Street on the roof of the Leeward Health Center in a commercial, residential, and light industrial area approximately 1.5 miles northwest of the Waiau power plant and near the Pearl Harbor Naval Complex. It is located approximately 6.9 miles from the OCCC site, 5.1 miles from the Halawa Correctional Facility site, 4.7 miles from the Animal Quarantine Station site, 6.6 miles from the Mililani Technology Park Lot 17 site, and 14.2 miles from WCCC.
- The Kapolei Monitoring Station is located in the Kapolei Business Park, southeast of Kapolei Fire Station and next to a drainage canal that separates the park from Barber's Point. It is located approximately 13 miles from the OCCC site, 12.7 miles from the Halawa Correctional Facility site, 12.1 miles from the Animal Quarantine Station site, 11.9 miles from the Mililani Technology Park Lot 17 site, and 22 miles from WCCC.

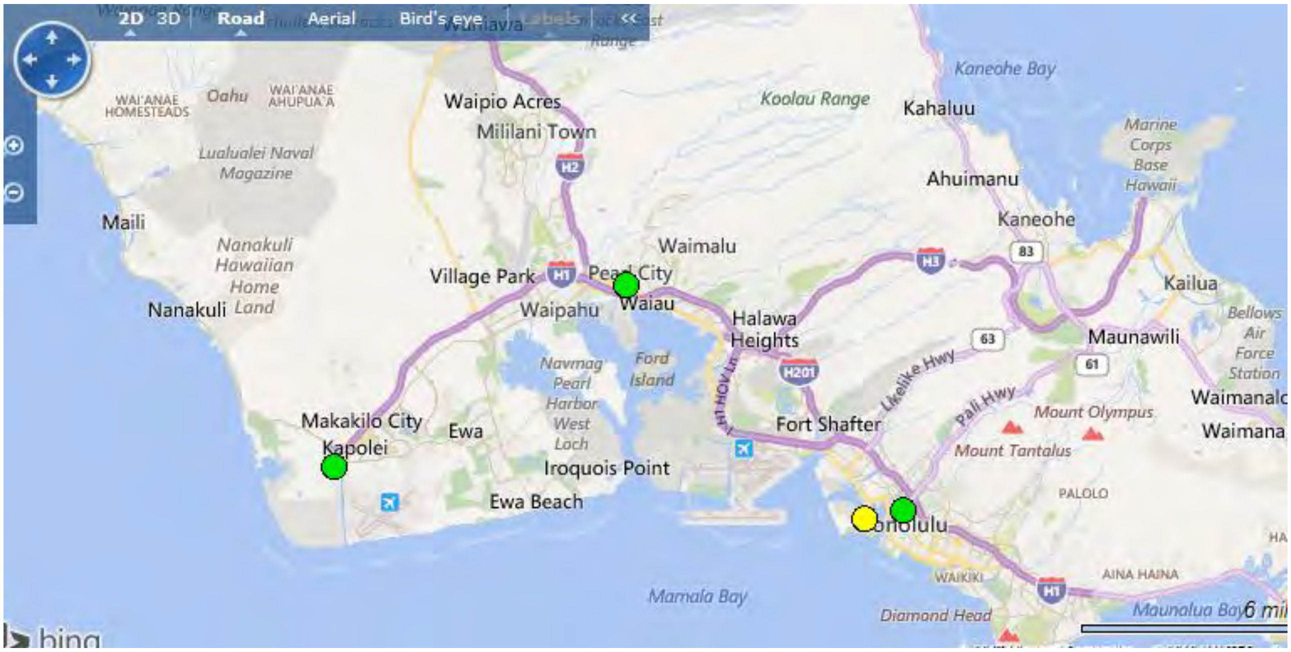

Exhibit 1: Oahu Air Monitoring Stations

3.2 Air Quality Monitoring Data/Current Conditions

In general, air quality in the state of Hawaii is among the best in the nation, and criteria pollutant levels remain well below state and federal ambient air quality standards. According to the Hawaii DOH, State of Hawaii Annual Summary 2015 Air Quality Data (December 2016), the ambient levels of pollutants measured between 2013 and 2015 at the Honolulu, Kapolei, Sand Island, and Pearl City air quality monitoring stations are provided in Table 3, along with state and federal air quality standards. The data shows existing concentrations of criteria air pollutants in the project area are below the applicable state and federal standards.

3.3 Regional and Local Climate Data

Regional and local climate affect air quality through the influence of wind, temperature, atmospheric turbulence, mixing height and rainfall. Although the climate of Hawaii, and the Island of Oahu, is relatively moderate, differences in these parameters may occur from one location to another because of the topography. The topography of Oahu is dominated by the two parallel mountain ranges that extend from the southeast to the northwest. The Waianae Range on the west side of the island and the Ko'olau Range on the east side are separated by a broad valley.

Table 3: Hawaii DOH Air Quality Data, 2013–2015

Pollutant	Period	Honolulu Monitoring Station	Kapolei Monitoring Station	Pearl City Monitoring Station	Sand Island Monitoring Station	State/Federal Air Quality Standards
CO	1-hour average (maximum)	1.4 ppm	2.4 ppm	a	a	9 ppm / 35 ppm
	8-hour average (maximum)	1.0 ppm	1.7 ppm	a	a	4.4 ppm / 9 ppm
PM_{10}	24-hour average (maximum)	36 µg/m3	32 µg/m3	46 µg/m3	a	150 µg/m3 / 150 µg/m3
	Annual average	11.5 µg/m3	15.8 µg/m3	21.1 µg/m3	a	50 µg/m3 / no federal standard
$PM_{2.5}$	24-hour average (based on 98th percentile)	11µg/m3	12 µg/m3	12 µg/m3	11µg/m3	No state standard / 35 µg/m3
	Annual average	4.5 µg/m3	3.6 µg/m3	4.9 µg/m3	5.4 µg/m3	No state standard / 12 µg/m3
O_3	8-hour average (based on 4th highest daily maximum)	a	0.049 ppm	a	0.051ppm	0.08 ppm / 0.075 ppm
NO_2	1-hour average (based on 98th percentile)	a	0.023 ppm	a	a	No state standard / 0.1 ppm
	Annual average	a	0.004 ppm	a	a	0.04 ppm / 0.053 ppm
SO_2	1-hour average (based on 99th percentile)	0.008 ppm	0.014 ppm	a	a	No state standard / 0.070 ppm
	3-hour average (maximum)	0.007 ppm	0.015 ppm	a	a	0.5 ppm (state and federal secondary standard)
	24-hour average (max)	0.003 ppm	0.004 ppm	a	a	0.14 ppm / no federal standard
	Annual average	0.000 ppm	0.001 ppm	a	a	0.03 ppm / no federal standard

Source: Hawaii DOH, 2017.

Notes: µg/m3 – micrograms per cubic meter

[a] Not monitored at this station.

The climate of Oahu is relatively moderate throughout most of the year and is characterized as semi-tropical with two seasons (Hawaii DOH 2016a). The summer period runs from May through September and is generally warm and dry, with predominantly northeast trade winds. In contrast, the winter season runs from October through April and is associated with lower temperatures, higher rainfall and less prevalent trade winds.

While the WCCC facility is located on the eastern side of the Ko'olau Mountain Range, the four OCCC project alternatives are located on the western side of the Range within a climate typical of the leeward coastal lowlands of Oahu. The area is characterized by abundant sunshine, persistent trade winds, relatively constant temperatures, moderate humidity, and the infrequency of severe storms. Northeasterly trade winds prevail throughout the year although its frequency varies. The mean temperature measured at Honolulu International Airport ranges from 70 degrees Fahrenheit (F) in the winter to 84 degrees F in the summer. Average annual precipitation is measured at approximately 30 inches, with rainfall occurring mostly between October and March.

4.0 AIR QUALITY IMPACTS AND MITIGATION

4.1 Potential Construction-Related Impacts

Regardless of the alternative site selected for OCCC development, short-term impacts to air quality would result either directly or indirectly as a consequence of project construction. For a project of this nature, the majority of the potential air emissions that could directly result in short-term air quality impacts during construction involve two types: fugitive dust from vehicle movement, site clearing, grading and excavation; and exhaust emissions from operation of on-site construction equipment. Indirect, short-term impacts could also result from transportation of construction equipment and materials to and from the project site, and from a temporary increase in local traffic caused by construction workers commuting to and from the project site. For purposes of this analysis, it has been assumed that construction of the proposed OCCC project would extend over an approximately 24- to 36-month period, while construction of improvements proposed at the WCCC would extend over an approximately 18- to 24-month period.

Construction methods, sequencing and duration for all aspects are well known as similarly-sized corrections and detention facilities have been developed on the mainland throughout much of the past two decades. These actions include, for example, site security, preparation of the project site for construction, utility connections, facility construction, etc. Reasonable assumptions have been made for construction methods, sequencing and schedule since the specific design, materials and equipment involving the OCCC and WCCC projects are not fully known at this early stage.

4.1.1 Construction Processes

To understand potential air quality impacts associated with construction activities, one requires familiarity with the construction process itself. The following provides an overview of the construction process involving a typical correctional facility as it may potentially affect air quality. The construction process for OCCC and WCCC would be similar although the scale of the construction activities involving OCCC would be considerably greater than for the proposed WCCC improvements.

Site Clearing and Preparation

Initial site clearing and preparation would involve the use of heavy equipment to remove all standing structures, pavements, and vegetation and carry out preliminary site grading within the construction zone so as to establish level building locations. Licensed commercial carters would remove demolition wastes for off-site recycling or final disposal in a licensed disposal (i.e., landfill) facility. Other necessary site preparation activities which would be undertaken during this stage include initial installation of underground utilities, soil erosion and sediment control measures, stormwater control measures, and similar preliminary site work.

Excavations and Foundations

Following initial site clearing and preparation, construction of the foundations and any below-grade components would commence. Excavation typically includes the use of heavy equipment to excavate and remove material in preparation for foundation construction. Foundation work would include preparation of forms and the pouring of concrete footings and foundation slabs. Heavy trucks would deliver concrete and other supplies to the project site.

Building Construction

This stage would include construction of the proposed structures (steel, concrete, reinforced concrete, etc.); the building facades (exterior walls and cladding); and roof. During this stage of construction, pouring of each building's concrete floors would occur. Installation of each structure's core, which consists of vertical riser systems for mechanical, electrical, and plumbing, as well as the satellite electrical and mechanical equipment rooms, individual cells, and plumbing facilities, would start during this stage and continue through the interior construction and finishing stage. These activities could require the use of cranes, derricks, exterior hoists, delivery trucks, forklifts, man lifts, and other similar equipment. Cranes would be used to lift structural components, facade elements, large pieces of equipment, etc. Heavy trucks would continue to deliver materials and licensed commercial carters would continue to remove construction debris as necessary. Construction of each structure's core and shell would be expected to overlap with interior construction and finishing.

Interior Construction and Finishing

Installation of interior mechanical, electrical, and plumbing systems would continue during this stage and include installation of ventilation and air conditioning equipment and ducting, interior installation of electric lines, water supply and wastewater piping. Installation and checking of telecommunications, security, and life safety systems would also take place at this time as would construction of interior walls systems and interior finishes (e.g., flooring, painting).

4.1.2 Typical Construction Equipment and Staging

Typical construction equipment used for site excavation and pouring the foundation would include excavators, bulldozers, backhoes, tractors, hammers, cranes and concrete pumping trucks. Equipment that would be used in construction would include mobile cranes, hoist complexes, dump trucks and loaders, concrete trucks, backhoes, and other pieces of large equipment. Trucks would arrive at the site with pre-mixed concrete and other building materials, and would remove any excavated material and construction debris. Typical equipment used during construction of the superstructure and framing would include cranes, compressors, hoists, and welding machines. During roof construction, hoists and cranes would continue to be used. Trucks would remain in use for material supply and construction waste removal.

Staging areas would be needed for all aspects of the construction phase and would be located within or adjacent to the building site. While placement of individual equipment would not be determined until a detailed development program has been outlined, it is anticipated that in most cases all of the construction activity can be accommodated on-site, with no off-site staging.

Construction-related impacts to air quality are generally limited to fugitive dust emissions that would occur in and around the construction site resulting from site preparation and construction operations. Fugitive dust emissions typically occur during building demolition, ground clearing and preparation, site grading, the stockpiling of materials, on-site movements of construction equipment, and the transportation of construction materials to and from the site. Actual quantities of fugitive dust emissions depend on the extent and nature of the clearing operations, the type of equipment employed, the physical characteristics of the underlying soil, the speed at which construction vehicles are operated, and the type of fugitive dust control methods employed. Much of the fugitive dust generated by construction activity consists of relatively large-size particles. These particles would settle within a short distance from the construction work areas and, as a result, not pose a significant adverse impact upon neighboring properties or residents of the vicinity of the project site.

The potential for air quality impacts during construction would be short-term/temporary, occurring only while construction is in progress and during certain meteorological conditions. Fugitive dust emissions can occur during dry weather periods, periods of maximum construction activity, and high wind conditions.

4.1.3 Recommended Mitigation—Construction Activities

To mitigate potential air quality impacts during construction, best management practices would be incorporated within standard operating procedures for site construction activities. Such practices to limit adverse air quality impacts during construction include using properly maintained equipment, limiting unnecessary idling times on diesel powered engines, using tarp covers on trucks transporting materials to and from the construction site, periodically wetting unpaved surfaces to suppress dust, and prohibiting the open burning of construction wastes on-site. In addition, construction equipment would be maintained and operated in accordance with the manufacturer's specifications to further minimize air emissions. Restoration of the ground surface by the introduction of grass or native ground-cover following completion of construction would further minimize fugitive dust emissions.

Precautions to control fugitive dust are determined on a case-by-case basis. Site topography and surroundings, soil conditions, meteorological conditions, site activities, site equipment, and types of material processed must be considered. Control measures to minimize generating and dispersing fugitive dust could include:

- Paving and regularly cleaning permanent access and haul roads;
- Regularly applying water to unpaved roads and any disturbed surfaces that could be subject to dust generation;
- Landscaping the areas where no buildings are proposed;
- Covering moving, open-bodied trucks transporting materials which may result in fugitive dust;
- Cleaning truck tires and truck bodies prior to entering public roadways; and
- Covering or otherwise treating stockpiled materials or other surfaces which may result in fugitive dust.

4.2 Potential Facility Operation-Related Impacts

4.2.1 Potential Impacts—Facility Operation

The following provides an overview of the potential air quality impacts associated with operation of the proposed OCCC and WCCC facilities. Systems for hot water and HVAC would be installed and would be the primary stationary source of potential air quality impact. The final choice of fuel would be determined by fuel availability, costs, and other considerations. It should be noted that installation of new hot water heaters and HVAC equipment would replace the existing older and less efficient models currently in use at the existing OCCC and would not represent a new or additional sources of stationary source emissions. Therefore, the volume of combustion emission by-products from proposed facility operation would not pose a significant adverse air quality impact.

The proposed OCCC would also be equipped with one or more standby generators to produce electrical energy in the event of a power failure. As with other electrical and mechanical equipment, those in use at the proposed OCCC facility would replace the older and less efficient models currently in use at the existing OCCC and would not represent new sources of stationary source emissions. It is likely that an additional standby generator would be added to supplement those already in place at WCCC to ensure sufficient contingency power is available to maintain uninterrupted operation of the proposed housing unit and other planned improvements. All new emergency generators would be installed in conformance with applicable regulations for use on a contingency basis. Emissions from maintenance, periodic testing, and emergency operation of the OCCC and WCCC generators are not expected to result in a significant increase in CO or NO_2 levels or an exceedance of NAAQS.

4.2.2 Recommended Mitigation—Facility Operation

Other than selection of energy-efficient equipment that meets applicable permitting and emission control standards, no mitigation measures are warranted. Potential air quality impacts during facility operation would be minimized by designing and constructing the new facilities to be energy-efficient, thereby minimizing the use of fossil fuels and the potential emission of air pollutants.

4.2.3 Potential Impacts—Mobile Sources

Motor vehicle operations represent an additional potential source of project-related air quality impacts. For air quality assessments of motor vehicle emissions, the major issues are microscale impacts (localized areas immediately adjacent to the roadways) and mesoscale impacts (the area comprising the entire region). The predominant air quality impact associated with motor vehicle-related emissions is PM. CO, VOC, and NO_2 with VOC and NOx/NO_2 emissions precursors for the formation of ozone. A review of the trip-generation tables included as part of the Traffic Impact Assessment indicates that approximately 190 and 26 vehicle trips would arrive and depart during the AM and PM peak hours, respectively, during typical weekday operation of the new OCCC only, with most visitor and service/delivery vehicle traffic occurring during off-peak hours. For WCCC, only 27 and 0 vehicle trips would arrive and depart during the AM and PM peak hours, respectively, during typical weekday operation, with most visitor and service/delivery vehicle traffic occurring during off-peak hours.

It should be noted that development of the new OCCC would replace the existing OCCC and would not represent an additional source of motor vehicle emissions. Little if any adverse impact to air quality is anticipated from the relative small volume of traffic arriving and departing the facility during the peak hours. Microscale modeling of vehicular emissions was not conducted because of the relatively low volumes of traffic and because of the zero or low net increase in annual average daily traffic on Oahu and along principal access routes leading to the selected OCCC site.

Reductions in vehicular emissions resulting from continually improving emissions-control technology along with increased use of all-electric and hybrid-power vehicles further precludes the likelihood of any significant air quality impacts. Motor vehicle traffic associated with the proposed OCCC facility is not expected to pose local or regionally significant adverse impacts to air quality at the selected site.

4.2.4 Recommended Mitigation—Mobile Sources

Agencies of the Hawaii State government routinely encourage the formation of carpools and vanpools and, where available, the use of public transit to minimize the potential for air quality impacts from motor vehicle operations. Encouraging the use of carpools and vanpools offers a particularly viable option given the almost exclusive reliance on private auto use for accessing the current OCCC and WCCC and the large pool of workers, volunteers, vendors and visitors traveling daily to both facilities. The analysis of potential air quality impacts has indicated that no mitigation beyond these actions would be warranted.

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Appendix P: Solid and Hazardous Waste Management

Oahu Community Correctional Center

October 27, 2017

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SOLID AND HAZARDOUS WASTE MANAGEMENT

1.0 INTRODUCTION

The Hawaii Department of Public Safety (PSD) operates the Oahu Community Correctional Center (OCCC), which acts as the local detention center for the First Circuit Court. Located at 2199 Kamehameha Highway in Honolulu, the OCCC is currently the largest jail facility in the state of Hawaii. With increasingly aged and obsolete correctional facilities, PSD is proposing to improve its corrections infrastructure through modernization of existing facilities when possible and construction of new institutions to replace others when necessary. Among its priority projects is the replacement of OCCC.

Four sites located on the island of Oahu have been identified as potential locations for the proposed OCCC facility: the Animal Quarantine Station in Halawa; the Halawa Correctional Facility in Halawa; the current site of the OCCC in Kalihi; and the Mililani Technology Park, Lot 17, in Mililani. The project also involves upgrades and expansions to the housing and supporting infrastructure at the Women's Community Correctional Center (WCCC) in Kailua to accommodate the relocation of female inmates from OCCC to that facility. The purpose of the proposed project is to provide a safe, secure, and humane environment for the care and custody of adult male and female offenders originating from the County of Oahu.

Development of the proposed OCCC and improvements to WCCC will generate solid and/or hazardous wastes requiring collection and disposal during both the construction and operating phases of the facilities. In addition, the potential exists to encounter contamination at each of proposed project locations. This report addresses the nature and volumes of solid wastes currently being generated at OCCC and WCCC and following development. In addition, the potential to encounter contamination at each project location, based on previous studies and recent field inspections has also been addressed.

2.0 SOLID WASTE MANAGEMENT

2.1 Current Environment

The Island of Oahu produces over 1.7 million tons of solid waste annually with approximately 30 percent (500,000 tons) comprising construction and demolition debris. To dispose of such wastes, there are two landfills operating on Oahu.

The Waimanalo Gulch Sanitary Landfill, located at 92-460 Farrington Highway in Kapolei, is owned by the City and County of Honolulu and operated by Waste Management of Hawaii. The landfill, in operation since 1989, occupies a total area of approximately 200 acres of which approximately 100 acres are used for the disposal of approximately 1,100 tons of municipal solid waste per day (residential and commercial wastes) and approximately 500 to 600 tons of ash per day from the waste-to-energy facility. At the present loading rate, it is estimated that the facility has an expected life of 15 years (City and County of Honolulu website, 2017). The City and County of Honolulu has been studying alternative locations for development of a new landfill to accommodate the long-term solid waste disposal needs of the island and has been working for many years to develop a new facility.

The PVT Land Company, Ltd. owns and operates the PVT Integrated Solid Waste Management Facility at 87-2020 Farrington Highway in Waianae, Hawaii. The PVT facility encompasses approximately 135 acres that is currently accepting between 1,400 to 1,500 tons of waste per day. The facility is licensed to accept non-hazardous construction and demolition debris and over the past decade, has been transformed from primarily a landfill to an integrated waste management facility. The facility recycles much of the debris that it receives and processes as much as possible as feedstock for energy production. In 2014, a new recycling system increased the facility's processing capacity to 1,775 tons of debris daily and diverts up to 80 percent of the waste for reuse and recycling rather than disposing the wastes into a landfill.

The City and County of Honolulu also have another means for dealing with solid wastes generated on the island. The Honolulu Program of Waste Energy Recovery (HPower) waste-to-energy facility is capable of processing approximately 2,200 tons per day of municipal solid waste into refuse derived fuel (RDF) for combustion and generates approximately 57 megawatts which is then sold to HECO. The HPower process reduces the volume of the waste that requires placement in the landfill by 90 percent. The HPower facility also separates and recycles nearly 100 percent of the ferrous and nonferrous metals brought to the facility.

2.1.1 Oahu Community Correctional Center

Solid wastes generated at the existing OCCC facility by the current population of approximately 1,000 inmates totals approximately 30 tons per month or two pounds per inmate per day. Solid wastes are collected twice weekly by Honolulu Disposal for transport and disposal at the Waimanalo Gulch Sanitary Landfill. Currently, no formal recycling program is in operation at OCCC that diverts paper, cardboard, metals, glass or other recyclable material from the solid waste stream.

In addition to solid wastes, approximately 1,250 gallons of used cooking grease are generated monthly at OCCC, collected by Pacific Biodiesel, Inc. for recycling at its Oahu facility. In operation since 2000, the Pacific Biodiesel facility is capable of recycling approximately one million gallons of waste oils and greases annually into biodiesel fuel.

2.1.2 Women's Community Correctional Center

Solid wastes generated at WCCC are estimated to total approximately 19 tons per month or four pounds per inmate per day. Solid wastes are collected on a regular schedule by West Oahu Aggregate for transport and disposal at the Waimanalo Gulch Sanitary Landfill. Currently, a program is in place at WCCC that separates cardboard from the solid waste stream with approximately 1,944 cubic yards of waste cardboard collected for recycling annually.

2.2 Short-Term Construction Impacts and Mitigation

2.2.1 Existing OCCC Site

Construction of the proposed OCCC facility at the existing OCCC site would generate solid waste requiring collection and disposal by one or more of the private haulers which serve the Island of Oahu. During the construction phase, solid wastes of various types and quantities would be generated by the demolition and removal of at least five concrete and wooden structures, one concrete guard tower, various underground utilities, parking lot pavement, fencing, etc. currently occupying the northwest portion of the overall site (the area slated for new OCCC development). A precise estimate of the volume of demolition debris involved in clearing this site for OCCC development is unknown. However, given the number and scale of structures, parking areas, etc. currently occupying the development area, the volume of debris will be the highest among the alternative sites. During the normal construction process, additional solid wastes will also be generated consisting of concrete block, wood, metal, and similar building materials.

2.2.2 Animal Quarantine Station Site

Construction of the proposed OCCC facility at the Animal Quarantine Station site would also generate solid waste requiring collection and disposal by one or more of the private haulers which serve the Island of Oahu. During the construction phase, solid wastes of various types and quantities would be generated by the demolition and removal of one large concrete structure and several wooden and metal structures, over 1,000 metal and concrete kennels housing dogs and cats, various underground utilities, concrete sidewalks and parking lot pavement, fencing, etc. currently occupying the overall site (the area slated for new OCCC development and the relocated/replacement Animal Quarantine Station facility. A precise estimate of the volume of demolition debris involved in clearing this site for OCCC development is unknown. However, given the number and scale of structures, kennels, sidewalks, parking areas, etc. currently occupying the development areas, the volume of debris will be large, second only to the existing OCCC site among the alternatives. During the normal construction process, additional solid wastes will also be generated consisting of concrete block, wood, metal, and similar building materials.

2.2.3 Halawa Correctional Facility Site

Construction of the proposed OCCC facility at the Halawa Correctional Facility site would also generate solid waste requiring collection and disposal by one or more of the private haulers which serve the Island of Oahu. During the construction phase, a minimal amount of solid wastes of various types would be generated by the removal (and later replacement) of perimeter security fencing and light fixtures which surround the vacant and undeveloped project site. Unlike other alternative sites, no standing structures require removal or replacement. During the normal construction process, solid wastes requiring disposal would include concrete block, wood, metal, and similar building materials.

2.2.4 Mililani Technology Park Site

Construction of the proposed OCCC facility at the Mililani Technology Park site would also generate solid waste requiring collection and disposal by one or more of the private haulers which serve the Island of Oahu. As documented earlier, the Mililani Technology Park site is undeveloped with dense stands of tall grasses, shrubs and young and mature trees requiring clearing, chipping, composting and/or disposal prior to actual construction. Unlike some alternative sites, no standing structures require removal or replacement. During the normal construction process, solid wastes requiring disposal would include concrete block, wood, metal, and similar building materials.

2.2.5 Women's Community Correctional Center

As noted earlier, plans are to relocate female inmates from OCCC to WCCC located in Kailua in order to provide female inmates greater access to rehabilitation programs and improved family visitation. To accommodate the additional female population to be relocated from OCCC, plans are being developed for improving inmate housing and supporting infrastructure at WCCC. Improvements under consideration include development of a new housing unit comprising approximately 180 dormitory-style beds (Pods A and B), 14 segregation unit cells and 14 mental health unit cells (Pod C), intake control and intake services, medical and mental health units, a central control station, non-contact visiting room, outdoor recreation area, laundry department, a maintenance/warehouse building, and other ancillary facilities.

Construction of the improvements proposed at WCCC would also generate solid waste requiring collection and disposal by one or more of the private haulers which serve the Island of Oahu. The area at WCCC under consideration for development is vacant with large areas of mowed turf bordering dense stands of tall grasses requiring clearing prior to actual construction. In the case of WCCC, no standing structures require removal or replacement prior to development, however, following development, the current maintenance building/ warehouse and greenhouse would be demolished and removed from the site. During the normal construction process, solid wastes requiring disposal would include concrete block, wood, metal, and similar building materials.

2.2.6 Construction Waste Collection and Disposal

The collection of demolition and/or construction-derived wastes originating from the selected OCCC development site and at WCCC would be the responsibility of the contractors involved in OCCC and WCCC construction. While a precise estimate of the volume of construction-related solid wastes requiring collection and transportation from each project location is unknown at this time, it will be a relatively small percentage of the total volume of construction-related wastes collected annually and is not expected to adversely impact solid waste collection services currently available on the island.

Solid wastes generated during OCCC and WCCC construction activities would be disposed of only at facilities permitted for construction and demolition wastes. While a precise estimate of the volume of construction-related wastes requiring disposal from each project location is unknown at this time, it will be a relatively small percentage of the total volume of construction-related solid wastes disposed of annually on Oahu. With a dedicated construction and demolition debris disposal facility operating on Oahu (PVT Integrated Solid Waste Management Facility), the volume of construction waste associated with project development at any of the alternative OCCC sites and WCCC is not anticipated to adversely impact solid waste disposal services on Oahu. Construction-related wastes would be properly stored on-site in containers that would be periodically removed for disposal as necessary.

Prior to initiating construction at the selected OCCC development site and WCCC, a construction waste management plan will be developed for each project location. The plan objectives will be to divert construction and debris wastes from landfill disposal by implementing recycling and other waste reduction and reuse methods to minimize the volume of wastes requiring disposal. The construction waste management plan would include, but not be limited to, the following:

- Assess the probable waste streams and estimated quantities to be generated during site clearing (demolition) and construction.
- Identify construction waste reduction opportunities.
- Identify local recycling facilities and haulers that would be available to accommodate recycled materials resulting from demolition and construction.
- Designate waste storage areas within the construction sites to sort, segregate, and recycle a portion of the construction wastes.
- Track the waste during the demolition and construction phases.

No additional mitigation measures, other than those described above, would be warranted during the OCCC and WCCC construction phases.

2.3 Long-Term Operating Impacts and Mitigation

2.3.1 Oahu Community Correctional Center

Solid wastes generated at the proposed OCCC facility by the projected population of approximately 1,250 inmates is conservatively estimated to total approximately two pounds per inmate per day or approximately 39 tons per month. While slightly higher than the current estimate of solid wastes generated monthly at the existing OCCC, the projected volume anticipates State of Hawaii inmates currently housed at the Federal Detention Center to be relocated to the proposed OCCC. The proposed OCCC is intended to replace the existing facility so only the net increase in the volume of solid waste requiring disposal is of interest. When accounting for the total population of State of Hawaii jail inmates on Oahu (regardless of their location), the total volume of solid wastes generated now and in the future by the OCCC will be virtually the same.

The collection of solid wastes from the proposed OCCC facility would be the responsibility of the waste carter selected prior to activation of the proposed facility with final disposal of such wastes expected to occur at the Waimanalo Gulch Sanitary Landfill or its eventual replacement facility. Solid waste generated during operation of the facility would continue to be stored in on-site self-contained dumpsters until collection (on a regular schedule), then transported by licensed haulers to a transfer station, recycler, or landfill. The volume of solid waste generated by the proposed facility would not represent a significant proportion of the total volume accepted for disposal annually on the island.

While no formal recycling program is currently in operation at OCCC that diverts paper, cardboard, metals, glass or other recyclable material from the solid waste stream, plans are to institute such a program during operation of the new OCCC. The proposed facility would be designed and operated in the context of a comprehensive environmental management program in which:

- Efforts are made to procure items that promote recycling, are made of recycled materials, and/or reduce waste generation;
- Wastes expected to be generated would be identified along with the location of various recycling facilities, and the means by which recyclable materials must be sorted, segregated and delivered to the respective recycling facility;

- A cost-effective recycling program is incorporated into the operational procedures of the proposed facility, including the recycling of cardboard, paper, plastic, metal, glass, used oils and greases, and/or other materials as appropriate; and
- Other operational initiatives for solid waste reduction and recycling will be examined and implemented when appropriate.

2.3.2 Women's Community Correctional Center

Solid wastes generated at the expanded/improved WCCC by the projected population of approximately 550 - 600 inmates is conservatively estimated to total approximately four pounds per inmate per day or approximately 37 tons per month. While slightly higher than the current estimate of solid wastes generated monthly at WCCC, the projected estimate anticipates State of Hawaii female inmates currently housed at OCCC to be relocated to WCCC. Therefore, only the net increase in the volume of solid waste requiring disposal is of interest. When accounting for the total population of State of Hawaii female jail inmates on Oahu (regardless of their location), the total volume of solid wastes generated now and in the future at WCCC will be virtually the same.

The collection of solid wastes from the expanded/improved WCCC facility would be the responsibility of the waste carter selected by the State of Hawaii with final disposal of such wastes expected to occur at the Waimanalo Gulch Sanitary Landfill or its eventual replacement facility. Waste generated during operation of WCCC would continue to be stored in on-site self-contained dumpsters until collection (on a regular schedule), then transported by licensed haulers to a transfer station, recycler, or landfill. The volume of solid waste generated by WCCC would not represent a significant proportion of the total volume accepted for disposal annually on the island.

Currently, a program is in place at WCCC that separates cardboard from the solid waste stream with approximately 1,944 cubic yards of waste cardboard collected for recycling annually. While no formal recycling program is currently in operation at WCCC that diverts paper, metals, glass or other recyclable material from the solid waste stream, plans are to institute such a program during future operation of WCCC. Following the planned expansion/improvements, the facility would be operated in the context of a comprehensive environmental management program in which:

- Efforts are made to procure items that promote recycling, are made of recycled materials, and/or reduce waste generation;
- Wastes expected to be generated would be identified along with the location of various recycling facilities, and the means by which recyclable materials must be sorted, segregated and delivered to the respective recycling facility;
- A cost-effective recycling program is incorporated into the operational procedures of the proposed facility, including the recycling of cardboard, paper, plastic, metal, glass, used oils and greases, and other materials as appropriate; and
- Other operational initiatives for solid waste reduction and recycling will be examined and implemented when appropriate.

3.0 POTENTIAL FOR HAZARDOUS MATERIALS CONTAMINATION

3.1 Current Environment

3.1.1 Oahu Community Correctional Center Site

The existing OCCC site has largely been developed with inmate housing, administrative, program and support structures, maintenance and storage buildings, a vehicle sallyport, and parking areas among similar uses. The few undeveloped areas within the overall site consist of a large outdoor recreation field, areas with sidewalks and pavement, and small grass lawns located between structures.

Previous Studies

Previous studies of the existing OCCC site were reviewed to determine past conditions of the property. In 2008, a preliminary hazardous materials screening of the existing OCCC property was conducted to identify evidence of the potential presence of Recognized Environmental Conditions (RECs). RECs are the presence or likely presence of hazardous materials, toxic materials or petroleum products under conditions that indicate an existing release, a past release, or a material threat of release of such substance onto a subject property. That screening, intended as a precursor to more in-depth investigations conducted during later stages of facility planning, consisted of a limited field reconnaissance of the property as well as review and evaluation of various environmental databases containing information concerning the site and its environs.

The search of available environmental records was performed in 2008 by Environmental Data Resources, Inc. (EDR). The database search conducted at that time reviewed and evaluated local and federal databases including the National Priorities List (NPL), Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) List, CERCLIS-No Further Remedial Action Planned List (NFRAP), Resource Conservation and Recovery Act of 1976 (RCRA) Treatment, Storage, and Disposal Facility List, RCRA Generators List, RCRA Corrective Action Report List, Emergency Response Notification System List, and various local databases.

At that time, the existing OCCC site was listed in several databases searched in association with a RCRA Section 9006 Order issued in 2000 related to two 5,000-gallon underground storage tanks (USTs) used to store and dispense gasoline. These tanks were permanently closed in 2001. Also identified on the site were four 500-gallon diesel USTs that were installed in 1976 and permanently closed in 1999. There was no record of leaks associated with these six tanks.

Other databases reviewed in 2008 identified OCCC as a small quantity generator of hazardous and inorganic wastes (between 100 and 1,000 kilograms of hazardous waste per month). In addition, the site was listed as in the Hawaii Department of Health (HDOH), Office of Hazard Evaluation and Emergency Response (HEER) database as having an accidental release of mercury in 1998. An environmental contractor was reportedly enlisted to conduct remedial activities associated with the release; however, the HEER database did not provide a final decision of the site or a file closure date.

The environmental database identified 20 USTs located within 0.25 mile of the OCCC site and 43 leaking underground storage tank (LUSTs) within 0.5 mile. The majority of the up-gradient LUST sites have been designated as requiring no further action. One of the up-gradient LUST sites had a 1,000-gallon gasoline UST that was permanently closed in 1992 and was designated as remedy decision pending with on-going monitoring. Engineering and/or institutional controls were implemented on seven sites within 0.50 mile of the OCCC site; however, none of these sites appear to be up-gradient of the OCCC site. Two U.S. brownfields sites were identified with 0.5 mile; one of which was located approximately 0.13 mile up-gradient of the OCCC site.

Review of the State Hazardous Waste Sites (SHWS) records at that time revealed 44 SHWS sites within one mile of the site. Of those, four were located within 0.25 mile of the site and only two appeared to be up-gradient. One site, in addition to OCCC, was identified as a RCRA small quantity generator (SQG), one site was identified as a RCRA treatment/storage/disposal facility (TSDF), and one site was identified in the RCRA correction action activity database (CORRACTS). The TSDF and CORRACTS sites were located 0.32 mile and 0.44 mile up-gradient, respectively. One site from each of the CERCLIS and CERCLIS-NFRAP databases was identified up-gradient within 0.5 mile of OCCC.

No indications of widespread contamination or obvious indication of the use or disposal of hazardous substances involving the OCCC site were noted during field visits of OCCC conducted in 2008 and no RECs were identified. The potential for widespread contamination was considered low and did not appear to be a significant constraint to redevelopment of the site at that time.

Current Site Conditions

The existing OCCC site remains largely developed with inmate housing, administrative, program and support structures, maintenance and storage buildings, a vehicle sallyport, and parking areas among similar uses. The few undeveloped areas within the overall site in 2017 consist of a large outdoor recreation field, areas sidewalks and pavement, and small grass lawns located between structures. Field inspections of the overall property were conducted during 2017 at which time the following was revealed:

- No evidence of the manufacturing, storage, handling or disposal of hazardous substances or petroleum products was observed within the existing OCCC site.
- No surficial evidence or visual signs of contamination, stained soils, stressed vegetation, unusual mounds, or other indication of the use, handling, storage, or disposal of hazardous materials was identified.
- No adjoining land uses were identified that would be expected to pose a potential environmental risk to the continued use and future redevelopment of the existing OCCC site.
- No evidence of leaking aboveground or underground storage tanks was observed within the existing OCCC site.
- Materials considered hazardous in use at OCCC include janitorial supplies, laundry detergents and sanitizers, maintenance materials, and paint. All of these items are properly managed and stored in labeled and locked cabinets or in locked cages.

With many years of state government control over occupation, development and use of the OCCC property, the potential for contamination from hazardous materials is considered low. No indications of contamination or obvious indication of the use or disposal of hazardous substances involving this site was noted during recent field studies.

3.1.2 Animal Quarantine Station Site

The Animal Quarantine Station property has largely been developed with over 1,000 animal kennels, administrative and support structures, maintenance and storage buildings, and vehicle parking areas. The few undeveloped areas within the overall property consist of a large pasture devoted to horse and cattle grazing, grassed areas for small animal use, and vacant areas located on the periphery of the property.

Previous Studies

1970–1980

Research concerning conditions at the Animal Quarantine Station site revealed that pesticides were disposed of at the property in the 1970s. The pesticides needed disposing due to the deteriorating condition of the containers holding the pesticides with contents leaking or spilling; workers being exposed to the pesticides; the lack of any acceptable incinerators available in Hawaii; and no approved sanitary landfill for pesticide disposal available locally. The amount of chemicals requiring disposal was sufficient to fill three 55-gallon steel drums containing Rtu 10 percent DDT and six 5-gallon drums of 10 percent DDT. Other pesticides, including Malathion and tomato dust, appear to have been buried. The containers comprised approximately 4.5 cubic feet in volume within an underground oubliette and were covered with soil and aggregate and a solid lid. According to records dating to the 1970s and 1980s, the decision to dispose of pesticides at the Animal Quarantine Station (bury) was made following consultations with various state and federal agencies.

The actions taken by the Hawaii Department of Agriculture (HDOA) to bury pesticides appear to be in accordance with U.S. Environmental Protection Agency (USEPA) regulations for the disposal and storage of pesticides in effect in 1976. More recent correspondence from the Hawaii Department of Health reported that the stored10 percent DDT originally thought to have been buried with other pesticides was in fact shipped to Oregon for disposal by a contractor (UNITEK Environmental Services). A copy of the manifest for the DDT waste from the Animal Quarantine Station was later obtained from UNITEK.

The HDOH, HEER Office, in correspondence dated May 24, 2005, requires that no excavation or construction work be performed near, around or in the disposal site itself. The HEER Office should be notified about the possible development of the OCCC facility at the Animal Quarantine Station site and discussions initiated about the potential for contamination and the possible need to properly remove, treat and dispose of such materials prior to development.

2003 Sampling

During the 1940s and 1950s, the property was occupied by the U.S. Navy. Historical aerial photos taken in 1944 and 1952 show various structures situated on the property. However, it is unclear from the photos if some of the buildings were actually situated on the parking lot area. By 1965, many of the Navy buildings had been removed. In 1968, the State of Hawaii acquired the property to develop the Animal Quarantine Station and no structures were located in the parking lot area. Prior to construction of the Animal Quarantine Station in 1968, the elevation of the parking lot was approximately 70 feet above mean sea level (amsl). The topography changed in 1969 with the ground surface raised to between 85 and 90 feel amsl. During the 1970s, the HDOA Disease Education Building, U.S. Department of Agriculture building and two corrals were built in the area of parking lot and were later demolished in 1999 to build the parking lot.

In the early 2000s, a black, viscous, tar-like substance was observed on a small area of the parking lot surface along the western portion of the overall property. The source of the substance was uncertain. In June 2003, Muranaka Environmental Consultants, Inc. collected two composite samples of the tar-like substance found in the parking lot. One sample was collected from parking lot stalls while the second sample was collected from the tar material located on the west side of the parking lot.

The samples were analyzed for polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH) in diesel, TPH in gasoline, volatile compounds, semi-volatile compounds and eight RCRA metals. Laboratory results indicated that the sample taken from the parking lot stalls contained detectable levels of acetone, barium, cadmium, and chromium while the sample taken from the west side of the parking lot was found to contain barium, cadmium, chromium, and lead at detectable concentrations. Two samples were analyzed for Toxic Characteristic Leaching Procedure (TCLP) for the eight RCRA metals, volatile compounds, and semi-volatile compounds. Only barium and chromium were detected above the method detection limits for TCLP and the laboratory results indicated TCLP levels did not exceed USEPA's regulatory limits.

Limited Phase I Environmental Site Assessment—2004

In 2004, Kimura International, Inc. was contracted to conduct a limited Phase I Environmental Site Assessment (ESA) for the Animal Quarantine Station. According to the limited Phase I ESA, a black, viscous, tar-like substance was observed on the parking lot surface along the western portion of the overall property. The source of the substance was uncertain, however, the substance was previously analyzed in 2003 for PCBs, TPH in diesel, TPH in gasoline, volatile compounds, semi-volatile compounds and eight RCRA metals. Based on the laboratory results, the material was not considered a hazardous substance.

Due to the material's physical characteristics, the source is believed to be a release from a low-refined petroleum product such as commercial fuel oil, waste oil, or asphalt. Since the material at the site is known and suspected to have originated from a nearby source, the scope of the 2004 investigation was limited to on-site and geologically up-gradient sources and not the recommended ASTM search distances for a typical Phase I ESA investigation.

As noted earlier, the State of Hawaii acquired the property in 1968 from the United States of America. Property records show that the U.S. Navy owned the property from1941 and the earliest owner was the Emma Kaleleonalani Estate. Historical aerial photos taken in 1944 and 1952 show various structures on the property including in the vicinity of the present-day parking lot. The buildings were subsequently demolished and the Animal Quarantine Station was constructed in 1968. The U.S. Navy's Regional Engineers did not have any knowledge of the operations that were performed by the Navy at the Animal Quarantine Station property.

A limited database search was conducted in 2004 for the property and the facilities on the property. The databases consulted included the NPL, CERCLIS, and the HDOH UST, LUST and Releases databases. The database search identified several possible sources of petroleum material including releases or fuel tanks associated with commercial fuel oil, asphalt, or any black viscous petroleum product. Other petroleum products such as gasoline, kerosene, or jet fuel were not considered a concern.

One 8,000-gallon bunker oil UST was registered on the HDOH UST database to Prestressed Concrete located on Halawa Valley Road (the file did not indicate the status of the tank). A release from the tank could potentially travel onto the Animal Quarantine Station property but is not likely based on the distance from the parking lot where the material is found.

A release associated with commercial fuel oil and asphalt cement USTs removed at the Grace Pacific facility at 1300 Halawa Valley Road was reported to the HDOH HEER Office. Several investigations regarding the release were conducted. The investigations included contaminant delineation, soil remediation, and groundwater monitoring. Findings from the most recent investigation suggested that the contamination was restricted to the Grace Pacific facility.

Kimura visited the Animal Quarantine Station to inspect the surface contamination and surrounding areas. The tar-like material was inspected and it appeared to be coming from the ground and was not poured onto the surface.

Interviews with HDOA personnel revealed that the material surfaced in approximately 1999. The asphalt paving company was contacted but there was no resolution. HDOA personnel reported that roofing materials were spilled onto the ground surface during construction of the HDOA Laboratory Building and was never cleaned up.

Kimura concluded that the tar-like material was not illegally dumped onto the parking lot and is coming from below the surface. Several potential sources located up-gradient were identified in the databases. Kimura recommended a subsurface investigation be conducted to determine the horizontal and vertical limits of the material. If the material originated from an up-gradient source, then the material would be found along the north and/or east ends of the property and a pathway should be traced. The subsurface investigation would also indicate whether the material is limited to the subject property and whether the material was on the property by the Animal Quarantine Station was constructed

The property was owned by the U.S. Navy until 1968 and Formerly Used Defense Sites (FUDS) are supposed to be assessed by the military for environmental issues. The U.S. Army Corps of Engineers did not list any FUDS in the Halawa area.

Current Site Conditions

The Animal Quarantine Station site, as described earlier, has largely been developed with over 1,000 animal kennels, administrative and support structures, maintenance and storage buildings, sidewalks and vehicle parking areas. The few undeveloped areas within the overall property in 2017 consist of a large pasture devoted to horse and cattle grazing, grassed areas for small animal use, and vacant areas located on the periphery of the property. Field inspections of the overall property were conducted during 2017 at which time the following was revealed:

- No evidence of the manufacturing, storage, handling or disposal of hazardous substances or petroleum products was observed within the Animal Quarantine Station site.
- No adjoining land uses were identified that would be expected to pose a potential environmental risk to the continued use and future redevelopment of the Animal Quarantine Station site.

- No evidence of leaking aboveground or underground storage tanks was observed within the Animal Quarantine Station site.

With many years of state government control over occupation, development and use of the Animal Quarantine Station property, the potential for contamination from hazardous materials is considered low. Excluding the small area with the black, viscous, tar-like substance observed on the parking lot surface along the western portion of the overall property, no other surficial evidence or visual signs of contamination, stained soils, stressed vegetation, unusual mounds, or other indication of the use, handling, storage, or disposal of hazardous materials has been identified.

3.1.3 Halawa Correctional Facility Site

The Halawa Correctional Facility property has largely been developed with inmate housing, administrative and support structures, maintenance and storage buildings, the Special Needs Facility, a vehicle sallyport, and parking areas among similar uses. The few undeveloped areas within the overall site consist of a large outdoor recreation field (the proposed OCCC development site), pavement, and narrow grass lawns located along the periphery of the facility.

Previous Studies

Previous studies of the Halawa Correctional Facility site were reviewed to determine past conditions of the property. In 2008, a preliminary hazardous materials screening of the Halawa Correctional Facility property was conducted to identify evidence of the potential presence of RECs. That screening, intended as a precursor to more in-depth investigations conducted during later stages of facility planning, consisted of a limited field reconnaissance of the property as well as review and evaluation of various environmental databases containing information concerning the site and its environs.

Based on field surveys conducted in 2008, no evidence of the manufacturing, storage, handling or disposal of hazardous substances or petroleum products was observed within the Halawa Correctional Facility site and no surficial evidence or visual signs of contamination, stained soils, stressed vegetation, unusual mounds, or other indication of the use, handling, storage, or disposal of hazardous materials was identified during previous field surveys of the property.

Predominant land uses surrounding the Halawa Correctional Facility site at the time consisted of a large quarry along with a mix of warehouses, commercial and light industrial uses. These adjoining land uses did not appear to pose a potential environmental risk to development of the proposed Halawa Correctional Facility site. No evidence of leaking aboveground or underground storage tanks was observed at the time within the Halawa Correctional Facility site. With many years of state government control over occupation, development and use of the Halawa Correctional Facility site, the potential for contamination from hazardous materials was considered low.

The search of available environmental records was performed by EDR. The database search conducted at that time reviewed and evaluated local and federal databases including the NPL, CERCLIS List, CERCLIS-NFRAP List, RCRA Treatment, Storage, and Disposal Facility List, RCRA Generators List, RCRA Corrective Action Report List, Emergency Response Notification System List, and various local databases.

The Halawa Correctional Facility property was listed as having USTs and LUSTs. Two 2,000-gallon gasoline USTs and one 550-gallon UST were permanently closed in 1994. In 1999, three 2,550-gallon gasoline USTs and a 4,000-gallon diesel UST were closed. Site remediation associated with the removal of all of these tanks was deemed completed in 2000.

The RCRA database identified the Halawa Correctional Facility as a small quantity generator of hazardous waste (between 100 and 1,000 kilograms of hazardous waste per month). In addition, the site was listed as in the ERNS database as having an accidental release of diesel fuel in 1996 when a pin-sized hole developed in a boiler day tank allowing the discharge of fuel into the Halawa Stream via a storm drain. Environmental contractors repaired the tank, as well as cleaned the storm drain and the stream. In 2002, the site was also identified as having a release of paint chips associated with power washing furniture prior to refinishing. The wash water was allowed to discharge into the storm drain system. Although the site was listed as receiving a "No Further Action" determination, no file closure date was associated with the report.

The environmental database identified no other USTs within 0.25 mile of the Halawa Correctional Facility property and one LUST within 0.5 mile. The LUST site appears to be down-gradient and have been designated as requiring no further action. Engineering and/or institutional controls have been implemented at one location within 0.5 mile of the Halawa Correctional Facility property; however, the site appears to be down-gradient of the property.

Review of the SHWS records revealed five sites located within one mile of the Halawa Correctional Facility property. The closest of these sites is found approximately 0.4 mile down-gradient of the Halawa Correctional Facility property. One site, in addition to the Halawa Correctional Facility property, was identified as a RCRA small quantity generator, and one site was identified as a RCRA conditionally exempt small quantity generator. Neither of these sites is located up-gradient of the Halawa Correctional Facility site.

No indications of widespread contamination or obvious indication of the use or disposal of hazardous substances involving the Halawa Correctional Facility site were noted during field visits of the Halawa Correctional Facility conducted in 2008 and no RECs were identified. The potential for widespread contamination was considered low and did not appear to be a significant constraint to development of the site at that time.

U.S. Navy Actions

The U.S. Navy currently operates installations in the vicinity of the Halawa Correctional Facility property. Recently, U.S. Navy officials requested permission of PSD to install a single groundwater monitoring well along the perimeter of the Halawa Correctional Facility property. Installation of the monitoring well, expected to occur soon, is intended to determine whether any liquids have been inadvertently released into the environment from a U.S. Navy facility and if so the volume and direction of such a release. The agreement to install the monitoring well within the Halawa Correctional Facility property includes a provision requiring the U.S. Navy to share the results of its monitoring activities. At this time there is no evidence of any pollution underlying any portion of the Halawa Correctional Facility property.

Current Site Conditions

The Halawa Correctional Facility property remains largely developed with inmate housing, administrative and support structures, maintenance and storage buildings, the Special Needs Facility, a vehicle sallyport, and parking areas among similar uses. The few undeveloped areas within the overall site in 2017 consist of a large outdoor recreation field (the proposed OCCC development site) and narrow grass lawns located along the periphery of the facility. Field inspections of the overall property were conducted during 2017 at which time the following was revealed:

- No evidence of the manufacturing, storage, handling or disposal of hazardous substances or petroleum products was observed within the Halawa Correctional Facility site.
- No surficial evidence or visual signs of contamination, stained soils, stressed vegetation, unusual mounds, or other indication of the use, handling, storage, or disposal of hazardous materials was identified.
- No adjoining land uses were identified that would be expected to pose a potential environmental risk to the future development of the Halawa Correctional Facility site.
- No evidence of leaking aboveground or underground storage tanks was observed within the area comprising the Halawa Correctional Facility site.
- Materials considered hazardous in use at the Halawa Correctional Facility include janitorial supplies, laundry detergents and sanitizers, maintenance materials, and paint. All of these items are properly managed and stored in labeled and locked cabinets or in locked cages.
- With many years of state government control over occupation, development and use of the Halawa Correctional Facility site, the potential for contamination from hazardous materials is considered low.

No indications of contamination or obvious indication of the use or disposal of hazardous substances involving this site was noted during recent field studies.

3.1.4 Mililani Technology Park, Lot 17 Site

The entire 40-acre Mililani Technology Park site is currently undeveloped with approximately 19 acres of the 40-acre site formerly used for agricultural cultivation. The remainder represents steeply sloping terrain. All but the edges of the developable terrace is covered with extremely dense vegetation comprising tall grasses (5 to 7 feet high), small shrubs, and young and mature trees. Field inspections of the overall property were conducted during 2017 at which time the following was revealed:

- No evidence of the manufacturing, storage, handling or disposal of hazardous substances or petroleum products was observed within the Mililani Technology Park site.
- Around the perimeter of the terrace landform, occasional modern refuse was observed and included heavily corroded iron machine and appliance parts and small areas of building materials, including concrete blocks and carpeting.
- Around the northeast edge of the property, near the recently constructed neighboring warehouse, there were fragments of concrete and black plastic sheeting. The plastic sheeting is a remnant of the pineapple fields, where it was often used to control weed growth.

- No surficial evidence or visual signs of contamination, stained soils, stressed vegetation, unusual mounds, or other indication of the use, handling, storage, or disposal of hazardous materials was identified.
- No adjoining land uses were identified that would be expected to pose a potential environmental risk to the future development of the Mililani Technology Park site.
- No evidence of leaking aboveground or underground storage tanks was observed within the area comprising the Mililani Technology Park site.

With many years of private ownership and control over property access and the development and use of adjoining properties, the potential for contamination from hazardous materials is considered low. No indications of contamination or obvious indication of the use or disposal of hazardous substances involving this site was noted during recent field studies.

3.1.5 Women's Community Correctional Center

A relatively small portion of the overall WCCC property has been developed with inmate housing, administrative, program and support structures, maintenance and storage buildings, outdoor recreation areas, and vehicle parking areas among similar uses. The undeveloped areas within the overall site in 2017 consist of large formal and informal outdoor recreation fields, grass lawns located between buildings and areas of steeply sloping terrain. Portions of the site not developed with WCCC facilities are currently covered with tall grasses, small shrubs, and young/mature trees. Field inspections of the overall property were conducted during 2017 at which time the following was revealed:

- No evidence of the manufacturing, storage, handling or disposal of hazardous substances or petroleum products was observed within the WCCC property.
- No surficial evidence or visual signs of contamination, stained soils, stressed vegetation, unusual mounds, or other indication of the use, handling, storage, or disposal of hazardous materials was identified.
- No adjoining land uses were identified that would be expected to pose a potential environmental risk to the future development of the WCCC property.
- No evidence of leaking aboveground or underground storage tanks was observed within the area comprising the WCCC property.
- Materials considered hazardous in use at the WCCC include janitorial supplies, laundry detergents and sanitizers, maintenance materials, and paint. All of these items are properly managed and stored in labeled and locked cabinets or in locked cages.
- With many years of state government control over occupation, development and use of the WCCC property, the potential for contamination from hazardous materials is considered low.

No indications of contamination or obvious indication of the use or disposal of hazardous substances involving WCCC was noted during recent field studies.

3.2 Potential Impacts and Mitigation

3.2.1 Construction Phase

Activities associated with the construction of the proposed OCCC facility and WCCC improvements would require the use and storage of potentially hazardous materials (e.g., solvents, fuel oil, lubricants, etc.). To avoid potential releases of such materials into the environment during construction activities, temporary staging areas would be designated at each selected facility construction site for the storage and handling of such materials. Stored materials would be removed from such areas by authorized personnel only, and removals would be recorded by on-site personnel overseeing the construction of the facilities. Any liquid waste storage areas would have secondary containment systems in place to reduce the risk of potential spillage. The storage of hazardous materials on-site during the construction phases would be minimized or avoided where practicable (e.g., fuels for construction and other equipment would be transported to the site by fuel trucks as needed).

Wastes considered hazardous that are generated during construction of the OCCC and WCCC improvements (i.e., waste fuel oils, spent lubricants and solvents, etc.) would be handled, stored and disposed of in accordance with applicable federal and state regulations. The amount of waste generated during OCCC and WCCC facility construction should have no significant impact on the ability or availability of waste handlers to collect and properly dispose of such wastes. No mitigation measures, other than those described above, would be warranted during the OCCC and WCCC facility construction phases.

3.2.2 Operating Phase

Materials that are currently in use at the existing OCCC and WCCC facilities include janitorial supplies, laundry detergents and sanitizers, maintenance materials, paints, and similar materials. Operation of the proposed facilities, regardless of location, would result in the continued routine use of small quantities of chemical cleaners, paints, petroleum products, thereby resulting in the generation of small amounts of regulated wastes.

All hazardous materials, biohazardous and medical waste (from operation of the medical units) would continue to be handled in accordance with applicable regulatory requirements. PSD would continue its current practice of proper management, use, storage, and disposal of hazardous materials. In addition, the volume of hazardous wastes generated during OCCC and WCCC facility operations should have no significant impact on the ability or availability of waste handlers to collect and properly dispose of such wastes. As a result, the proposed action is not expected to result in the release of contaminants into the environment and, therefore no significant adverse impacts are anticipated. No mitigation measures, other than those described above, would be warranted during the facility's operating phase.

3.2.3 Existing OCCC Site

The existing OCCC site has largely been developed with inmate housing, administrative, program and support structures, maintenance and storage buildings, a vehicle sallyport, and parking areas among similar uses. The few undeveloped areas within the overall site consist of a large outdoor recreation field, areas of pavement, and small grass lawns located between buildings.

As noted earlier, no indications of contamination or obvious indication of the use or disposal of hazardous substances involving this site was noted during recent field studies. In the event the existing OCCC site is selected for development, further investigation, including a Phase I ESA conducted in accordance with ASTM requirements, should be performed to confirm the initial findings.

3.2.4 Animal Quarantine Station Site

The Animal Quarantine Station property has largely been developed with over 1,000 animal kennels, administrative and support structures, maintenance and storage buildings, and vehicle parking areas. The few undeveloped areas within the overall property consist of a large pasture devoted to horse and cattle grazing, grassed areas for small animal use, and vacant areas located on the periphery of the property.

Excluding the black, viscous, tar-like substance observed on a small area the parking lot surface along the western portion of the overall property, no other surficial evidence or visual signs of contamination, stained soils, stressed vegetation, unusual mounds, or other indication of the use, handling, storage, or disposal of hazardous materials was identified. In the event the Animal Quarantine Station site is selected for OCCC development:

- Further investigation, including a Phase I ESA conducted in accordance with ASTM requirements, should be performed to confirm the initial findings.
- The HDOH HEER Office should be notified about the possible development of the OCCC facility at the Animal Quarantine Station site and discussions initiated about the possible need to properly remove, treat and dispose of previously buried materials prior to development.
- Further investigation of the black, viscous, tar-like substance observed on the parking lot surface along the western portion of the overall property should be undertaken.

3.2.5 Halawa Correctional Facility Site

The Halawa Correctional Facility property has largely been developed with inmate housing, administrative and support structures, maintenance and storage buildings, the Special Needs Facility, a vehicle sallyport, and parking areas among similar uses. The few undeveloped areas within the overall site consist of a large outdoor recreation field (the proposed OCCC development site), pavement, and narrow grass lawns located along the periphery of the facility.

No indications of contamination or obvious indication of the use or disposal of hazardous substances involving this site was noted during recent field studies. In the event the Halawa Correctional Facility site is selected for OCCC development, further investigation, including a Phase I ESA conducted in accordance with ASTM requirements, should be performed to confirm the initial findings.

As noted earlier, the U.S. Navy is planning to install a single groundwater monitoring well along the perimeter of the Halawa Correctional Facility property to determine whether any liquids have been inadvertently released into the environment from a U.S. Navy facility. Although there is no evidence of any pollution underlying any portion of the Halawa Correctional Facility property, PSD should continue to work closely with the U.S. Navy to determine whether any portion of its property is affected by a release.

3.2.6 Mililani Technology Park, Lot 17 Site

The entire Mililani Technology Park site is undeveloped. Approximately 19 acres of the 40-acre site was formerly used for the cultivation of pineapples; today, the entire site is currently covered with dense, tall grasses, small shrubs, and young and mature trees.

No indications of contamination or obvious indication of the use or disposal of hazardous substances involving this site was noted during recent field studies. In the event the Mililani Technology Park site is selected for OCCC development, further investigation, including a Phase I ESA conducted in accordance with ASTM requirements, should be performed to confirm the initial findings.

3.2.7 Women's Community Correctional Center

A relatively small portion of the WCCC property has been developed with inmate housing, administrative, program and support structures, maintenance and storage buildings, and vehicle parking areas among similar uses. The undeveloped areas within the overall site in 2017 consist of large formal and informal outdoor recreation fields, grass lawns located between buildings and areas of steeply sloping terrain. Portions of the site not developed with the WCCC are currently covered with dense, tall grasses, small shrubs, and young and mature trees.

No indications of contamination or obvious indication of the use or disposal of hazardous substances involving the WCCC property was noted during recent field studies. Given plans to develop additional inmate housing and support structures at WCCC, further investigation, including a Phase I ESA conducted in accordance with ASTM requirements, should be performed to confirm the initial findings.

Appendix Q: Socioeconomic Profile

Oahu Community Correctional Center

October 27, 2017

Prepared for:

State of Hawaii
Department of Accounting and General Services
Department of Public Safety

Prepared by:

Louis Berger

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SOCIOECONOMIC PROFILE

1.0 INTRODUCTION

The Hawaii Department of Public Safety (PSD) operates the Oahu Community Correctional Center (OCCC), which acts as the local detention center for the First Circuit Court. Located at 2199 Kamehameha Highway in Honolulu, the OCCC is currently the largest jail facility in the state of Hawaii. With increasingly aged and obsolete correctional facilities, PSD is proposing to improve its corrections infrastructure through modernization of existing facilities when possible and construction of new institutions to replace others when necessary. Among its priority projects is the replacement of OCCC.

Four sites located on the island of Oahu have been identified as potential locations for the proposed OCCC facility: the Animal Quarantine Station in Halawa; the Halawa Correctional Facility in Halawa; the current site of the OCCC in Kalihi; and the Mililani Technology Park, Lot 17, in Mililani. The project also involves upgrades and expansions to the housing and supporting infrastructure at the Women's Community Correctional Center (WCCC) in Kailua to accommodate the relocation of female inmates from OCCC to that facility.

In order to gauge the potential effects of a project, the current socioeconomic characteristics of the area are first established and potential demographic and economic changes due to the project are then identified. A potentially significant adverse impact could result if a project would substantially alter the location, composition and distribution of the population or segment of the population within a given geographic area or cause the population to exceed historical growth rates.

2.0 DEMOGRAPHIC CHARACTERISTICS

In order to gauge the potential effects of a project, the current demographic characteristics of the area are first established and potential demographic changes due to the project are then identified. A potentially significant adverse impact could result if a project would substantially alter the location, composition and distribution of the population or segment of the population within a given geographic area or cause the population to exceed historical growth rates.

The Primary Study Area for the analysis of potential impacts to demographic conditions comprises the City and County of Honolulu within which the proposed OCCC facility would be located. Current demographic characteristics of the City and County are compared against the State of Hawaii as a whole. In addition, given the diverse locations of the five project locations (four potential OCCC development sites and the WCCC) on Oahu, demographic characteristics of the two census tracts comprising each of the five project locations were also gathered and analyzed and are considered the Secondary Study Areas.

2.1 Primary Study Area

2.1.1 Population Size and Growth

The total State of Hawaii population in 2015 was 1.41 million, representing an estimated average annual growth rate between 2005 and 2015 of 1.56 percent. The majority of Hawaii's population resides in Honolulu County, which accounted for about 70.5 percent of the State's total population in 2015. Over the same time period (2005-2015), the average annual growth rate for Honolulu County was 1.44 percent, with a 2015 County population estimate of 984,178. For comparative purposes, the U.S. population as a whole grew at an average annual rate of 1.15 percent during the same period (2005–2015).

2.1.2 Population Characteristics

Table 1 presents U.S. Census Bureau estimates of the demographic composition of Hawaii and Honolulu County in 2015. As shown in the table, Asians (alone, not in combination with other races) accounted for approximately 37.7 percent of the State's total population. In Honolulu County, Asians accounted for approximately 42.6 percent of the population that year. Residents classified as White (alone) accounted for 25.4 percent of the total State population and 21.7 percent of the Honolulu County population. The median age of Hawaii's population in 2015 was 38.0 years, compared to 36.9 years in Honolulu County and 37.6 years in the United States.

2.2 Secondary Study Areas

Select demographic data for each proposed project location is also provided in Table 1. The data presented are the result of combining two census tracts, to provide an overview of the area within which each project site is located.

2.2.1 Oahu Community Correctional Center Study Area

The OCCC Study Area consists of census tracts 15003005900 and 15003006000. Of the 10,341 residents of the OCCC Study Area in 2015, Asians (alone, not in combination with other races) accounted for approximately 75.6 percent of the total. Residents classified as White (alone) accounted for only 6.1 percent and Native Hawaiian and other Pacific Islander (alone) accounted for 16 percent of the total area population.

About half of the area's population, 50.7 percent, are classified as foreign born. Native residents that were born in Hawaii accounted for 37.4 percent, and residents born in a state other than Hawaii accounted for 6.4 percent of the local area population

The majority of residents comprising the OCCC Study Area range in age from 20 to 64 years old, representing 69.6 percent of the population, followed by residents ages 5 to 19 years old at 15.6 percent; those over 64 years of age comprised only 10.3 percent and those under 5 years only 4.5 percent. The local area population is comprised of approximately 54.1 percent males and 45.9 percent females; for comparative purposes, the State of Hawaii population is comprised of approximately 50.5 percent males and 49.5 percent females.

Table 1: Select Demographic Characteristics for Honolulu County, State of Hawaii, and Project Study Areas (2015)

Item	OCCC Study Area	Animal Quarantine/Halawa CF Study Area[a]	Mililani Tech Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii
Population, total	10,341	6,297	6,838	7,938	984,178	1,406,299
Population, by sex						
Male	54.1%	56.6%	51.6%	46.2%	50.6%	50.5%
Female	45.9%	43.5%	48.4%	53.8%	49.4%	49.5%
Median age[b] (years)	37.2	40.0	32.7	44.2	36.9	38
Population, by age						
Under 5 years	4.5%	5.5%	9.3%	3.6%	6.6%	6.5%
5 to 19 years	15.6%	12.6%	19.2%	17.7%	17.5%	17.7%
20 to 64 years	69.6%	64.7%	66.4%	58.0%	60.4%	60.1%
Over 64 years	10.3%	17.2%	5.1%	20.7%	15.5%	15.6%
Population, by race						
One race	88.6%	73.8%	73.9%	71.8%	77.3%	76.3%
White	6.1%	21.5%	30.3%	46.6%	21.7%	25.4%
Black or African American	1.9%	3.3%	6.9%	1.2%	2.6%	2.0%
American Indian and Alaskan Native	0.1%	0.1%	0%	0.1%	0.2%	0.2%
Asian	75.6%	67.8%	58.7%	43.0%	42.6%	37.7%
Native Hawaiian and other Pacific Islander	16.0%	6.7%	1.9%	8.2%	9.2%	9.9%
Some other race	0.2%	0.6%	2.2%	0.9%	0.9%	1.1%
Two or more races	11.4%	26.2%	35.4%	39.3%	22.7%	23.7%
Population, by place of birth						
Native born, Hawaii	37.4%	66.4%	55.3%	59.1%	53.8 %	53.4%

Item	OCCC Study Area	Animal Quarantine/Halawa CF Study Area[a]	Mililani Tech Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii
Native born, other State	6.4%	20.3%	32.2%	29.7%	25.4%	23.9%
Born: Puerto Rico, U.S. Islands, abroad to U.S. parents	5.5%	2.1%	3.0%	2.9%	3.1%	3.6%
Foreign born	50.7%	11.3%	9.6%	8.4%	17.7%	19.1%

Source: U.S. Census Bureau, 2015.

[a] Study areas for both Animal Quarantine Station and Halawa Correctional Facility sites comprise the same two census tracts.

[b] The median value reported is calculated as an average of both median values reported at the two census tracts in the study area.

2.2.2 Animal Quarantine Station/Halawa Correctional Facility Study Area

Given the proximity of these two project sites to each other, the Animal Quarantine Station and Halawa Correctional Facility Study Areas comprise the same two census tracts: 15003007502 and 15003007503. Of the 6,297 residents of this Study Area, Asians (alone, not in combination with other races) accounted for approximately 67.8 percent of the area population in 2015, followed by residents classified as White (alone), with 21.5 percent. Native residents that were born in Hawaii accounted for 66.4 percent, and residents born in a state other than Hawaii accounted for 20.3 percent of the local area population

The majority of residents comprising the Animal Quarantine Station/Halawa Correctional Facility Study Area range in age from 20 to 64 years old, representing 64.7 percent of the population, followed by residents over 64 years of age at 17.2 percent; those age 5 to 19 years old comprised 12.6 percent and those under 5 years only 5.5 percent. The local area population is comprised of approximately 56.6 percent males and 43.5 percent females.

2.2.3 Mililani Technology Park Study Area

The Mililani Technology Park Study Area consists of census tracts 15003008926 and 15003008927. Of the 6,838 residents of this Study Area, Asians (alone, not in combination with other races) accounted for approximately 58.7 percent of the area population in 2015, followed by residents classified as White (alone), with 30.3 percent. In comparison, Asians (alone) and White (alone) accounted for 37.7 percent and 25.4 percent of Hawaii's total population, respectively. Native residents that were born in Hawaii accounted for 55.3 percent, and residents born in a state other than Hawaii accounted for 32.2 percent of the local area population

The majority of residents comprising the Mililani Technology Park Study Area range in age from 20 to 64 years old, representing 66.4 percent of the population, followed by residents ages 5 to 19 years old at 19.2 percent; those under 5 years comprised 9.3 percent and those over 64 years only 5.1 percent of the total. The local area population is comprised of approximately 51.6 percent males and 48.4 percent females.

2.2.4 Women's Community Correctional Center Study Area

The WCCC Study Area consists of census tracts 15003011103 and 15003011000. Of the 7,938 residents of this Study Area, White (Alone, not in combination with other races) accounted for approximately 46.6 percent of the area population in 2015, followed by residents classified as Asian (alone), with 43.0 percent. Native residents that were born in Hawaii accounted for 59.1 percent, and residents born in a state other than Hawaii accounted for 29.7 percent of the local area population.

Slightly more than half of residents comprising the WCCC Study Area range in age from 20 to 64 years old, representing 58 percent of the population, followed by residents ages 64 years and older at 20.7 percent and ages 5 to 19 at 17.7 percent; only 3.6 percent of the population is under 5 years of age. The local area population is comprised of approximately 46.2 percent males and 53.8 percent females.

3.0 EDUCATION ATTAINMENT

3.1 Primary Study Area

Educational attainment among residents of Honolulu County is similar to that among all Hawaii residents. In 2015, 26.4 percent of Honolulu County residents over the age of 25 had received a high school diploma (or equivalency), those who held a Bachelor's degree comprised 21.6 percent of the county population, while those holding Graduate or professional degrees accounted for 11.1 percent of the county population (Table 2). Honolulu County residents who attained some college, but no degree accounted for 21.5 percent of the county population, while residents who attained an Associate's degree accounted for 10.3 percent.

By comparison, slightly more, 27.9 percent, of the statewide population over the age of 25 had attained a high school diploma (or equivalency). Those who held a Bachelor's degree comprised 20.4 percent, while those who held a Graduate degree or professional degree accounted for 10.5 percent. Hawaii residents who attained some college, but no degree accounted for 22 percent of the population, while residents who attained an Associate's degree accounted for 10.3 percent. College enrollment for Honolulu County and across the state was approximately 30 percent.

Honolulu County showed slightly improved English language skills than the State as a whole, with 10.1 percent of residents speaking English "less than very well," whereas the State's average was 12.5 percent. Approximately 73 percent of County residents spoke English only, while 19.2 percent spoke a language other than English. By comparison, approximately 75 percent of state residents spoke English only, while 25.2 percent spoke a language other than English.

3.2 Secondary Study Areas

Select educational attainment data for each proposed project location is also provided in Table 2. The data presented are compiled for the two census tracts comprising each secondary study area.

3.2.1 Oahu Community Correctional Center Study Area

In 2015, 36.3 percent of residents over the age of 25 in the OCCC Study Area had a high school diploma (or equivalency), notably higher than Honolulu County and the state as a whole. However, residents who held a Bachelor's degree accounted for only 6.1 percent of the study area population, while those who held Graduate or professional degrees accounted for only 1.3 percent of the population, both considerably less than Honolulu County and the state as a whole. Residents who attained some college, but no degree accounted for 19.1 percent of the county population, while residents who attained an Associate's degree accounted for 10.7 percent. Similar to the state and Honolulu County, enrollment in college for the OCCC Study Area was 32.3 percent.

Some 48 percent of residents in the OCCC Study Area reportedly speak English "less than very well," higher than the State and Honolulu County (12.5 and 14.5 percent, respectively). Residents who spoke only English accounted for 40.3 percent, considerably lower than the state and county levels of English-only speakers, while 58.6 percent of residents of the study area spoke a language other than English, which was markedly higher than state and county levels.

3.2.2 Animal Quarantine Station/Halawa Correctional Facility Study Area

In 2015, 29.3 percent of residents in the study area over the age of 25 were high school (or equivalency) graduates, slightly higher than Honolulu County and the state as a whole. Residents who held a Bachelor's degree comprised 27.2 percent of the study area population, while those who held Graduate or professional degrees accounted for 7.9 percent of the population. Residents who attained some college, but no degree accounted for 22.7 percent of the county population, while residents who attained an Associate's degree accounted for 9.2 percent. Enrollment in college for this study area was over 36 percent, higher than all other study areas.

Approximately 8 percent of residents in the Animal Quarantine Station/Halawa Correctional Facility Study Area reported to speak English "less than very well," a much lower percentage than that of the state and county. Residents who spoke only English accounted for the majority of the study area's population at 80.6 percent, higher than the state and county. Those who spoke a language other than English accounted for 19.4 percent.

3.2.3 Mililani Technology Park Study Area

In 2015, 8.0 percent of residents of the Mililani Technology Park Study Area over the age of 25 had attained only a high school diploma (or equivalent), a markedly lower percentage than any study area as well as Honolulu County and the state. Residents who held a Bachelor's degree totaled 35.4 percent of the study area population, while those who held Graduate or professional degrees accounted for 16.9 percent of the population; both considerably higher than the county population or the state as a whole. Residents who attained some college, but no degree accounted for 22.1 percent of the county population, while residents who attained an Associate's degree accounted for 15.3 percent. Enrollment in college for this study area was 19.8 percent, lower than all other study areas.

Just under 4 percent of residents in the Mililani Technology Park Study Area reported to speak English "less than very well", which is lower than any other study area. Residents who spoke only English accounted for the majority of the study area's population at 85.6 percent, higher than that of the state and county while those who spoke a language other than English accounted for 14.4 percent.

3.2.4 Women's Community Correctional Center Study Area

In 2015, 18.5 percent of residents in the WCCC Study Area over the age of 25 had attained only high school (or equivalent) levels of education, lower than that of Honolulu County and the state. Residents who held a Bachelor's degree were reported to be 28.4 percent of the study area population, while those who held Graduate or professional degrees accounted for 19.9 percent of the population. Residents who attained some college, but no degree accounted for 21.5 percent of the county population, while residents who attained an Associate's degree accounted for 8.1 percent. The rate of college enrollment in this study area was 35.6 percent.

Residents in the Women's Community Correctional Center Study Area who spoke English "less than very well" accounted for 4.6 percent of the study area's population, which is lower than the State and Honolulu County. Residents who spoke only English accounted for the majority of the study area's population at 89.6 percent while those that spoke a language other than English accounted for 10.5 percent.

Table 2: Educational Attainment for Honolulu County, State of Hawaii, and Project Study Areas (2015)

Item	OCCC Study Area	Animal Quarantine/Halawa CF Study Area*	Mililani Tech Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii
Total population, age 25 and older	7,478	3,781	3,194	2,790	667,370	962,052
Educational attainment, 25 years and older						
Less than 9th grade	10.3%	1.9%	1.8%	1.0%	4.4%	4.1%
Grades 9 to 12, no diploma	16.2%	1.9%	0.6%	2.6%	4.8%%	4.9%
High school graduate (includes equivalency)	36.3%	29.3%	8.0%	18.5%	26.4%	27.9%
Some college, no degree	19.1%	22.7%	22.1%	21.5%	21.5%	22.0%
Associate's degree	10.7%	9.2%	15.3%	8.1%	10.3%	10.3%
Bachelor's degree	6.1%	27.2%	35.4%	28.4%	21.6%	20.4%
Graduate or professional degree	1.3%	7.9%	16.9%	19.9%	11.1%	10.5%
Enrolled in school						
Nursery school, preschools	2.2%	8.0%	9.2%	3.7%	5.9%	6.2%
Kindergarten	5.2%	7.6%	5.5%	1.1%	4.9%	5.1%
Elementary school (grades 1-8)	34.8%	29.6%	31.4%	33.5%	37.5%	38.9%
High School (grades 9-12)	25.5%	15.2%	27.8%	18.0%	18.7%	19.6%
College or graduate school	32.3%	36.4%	19.8%	35.6%	33.1%	30.1%
Population 5 years and over	9,874	5,951	6,201	7,654	919,700	1,315,242
English language skills, age 5 and over						
English only	40.3%	80.6%	85.6%	89.5%	72.6%	74.8%
Language other than English	58.5%	19.4%	14.4%	10.5%	27.4%	25.2%
Speak English less than "very well"	47.6%	7.9%	3.8%	4.6%	14.5%	12.5%

Source: U.S. Census Bureau, 2015

[a] Study areas for both Animal Quarantine Station and Halawa Correctional Facility sites comprise the same two census tracts.

4.0 INCOME

4.1 Primary Study Area

Household income for both the State of Hawaii and Honolulu County are considerably higher than the national average. Median household income in 2015 was $69,515 for Hawaii and $74,460 for Honolulu County compared to only $53,889 for the U.S. as a whole. In 2015, Hawaii ranked 11th and Honolulu 109th among the 50 states and 3,142 counties in terms of median household income (Table 3). Per capita income for Honolulu County and the State of Hawaii were $31,041 and $29,822, respectively; also higher than the U.S. as a whole. Poverty rates in 2015 were also lower than the national average, with Hawaii and Honolulu County experiencing rates of 11.2 percent and 9.7 percent, respectively, compared to the national poverty rate of 15.5 percent.

4.2 Secondary Study Areas

Select income and poverty indicator data for each proposed project location is also provided in Table 3. Information is presented below for each study area.

4.2.1 Oahu Community Correctional Center Study Area

In the OCCC Study Area median household income was $70,401, somewhat lower than that of Honolulu County and roughly equivalent to the State of Hawaii. The poverty rate of 8.7 percent was well below the national average of 15.5 percent and also less than poverty rates of both Honolulu County and the State of Hawaii. Per capita income for the OCCC Study Area was $18,119, which is lower compared to the nationwide per capita income of $28,930. The OCCC Study Area was also below the state and county per capita income levels.

4.2.2 Animal Quarantine Station/Halawa Correctional Facility Study Area

In the Animal Quarantine Station and Halawa Correctional Facility Study Area, median household income was $96,791, somewhat higher than that of Honolulu County and the State of Hawaii. The poverty rate of 7.4 percent was well below the national average of 15.5 percent and also less than poverty rates of both Honolulu County and the State of Hawaii. Per capita income for the Animal Quarantine Station and Halawa Correctional Facility Study Area was $31,816, which is slightly higher than the nationwide per capita income of $28,930 as well as both state and county per capita income levels.

4.2.3 Mililani Technology Park Study Area

In the Mililani Technology Park Study Area, median household income was $96,349, somewhat higher than that of Honolulu County and the State of Hawaii. The poverty rate of 2.9 percent was well below the national average of 15.5 percent and also significantly less than poverty rates of both Honolulu County and the State of Hawaii. Per capita income for the Mililani Technology Park Study Area was $38,134, which is notably higher than the nationwide per capita income of $28,930 as well as both state and county per capita income levels.

4.2.4 Women's Community Correctional Center Study Area

In the Women's Community Correctional Center Study Area median household income was $123,940, which is almost twice that of Honolulu County and the State of Hawaii. The poverty rate of 2.3 percent was well below the national average of 15.5 percent and also significantly less than poverty rates of both Honolulu County and the State of Hawaii. Per capita income for the Women's Community Correctional Center Study Area was $41,133, which is well above the nationwide per capita income of $28,930 and also markedly higher than both state and county per capita income levels.

Table 3: Income and Poverty Indicators for Honolulu County, State of Hawaii, and Project Study Areas (2015)

Indicator	OCCC Study Area	Animal Quarantine/Halawa CF Study Area[a]	Mililani Technology Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii	U.S.
Median household income	$70,401	$96,791	$96,349	$123,940	$74,460	$69,515	$53,889
Mean household income	$86,450	$107,791	$106,301	$139,299	$92,649	$87,329	$75,558
Per-capita income	$18,119	$31,816	$38,134	$41,133	$31,041	$29,822	$28,930
2015 median household income rank (out of 3,142 counties and 50 states)	N/A	N/A	N/A	N/A	109	11	N/A
Percentage of people whose income in the past 12 months is below the poverty level	8.69%	7.41%	2.86%	2.28%	9.7%	11.2%	15.5%

Sources: U.S. Census Bureau, 2015; STATS Indiana, 2015; STATS America, 2015.

Note: where multiple census tracts comprise the study area, weighted averages of mean and median income and poverty percentages are reported.

[a] Study areas for both Animal Quarantine Station and Halawa Correctional Facility sites comprise the same two census tracts.

5.0 LABOR FORCE AND EMPLOYMENT

5.1 Primary Study Area

The Hawaiian economy as well as the regional economy of Honolulu County is heavily dependent on the "Arts, entertainment, recreation, accommodation, and food service" and "Educational services, and health care and social assistance" sectors as sources of employment. As shown in Table 4, employment in the private sector accounted for the majority (72.2 percent) of civilian employment in the State of Hawaii with an additional 20.6 percent in government and 6.9 percent self-employed. Approximately 21 percent of the civilian workforce in Hawaii in 2015 was employed in the "Educational services, and health care and social assistance" sector, while roughly 16 percent were in the "Arts, entertainment, recreation, accommodation, and food service" sector and 12 percent were in "Retail trade". The state's unemployment rate in 2015 averaged 6.1 percent.

In Honolulu County, the employment profile was similar to that of the state of Hawaii, with private sector employment accounting for 72 percent of all civilian employment and 22.1 percent in government and 5.7 percent self-employed. Employment by industry at the county level also mirrored that of the state, with employment in the "Educational services, and health care and social assistance"; "Arts, entertainment, recreation, accommodation, and food service"; and "Retail trade" sectors comprising 22 percent, 14 percent and 12 percent, respectively. The county's unemployment rate in 2015 averaged 5.6 percent.

As shown in Table 5, the number of civilian jobs in Hawaii increased 1.2 percent or 7,713 jobs in 2015 compared to the previous year. The largest job gains were experienced in the "Professional, scientific, and mgmt., admin., and waste mgmt. services" and "Arts, entertainment, recreation, accommodation, and food service" industries, which accounted for gains of 1,861 jobs and 1,848 jobs respectively, while job losses occurred in the "Educational services, and health care and social assistance" and "Agriculture, forestry, fishing and hunting, mining" sectors over the 12-month period. Honolulu County experienced net employment gains of 3,157civilian jobs (0.7 percent) between 2014 and 2015. The largest employment gains in Honolulu County were reported in "Construction" and "Arts, entertainment, recreation, accommodation, and food service" industries. Honolulu County reported the largest net job losses (1,092) in the "Educational services, and health care and social assistance" sector.

5.2 Secondary Study Areas

Select labor force and employment data for each proposed project location is also provided in Table 4. Data are presented for the two census tracts comprising the study areas in order to provide more detail for the areas within which each project site is located.

5.2.1 Oahu Community Correctional Center Study Area

Within the OCCC Study Area, private sector employment accounted for over 90 percent of civilian employment with only 8.9 percent in government and 0.6 percent self-employed. Among all sectors, the largest proportion of the civilian workforce in the study area in 2015 (27.8 percent) was employed in the "Arts, entertainment, recreation, accommodation, and food service" sector. An additional 15 percent were employed in the "Retail trade" sector, and 14 percent were employed in "Educational services, and health care and social assistance". The study area's unemployment rate in 2015 averaged only 3.7 percent.

As shown in Table 5, the number of civilian jobs in the study area increased 3.6 percent or 179 jobs in 2015 compared to the previous year. The largest job gains were experienced in the "Retail trade" and "Professional, scientific, and mgmt., admin., and waste mgmt. services" industries, which accounted for gains of 158 jobs and 122 jobs respectively, while notable job losses occurred in the "Wholesale trade" and "Arts, entertainment, recreation, accommodation, and food service" sectors over the 12-month period.

5.2.2 Animal Quarantine Station/Halawa Correctional Facility Study Area

Private sector employment within the Animal Quarantine Station/Halawa Correctional Facility Study Area accounted for 58.3 percent of civilian employment with 36.8 percent in government and 4.5 percent self-employed. Among all sectors, the largest proportion of the civilian workforce in the study area in 2015 (20.4 percent) was employed in "Public administration". Another 20.3 percent was employed in the "Educational services, and health care and social assistance" sector, and 11.3 percent was in the "Arts, entertainment, recreation, accommodation, and food service" sector. The study area's unemployment rate in 2015 was the highest among all study areas, the county and the state, averaging 6.8 percent.

As shown in Table 5, the number of civilian jobs in the study area increased by 7.8 percent or 181 jobs in 2015 compared to the previous year. The largest job gains were experienced in the "Public administration" and "Arts, entertainment, recreation, accommodation, and food service" sectors, which accounted for gains of 113 jobs and 67 jobs respectively, while the largest job losses over the 12-month period occurred in the "Construction" and "Professional, scientific, and mgmt., admin., and waste mgmt. services" sectors.

5.2.3 Mililani Technology Park Study Area

With the Mililani Technology Park Study Area, private sector employment accounted for nearly 60 percent of civilian employment with 34 percent in government and 6.1 percent self-employed. Among all sectors, the largest proportion of the civilian workforce in the study area in 2015 (21.6 percent) was employed in the "Educational services, and health care and social assistance" sector. Another 18.6 percent was employed in "Public administration", and 12.9 percent was employed in "Retail trade". The study area's unemployment rate in 2015 was the lowest among all study areas, the county and the state, averaging only 3.3 percent.

As shown in Table 5, the number of civilian jobs in the study area increased 2 percent or by 68 jobs in 2015 compared to the previous year. The largest job gains were experienced in the "Finance and insurance, real estate, rental and leasing" and "Retail trade" industries, which accounted for gains of 129 jobs and 103 jobs respectively, while notable job losses occurred in the "Public administration" and "Wholesale trade" sectors over the 12-month period.

5.2.4 Women's Community Correctional Center Study Area

Private sector employment within the WCCC Study Area accounted for 71 percent of civilian employment with 22.4 percent in government and 6.6 percent self-employed. Among all sectors, the largest proportion of the civilian workforce in the study area in 2015 (27.5 percent) was employed in the "Educational services, and health care and social assistance" sector. Just over 14 percent were employed in "Professional, scientific, and mgmt., admin., and waste mgmt. services" and another 21.5 percent equally divided between the "Public Administration" and "Finance and insurance, real estate, rental and leasing" sectors. The study area's unemployment rate in 2015 averaged only 3.9 percent.

As shown in Table 5, the number of civilian jobs in the study area decreased by 2.1 percent with a loss of 74 jobs in 2015 compared to the previous year. The largest job losses over the 12-month period occurred in the "Educational services, and health care and social assistance" and "Transportation and warehousing, and utilities" sectors, accounting for losses of 108 jobs and 50 jobs respectively. Major job gains in this study area were experienced in the "Information" and "Manufacturing" sectors.

Table 4: Labor Force and Employment Characteristics for Honolulu County, State of Hawaii, and Project Study Areas (2015)

Category	OCCC Study Area	Animal Quarantine/ Halawa CF Study Area	Miliani Technology Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii
Population 16 years and over	8,923	5,352	5,275	6,672	792,760	1,130,491
In labor force	5,296	3,132	4,081	3,778	523,197	736,939
Civilian labor force	5,296	2,671	3,587	3,639	482,523	695,572
Employed	5,098	2,490	3,469	3,498	455,481	653,284
Unemployed	198	181	118	141	27,042	42,288
Armed forces	0	461	495	139	40,674	41,367
Not in labor force	3,627	2,220	1,193	2,894	269,563	393,552
Percent unemployed	3.7%	6.8%	3.3%	3.9%	5.6%	6.1%
Civilian employment (total)	5,098	2,490	3,469	3,498	455,481	653,285
Civilian employment by type of employer						
Private company	90.3%	58.3%	59.9%	71.0%	72.0%	72.2%
Government	8.9%	36.8%	34.0%	22.4%	22.1%	20.6%
Self-employed	0.6%	4.5%	6.1%	6.6%	5.7%	6.9%
Unpaid family workers	0.2%	0.4%	0.0%	0.0%	0.1%	0.2%
Civilian employment by industry						
Agriculture, forestry, fishing and hunting, mining	0.1%	0.0%	0.3%	0.4%	0.7%	1.6%
Construction	5.5%	5.3%	3.3%	6.3%	6.8%	7.1%
Manufacturing	4.0%	3.9%	4.0%	4.0%	3.3%	3.0%
Wholesale trade	1.7%	3.5%	2.9%	3.0%	2.4%	2.3%
Retail trade	14.7%	10.5%	12.9%	6.4%	11.6%	11.8%

Category	OCCC Study Area	Animal Quarantine/ Halawa CF Study Area	Miliani Technology Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii
Transportation and warehousing, and utilities	3.7%	5.5%	9.0%	4.7%	6.2%	5.9%
Information	0.7%	0.9%	0.2%	3.8%	1.7%	1.6%
Finance and insurance, real estate, rental & leasing	4.8%	8.2%	11.1%	10.8%	6.6%	6.4%
Professional, scientific, and mgmt., admin., and waste mgmt. services	12.7%	4.9%	9.6%	14.2%	10.0%	10.2%
Educational services, and health care and social assistance	13.8%	20.3%	21.6%	27.5%	21.5%	20.5%
Arts, entertainment, recreation, accommodation, and food service	27.8%	11.3%	4.4%	7.4%	14.4%	16.3%
Other service, except public administration	7.8%	5.3%	2.1%	0.9%	4.4%	4.5%
Public administration	2.7%	20.4%	18.6%	10.7%	10.3%	8.9%
Civilian Employment, by occupation						
Management, business, science, and arts occupations	9.5%	48.1%	44.6%	52.4%	35.8%	34.0%
Service occupations	43.7%	14.8%	8.8%	12.3%	21.2%	22.8%
Sales and office occupations	21.7%	24.0%	26.7%	22.9%	25.1%	24.8%
Natural resources, construction, and maintenance occupations	8.9%	6.5%	9.0%	5.6%	9.1%	9.7%
Production, transportation, and material moving occupations	16.1%	6.7%	11.0%	6.8%	8.8%	8.7%

Source: U.S. Census Bureau, 2015.

Table 5. Employment Characteristics for Honolulu County, State of Hawaii, and Project Study Areas (2015)

Category	OCCC Study Area	Animal Quarantine/Halawa CF Study Area*	Miliani Technology Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii
Civilian employment (all industries)						
2014	4,919	2,309	3,401	3,572	452,324	645,571
2015	5,098	2,490	3,469	3,498	455,481	653,284
12-Month Change						
Civilian employment by industry						
Agriculture, forestry, fishing and hunting, mining						
2014	17	0	10	18	3,058	10,483
2015	6	0	11	13	3,075	10,233
12-Month Change	-11	0	1	-5	17	-250
Construction						
2014	305	188	95	220	29,783	44,775
2015	279	132	113	219	31,088	46,400
12-Month Change	-26	-56	18	-1	1305	1625
Manufacturing						
2014	195	96	190	107	14,885	19,694
2015	205	96	140	139	15,165	19,767
12-Month Change	10	0	-50	32	280	73
Wholesale trade						
2014	157	73	153	88	10,862	14,470
2015	87	87	101	106	11,000	14,845
12-Month Change	-70	14	-52	18	138	375

Category	OCCC Study Area	Animal Quarantine/Halawa CF Study Area*	Miliani Technology Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii
Retail trade						
2014	589	267	343	223	53,306	76,570
2015	747	261	446	224	53,050	77,030
12-Month Change	158	-6	103	1	-256	460
Transportation and warehousing, and utilities						
2014	170	128	249	215	28,000	38,296
2015	190	137	311	165	28,143	38,624
12-Month Change	20	9	62	-50	143	328
Information						
2014	40	30	47	67	7,683	10,295
2015	35	23	8	132	7,873	10,485
12-Month Change	-5	-7	-39	65	190	190
Finance and insurance, real estate, rental and leasing						
2014	274	211	256	417	30,292	41,281
2015	244	203	385	378	30,258	41,516
12-Month Change	-30	-8	129	-39	-34	235
Professional, scientific, and mgmt., admin., and waste mgmt. services						
2014	525	145	311	477	44,780	65,096
2015	647	123	332	497	45,608	66,957
12-Month Change	122	-22	21	20	828	1861
Educational services, and health care and social						

Category	OCCC Study Area	Animal Quarantine/Halawa CF Study Area*	Miliani Technology Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii
assistance						
2014	715	471	689	1,070	98,881	134,401
2015	702	505	750	962	97,789	133,756
12-Month Change	-13	34	61	-108	-1092	-645
Arts, entertainment, recreation, accommodation, and food service						
2014	1,451	214	201	236	64,396	104,459
2015	1,417	281	153	258	65,733	106,307
12-Month Change	-34	67	-48	22	1,337	1,848
Other service, except public administration						
2014	331	90	69	45	19,833	28,686
2015	400	133	73	32	19,959	29,162
12-Month Change	69	43	4	-13	126	476
Public administration						
2014	150	396	788	389	46,565	57,065
2015	139	509	646	373	46,740	58,202
12-Month Change	-11	113	-142	-16	175	1137

Sources: U.S. Census Bureau, 2014; U.S. Census Bureau, 2015.

6.0 HOUSING CHARACTERISTICS

6.1 Primary Study Area

In 2015, 527,388 housing units and 341,239 housing units were available in Hawaii and Honolulu County, respectively. Based on estimates from the 2015 American Community Survey (ACS), housing unit vacancy rates were 14.6 percent statewide and 9.3 percent for Honolulu County. Roughly 25 percent of the vacant units in Hawaii and 23 percent in Honolulu County were available to rent, while an additional 43.7 percent and 37.3 percent, respectively, were available for seasonal, recreational, or occasional use. Of the 450,572 occupied housing units in Hawaii and 309,602 units in Honolulu County, 56.9 percent and 54.4 percent, respectively, were owner-occupied, while the remaining units were renter-occupied.

The average household size in Hawaii in 2015 was 3.2 people among home-owners and roughly 2.8 among renters. In Honolulu County for the same year, the average household comprised 3.3 people among home-owners and roughly 2.8 among renters. The median 2015 owner-occupied home value was $515,300 in Hawaii and $580,200 in Honolulu County, while median monthly rental prices were $1,438 and $1,569, respectively (Table 6).

6.2 Secondary Study Areas

Select housing data for each proposed project location is also provided in Table 6. The data presented are the result of combining two census tracts, to provide an overview of the area within which each project site is located.

6.2.1 Oahu Community Correctional Center Study Area

Within the OCCC Study Area, there were 1,938 housing units in 2015. The housing unit vacancy rate in the study area was 6.5 percent, with roughly 74 percent of vacant units available to rent. Of the 1,814 occupied housing units in the study area, 24.8 percent were owner-occupied and 75.2 percent were renter-occupied.

The average household size in this study area in 2015 was approximately 4 people among both home-owners and renters. The median 2015 owner-occupied home value was $483,823 while median monthly rent was $1,248.

6.2.2 Animal Quarantine Station/Halawa Correctional Facility Study Area

Within the Animal Quarantine Station and Halawa Correctional Facility Study Area there were 1,778 housing units in 2015. The housing unit vacancy rate in the study area was 8.5 percent, with the largest proportion of vacant units falling into the "for rent" and "other vacant" categories, which excludes those properties available for sale, rent or seasonal use. A smaller proportion of vacant units in this study area were available for sale only. Of the 1,664 occupied housing units in the study area, 64 percent were owner-occupied and 36 percent were renter-occupied.

The average household size in this study area in 2015 was approximately 3s people among both home-owners and renters. The median 2015 owner-occupied home value was $638,900 while median monthly rent was $1,989.

6.2.3 Mililani Technology Park Study Area

Within the Mililani Technology Park Study Area, there were 2,434 housing units in 2015. The housing unit vacancy rate was 2 percent, with 74 percent of vacant units available for sale only and 26 percent available for rent. Of the 2,399 occupied housing units in the study area, 73.3 percent were owner-occupied and 26.6 percent were renter-occupied.

The average household size in this study area in 2015 was approximately 3 people among both home-owners and renters. The median 2015 owner-occupied home value was $536,954 while median monthly rent was $2,103.

6.2.4 Women's Community Correctional Center Study Area

Within the WCCC Study Area there were 2,353 housing units in 2015. The housing unit vacancy rate was 4.9 percent with the majority of vacant units falling into the "Other vacant", "For seasonal, recreational, or occasional use" and "For sale only" categories. Of the 2,867 occupied housing units in the study area, 83.4 percent were owner-occupied and 18.6 percent were renter-occupied.

The average household size in this study area in 2015 was approximately 3 people among both home-owners and renters. The median 2015 owner-occupied home value was $810,154 while median monthly rent was $3,035.

Table 6: Housing Characteristics for Honolulu County, State of Hawaii, and Project Study Areas (2015)

Item	OCCC Study Area	Animal Quarantine/ Halawa CF Study Area[a]	Mililani Technology Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii
Total housing units	1,938	1,778	2,434	2,353	341,239	527,388
Occupied units	1,814	1,664	2,399	2,867	309,602	450,572
Owner-occupied	24.8%	64.0%	73.3%	81.4%	54.4%	56.9%
Renter-occupied	75.2%	36.0%	26.6%	18.6%	45.6%	43.1%
Vacant units	124	114	35	116	31,637	76,816
For rent	74.2%	23.7%	25.7%	0.0%	23.2%	25.1%
Rented, not occupied	15.3%	0.0%	0.0%	0.0%	4.2%	3.0%
For sale only	10.5%	20.1%	74.3%	24.2%	6.0%	4.9%
Sold, not occupied	0.0%	0.0%	0.0%	0.0%	2.4%	2.9%
For seasonal, recreational, or occasional use	0.0%	0.0%	0.0%	32.9%	37.3%	43.7%
For migrant workers	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Other vacant	0.0%	56.2%	0.0%	42.9%	26.9%	20.3%
Vacancy rate						
Percent Vacant	6.5%	8.5%	2.0%	4.9%	9.3%	14.6%
Household size						
Average household size-owner-occupied unit	4.3	3.3	2.9	3.2	3.3	3.2
Average household size-rental unit	4.5	3.3	2.6	3.2	2.8	2.8
Housing values						

Item	OCCC Study Area	Animal Quarantine/ Halawa CF Study Area[a]	Mililani Technology Park Study Area	WCCC Study Area	Honolulu County	State of Hawaii
Median value, owner-occupied units	$483,823	$638,900	$536,954	$810,154	$580,200	$515,300
Median gross rent (monthly)	$1,248	$1,989	$2,103	$3,035	$1,569	$1,438

Source: U.S. Census Bureau, 2015.

Note: where multiple census tracts comprise the study area, weighted averages of mean and median income and poverty percentages are reported.

[a] Study areas for both Animal Quarantine Station and Halawa Correctional Facility sites comprise the same two census tracts.

[b] Either no sample observations or too few sample observations were available to compute a standard error and thus the margin of error. A statistical test is not appropriate.

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Appendix R: Economic Impact Assessment

Oahu Community Correctional Center

October 27, 2017

Prepared for:

State of Hawaii
Department of Accounting and General Services
Department of Public Safety

Prepared by:

CBRE

Louis Berger

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List of Acronyms and Abbreviations

ACS	American Community Survey
CCC	Community Correctional Center
County	City and County of Honolulu
DAGS	Hawaii Department of Accounting and General Services
DBEDT	Hawaii Department of Business, Economic Development, and Tourism
FDC	Federal Detention Center
GET	General Excise Taxes
GSP	Gross State Product
LWFC	Laumaka Work Furlough Center
OCCC	Oahu Community Correctional Center
PSD	Hawaii Department of Public Safety
State	State of Hawaii
TAT	Transient Accommodation Tax
UHERO	Economic Research Organization, University of Hawaii
USDA	U.S. Department of Agriculture
WCCC	Women's Community Correctional Center

1. EXECUTIVE SUMMARY

The redevelopment of the Oahu Community Correctional Center (OCCC) either on its present site on Kamehameha Highway in Kalihi or relocated elsewhere on the island and the expansion of the Women's Community Correctional Center (WCCC) on Kalanianaole Highway in Kailua will generate meaningful impacts within the Oahu and statewide economy through their development and long-term operation.

The primary benefits will arise from their construction, with the relocated OCCC facility preliminarily estimated to cost from $536.5 million to $614.3 million (before financing) depending upon the final design and which of the four sites under-consideration is selected and the forecast $45 million cost of expansion of the WCCC. Application of the DBEDT State of Hawaii Input/Output economic model indicates development will create thousands of Full Time Equivalent (FTE) worker-years of direct, indirect and induced employment, more than a billion dollars of economic output, nearly a half-billion dollars in income and millions of dollars in state tax revenues.

The operations of the new and expanded facilities will also have an economic impact although it is generally nominal as for OCCC it will merely be relocating the existing operations from one site to another without creating significant new economic activity or employment. The WCCC expansion is intended to provide for the female OCCC inmates who will require relocation to WCCC which will similarly not generate new economic activity or employment.

Table A summarizes the focal indicators and outcomes generated through application of the State Input/ Output model to the OCCC and WCCC project parameters.

Virtually all the direct economic activity, employment and income associated with the construction and operation of the facilities will remain in the Oahu community, with only nominal amounts flowing to the neighbor islands. Some indirect and induced aspects, though minimal, will benefit the neighbor islands. On a cumulative basis, it is estimated that 98.3 percent of all economic impacts will occur on Oahu with 1.7 percent on the neighbor islands.

In addition to the DBEDT, "The 2012 Hawaii Inter-County Input-Output Study" (primarily) and "The Hawaii State Input-Output Study: 2012 Benchmark Report", approved August 2016 (and tenth in a series stretching back to 1967), the analysis also used other DBEDT data and forecasts as source materials along with information derived from the U.S. Census, University of Hawaii Economic Research Organization (UHERO), STATS, Cumming (cost estimators), Criminal Justice Planning Services (operating expenses and staffing of new facility), Louis Berger U.S., Inc., other OCCC relocation team members, and as based on experience with similar scale projects and company files.

The following report is intended to summarize the identification and quantification of the primary and secondary economic indicators and outcomes associated with the relocation of OCCC and expansion of WCCC and display the model calculations and results. The focus is on tabular presentation with brief supporting narrative. Sources for each aspect are as cited on the tables and/or in the appendices.

TABLE A

SUMMARY OF PRIMARY ECONOMIC IMPACTS GENERATED BY THE REDEVELOPMENT/RELOCATION OF OCCC AND EXPANSION OF WCCC

Study Item	Direct	Indirect & Induced	Total
Construction Phase (in Constant 2017 Dollars)			
Construction Cost			
Relocation of OCCC (1, 2)			$576,710,107
Expansion of WCCC (2)			$45,000,000
Total			**$621,710,107**
Economic Activity	$621,710,107	$646,726,174	$1,268,436,280
Worker-Years Employment Created	3,071	3,637	6,709
Income Generated	$215,661,354	$184,510,540	$400,171,894
State Tax Revenue Produced	$39,646,725	$40,550,770	$80,197,495
Operating Phase (Stabilized Annual Figures in Constant 2017 Dollars) (3)			
Operating Cost			$61,582,949
Economic Activity	$61,582,949	$64,970,011	$126,552,960
Worker-Years Employment Created	458	247	705
Income Generated	$53,885,080	$30,983,921	$84,869,002
State Tax Revenue Produced	$5,488,272	$953,304	$6,441,576

(1) Average of estimated "all-in" costs of the four scenarios currently under consideration.
(2) Before financing/construction loan interest costs.
(3) Relocated OCCC-only.

Source: CBRE/Hallstrom Team 2017 Study.

2. INTRODUCTION

2.1 Background

The Hawaii Department of Public Safety (PSD) operates the Oahu Community Correctional Center (OCCC), which acts as the local detention center for the First Circuit Court. OCCC is located on an approximately 16.46-acre property at 2199 Kamehameha Highway in Kalihi, is the largest jail facility in the State of Hawaii, and services all of Oahu the county with the largest resident and visitor population.

Since its opening in 1975 as part of a community corrections system with 456 beds, OCCC has been expanded to its current design capacity of 628 beds and operational capacity of 954 beds. It has consistently operated above these capacities. PSD also operates the nearby Laumaka Work Furlough Center (LWFC) where assigned inmates are working in the community or actively seeking employment.

Given the increasing age and obsolescence of the existing correctional facilities, PSD is seeking to improve the statewide corrections infrastructure through modernization of existing facilities when possible or construction of new institutions where necessary. The replacement of OCCC is among its top priorities with a new facility which will maximize the use of cost-saving technologies while improving correctional services and safety for inmates, staff and the public.

Additionally, should OCCC be relocated to a less valuable site outside the urban core (as is being considered), the State will benefit from the rapidly appreciating value of the Kalihi property which is located within a Transit-Oriented District having high market demand and evolving, denser highest and best use development opportunities.

2.2 OCCC Facility and History

OCCC provides the customary county jail functions; primarily managing pre-trial detainees and short-term locally sentenced inmates (misdemeanor offenders and others with a sentence of one year or less). OCCC also provides pre-release preparation/transition functions for system-wide prison inmates having less than a year until their scheduled release.

Inmates housed at OCCC are under the jurisdiction of the Judiciary system (courts) and not PSD. Members of the OCCC population can only be released, placed in outside programs or assigned to other alternatives to incarceration via judicial action.

The three groups of OCCC inmates have varying housing and programming needs:

1. Pre-trial inmates have been charged with a crime(s) and are progressing through the pre-trial judicial process.
2. The detention population are those who have been found guilty of a crime(s) and have received a sentence of up to one year.
3. Pre-release inmates are nearing the end of lengthier sentences and are transitioning from direct prison detention back into the community.

There has been a series of correctional facilities occupying the OCCC property since the early 1900s. A territorial prison on the site surrounded largely by vacant and agricultural lands is depicted in photographs taken as early as 1939. The facility initially came under state control in 1975, when it was transferred from the City and County of Honolulu in conjunction with the State assuming responsibility for all aspects of incarceration throughout the islands.

Annex 1 to the old jail was built at the time of transfer. The existing main OCCC jail building opened in 1980 and was fully occupied by 1982. From 1978 to 1987, OCCC served as both local jail and State prison. In 1987, the Halawa Correctional Facility was completed, after which OCCC assumed its current primary function as a detention facility.

2.3 Project Description

2.3.1 Proposed Oahu Community Correctional Center

The State of Hawaii proposes to develop a new community jail facility to replace OCCC at one of four identified alternative sites on Oahu; three of which would result in relocation with the fourth utilizing the existing property. The proposed facility would provide multi-custody security services (minimum, medium, maximum, close custody, special management, and furlough) for adult males who are in pretrial status or sentenced inmates.

The population of OCCC has declined in recent years, dropping from an inmate count of 1,482 persons in the 2013 fiscal year (FY) to a current assigned count of 1,383 persons (August 2017), a compounded annual decrease of 4.8 percent.

This primary component of change has been a decline in the number of male inmates from 1,330 in FY 2013 to a current assigned count of 1,228 (a decrease of 2.0 percent annually compounded). Conversely there has been an increase of the female population housed at OCCC moving upward from 152 persons in FY 2013 to an assigned count of 165 persons in August 2017 (a growth rate of 2.1 percent annually compounded).

Despite the decline in the number of inmates the current population of OCCC remains well-above its optimum capacity of 954 persons (beds). To address overcrowding issues, some inmates are regularly temporarily held at the Federal Detention Center (FDC) located at Daniel K. Inouye International Airport.

The proposed facility would be designed for an operating capacity of approximately 959 male detention detainees (FY 2026), with approximately 33 percent being sentenced offenders. Projections are based on trending in the number of male offenders and the anticipated growth in the City and County of Honolulu de facto population.

Because housing is built in modules, the actual number of rated beds upon completion will be higher than the proposed operating capacity. Current plans call for 1,044 new rated detention beds.

In addition to inmate housing, the proposed OCCC would include areas for building administration and security, intake/transfer/release, food preparation, laundry services, medical/mental health services, program services, visitation, and spaces for building support with technology and building systems and maintenance functions. All spaces would be sized and organized to meet applicable American Correctional Association standards.

2.3.2 Proposed Pre-Release Programs and Facilities

The LWFC and Module 20 at OCCC are partial confinement pre-release programs for males including community corrections, day reporting and work furlough. The LWFC has 96 beds and is located approximately one block from OCCC in Kalihi while Module 20 has 120 beds and is located on the grounds of OCCC. Female offenders participate in these programs through the Women's Community Correctional

Center (WCCC); currently, there is capacity for 44 female inmates to participate in WCCC's pre-release program.

Contrary to the male detention population, the pre-release population has been increasing. On Oahu, approximately 300 male offenders are ready for pre-release at any given time. It is predicted that the number of pre-release males will increase to approximately 392 by FY 2026. Assuming the 96-bed LWFC remains operational, there will be a net future need of 296 pre-release beds for males. The plan to address the future housing needs of the OCCC male pre-release population comprises these alternatives:

- All four proposed OCCC development sites will include both detention and pre-release functions either in one shared building or two separate buildings.
- The LWFC in Kalihi will remain operational at 96 beds. PSD intends to expand the Laumaka facility in the future but at this time only the 96 beds will be considered when distributing the total number of planned pre-release beds.
- The pre-release component of the proposed OCCC facility at each of the four sites will be sized to accommodate the total population anticipated in the 10-year inmate population forecast, minus the 96 existing LWFC beds, or 296 inmates. Because of the housing module layout, the actual planned pre-release beds at the new OCCC facility will total either 288 (six 48-bed modules) or 336 (seven 48-bed modules). However, if the new OCCC facility is built on the site of the existing OCCC facility in Kalihi, it will be responsible for the full population of 392 inmates. Because of the housing module lay-out the actual planned pre-release beds for the Kalihi facility is 384 (eight 48 bed modules).

PSD aims to divert as many pre-release inmates as possible from the new OCCC facility into community-based programs. However, until specific plans, providers, facilities, timeframes, and contractual arrangements are established, PSD plans to house all pre-release inmates within its facilities.

An improved LWFC will provide guidance in a more normative staff-secure setting to help eligible inmates prepare for their release from confinement and the strict controls of a correctional institution to independent community living. Spaces for counseling, individual and small group activities, applicable treatment and transitional/re-entry focused programs and housing would be provided within the new LWFC. An updated LWFC will also improve conditions under which inmates practice living skills and responsibilities not used during prison confinement and control. Fixing their own meals, doing their laundry, rehearsing for job interviews, meeting the daily requirements of employment, and other normal expectations for daily routines of independent living will be facilitated with a new and expanded facility.

2.3.3 Proposed Improvements to Women's Community Correctional Center

Pretrial offenders, higher security female offenders and female offenders eligible for Community Release on Oahu are currently housed at OCCC. Although OCCC's male inmate population has shown a decline in recent years, the number of female inmates has grown. The number of females in detention is predicted to increase to 243 by FY 2026 with approximately 25 percent being sentenced offenders. An additional 38 females are forecasted to participate in pre-release by next decade bringing the total number of additional female beds needed by FY 2026 estimated at 281.

The Women's Community Correctional Center (WCCC) is the only all-female facility in Hawaii, providing for the long-term care and custody of female sentenced felons. Located on the site of the former Hawaii Youth Correctional Facility in Kailua, the original housing buildings, (Ka'ala, Maunawili, and Olamana Cottages) along with most of the support infrastructure were constructed in 1952 and adapted with minor renovations to house the female sentenced population from 1992 to 1994. An additional cottage – Ahiki – was constructed specifically to house female offenders in 1999. The current rated capacity for WCCC is 260 beds although it is currently housing approximately 283 inmates.

Plans are to relocate female inmates from the existing OCCC to the WCCC in order to provide greater access to rehabilitation programs and improved family visitation. However, at the present time female inmates would continue to receive intake services in the future at the new OCCC.

Taken together, the development of a replacement to the existing OCCC, provision of sufficient pre-release facilities to accommodate future populations, and relocation of OCCC female inmates to the WCCC and its subsequent improvements, are collectively described as the "Proposed OCCC Project."

Table B summarizes the proposed new and expanded capacities for the two facilities. The total number of required new rated beds for detention and pre-release males in FY 2026 is approximately 1,255; when modules and optimized layouts are considered the total number of new beds to be developed is expected to total 1,380. The demand for additional capacity at WCCC is 281 total beds; the actual amount planned/to be built has yet to be finalized.

TABLE B

SUMMARY OF PROPOSED REDEVELOPED OCCC CAPACITY AND WCCC EXPANSION REQUIREMENTS

Population Group	Number of Beds in 2026 Required	Planned
At Redeveloped OCCC		
Detention Males	959	1,044
Pre-Release Males (1)	296	336
Total Male Population/Beds	1,255	1,380
At Expanded WCCC		
Detention Females	243	(2)
Pre-Release Females	38	
Total Female Population/Beds	281	

(1) Assumes 96-bed Laumaka Work Furlough Center remains operational.
(2) To be determined.

Source: Planning team publications.

2.4 Purpose and Need for the Proposed OCCC Project

2.4.1 Background

Since 1991, Hawaii's prison and jail inmate population has grown well beyond the system's capacity, but there have been no facilities added. To cope with the increasing population, PSD has been forced to double-bunk cells, add beds to existing dorms, and convert spaces normally used for programs and services to inmate housing. Additionally, some inmates have been sent to the mainland for incarceration, currently at 1,617 persons.

The current design capacity for the State's four jails is 1,153 beds while the operational bed capacity is 1,609. Since 2014, OCCC alone has averaged about 1,157 inmates (head count) or 1,345 inmates (assigned count); or some 21 to 41 percent above its operational capacity of 954 beds.

In addition to the correctional population in state facilities, Hawaii has found it necessary to contract for beds on the mainland for lack of suitable space in the islands. Contracting for beds on the mainland began in 1995 when 300 male prison inmates were transferred to facilities in Texas. Additional transfers followed in 1997 with 236 male and 64 female inmates, and have continued to grow since then. As of August 2017, there were approximately 1,617 State of Hawaii male prison inmates housed in facilities on the mainland. If the mainland prison inmates were to be housed in Hawaii, the demand for beds would total over 5,000 (PSD, 2017).

2.4.2 Project Purpose

PSD is relying upon aged and obsolete correctional facilities to carry out its mission and proposes to improve its corrections infrastructure through modernization of its existing facilities and construction of new replacement institutions where necessary. The purpose of the proposed OCCC project is to improve the physical (health and safety) conditions for the benefit of detainees, corrections staff, and the public, and achieve greater operating efficiencies through modernization of buildings and systems.

2.4.3 Project Need

The current OCCC facility is undersized for the present and projected future inmate population. Originally designed for 628 detainees, the facility was rebuilt and expanded more than 40 years ago and subsequently modified to accommodate 954 detainees. Assessments by PSD indicate OCCC is overcrowded and is functioning above its design capacity. At present, there is a head count of 1,069 detainees (of which approximately 146 are females) and an assigned count of 1,228 detainees (165 females) while there are only 954 total available beds. OCCC is inadequate to meet future projected jail population levels. Conditions created by overcrowding place the State of Hawaii under a cloud of liability that could threaten continued autonomous control and supervision of OCCC as well as other jails throughout the state.

OCCC is also operationally inefficient. Among the in-use structures comprising OCCC, one was built in 1914 and the security system is antiquated. At the time OCCC was redeveloped during the 1970's and 1980's, the primary intended use was for long-term inmates, not for a short-term, high turnover population. OCCC is also not designed to separate detainees with mental health issues from the general detainee population, which creates risks for both groups as well as corrections staff.

The design of OCCC is substantially different from the CCCs operating on the islands of Kauai, Maui and Hawaii, although it does have design elements that attempt to integrate some "normative" environmental features into a confinement facility, as was reflecting the design trends at the time it was built. Essentially, it is reflective of contemporary secure jail design standards in common use rendering OCCC operationally inefficient, with a housing unit configuration requiring a detainee/security officer ratio well above industry standards. These facts, combined with the age, condition, and limited expansion potential of the existing facility, require a new replacement facility to meet both current and future needs.

2.5 Alternative OCCC Development Sites

Following detailed professional analyses and cooperation with the public, four available sites on Oahu were identified as having the most favorable characteristics to support a replacement OCCC facility. The property alternatives are summarized following. Three would relocate OCCC, the fourth would be redevelopment on the existing jail property.

2.5.1 OCCC Site—Kalihi

The current site of OCCC is located in the Kalihi neighborhood of Honolulu on a single 16.46-acre parcel at 2199 Kamehameha Highway/Dillingham Boulevard. This site has been used for correctional purposes since the early 1900s. The fee simple estate for the OCCC property is controlled by the State of Hawaii, which has owned the property for many years.

The area of "Kalihi" is situated north of Chinatown and downtown Honolulu, generally bounded by North King Street to the east, Nimitz Highway to the west, Middle Street to the north, and River Street to the south. It encompasses the Kapalua and Iwilei areas which contain a variety of commercial, light industrial and service commercial uses, including several national fast food operations, independently owned restaurants and bars, automotive repair shops, the Honolulu Community College campus, and numerous factories and light industrial warehousing facilities. The Sand Island industrial subdivisions, and Honolulu Harbor with its related waterfront activities, are located Makai of Nimitz Highway. Primary shopping facilities are the Kapalama Shopping Center, City Square, Dillingham Plaza, Kokea Center, Costco and Home Depot at Iwilei, and numerous small retail shopping facilities lining the commercial strips along Dillingham Boulevard and North King Street.

2.5.2 Animal Quarantine Station Site—Halawa

The Animal Quarantine Station site consists of approximately 35 acres in Halawa Valley at 99-951 Halawa Valley Street, not far from Halawa Correctional Facility. The site represents a portion of an underutilized State-owned property. Halawa Valley Street provides access to the site and forms the site's western and northern borders. The site lies just north of Moanalua Freeway while the H-3 Freeway bisects the site from the southwest to the northeast. Development of the new OCCC is planned to be limited to the portion of land east of the H-3 Freeway.

There is a transit stop servicing bus routes in close proximity. When completed, the Honolulu Authority for Rapid Transit's Aloha Stadium rail station will be about 2 miles away. At a distance of 5 miles, it is close to the existing OCCC with the First Circuit Court approximately 8 miles away. The surrounding neighborhood is largely industrial in nature. Adjacent land uses include the Hawaiian Cement Company, undeveloped land, industrial warehouses, and Department of Agriculture livestock and research facilities.

This site is currently home to the Department of Agriculture's Animal Quarantine Station, which includes the Animal Quarantine Headquarters building and approximately 1,600 kennels used to quarantine cats and dogs arriving in Hawaii. The facilities no longer meet the needs of the Department of Agriculture and officials are exploring relocation options. This site's possible use for OCCC development has been discussed with the Department of Agriculture and both PSD and the Department are cooperating in the on-going studies. In addition to the Department of Agriculture, a number of tenants currently occupy portions of the property.

2.5.3 Halawa Correctional Facility Site—Halawa

The Halawa Correctional Facility occupies approximately 31 acres in Halawa Valley at 99-902 Moanalua Road and has been used for correctional purposes since 1991. The area being considered for the new OCCC is represented by an undeveloped 5-acre portion of the 31-acre tract.

The Halawa Correctional Facility property is owned by the State of Hawaii and is under executive order to the Department of Public Safety. The principal access road is Halawa Valley Street, the closest bus route at this time is 1.5 miles away, and the closest planned rail station is Aloha Stadium Station which, when constructed, will be approximately 3 miles away. It is 6.4 miles away from the existing OCCC and approximately 9 miles away from the First Circuit Court. The site is located relatively remote from residential development. Surrounding land uses are primarily industrial and a quarry is located to the north.

2.5.4 Mililani Technology Park, Lot 17 Site—Mililani

This site comprises approximately 40 acres represented by Lot 17 within the undeveloped portion of the Mililani Technology Park. The fee simple estate for the property is controlled by Castle & Cooke, which has owned the property for many years.

The site can be accessed from Kahelu Avenue and is a short distance from the H-2 Freeway. The closest bus route is currently approximately a mile away and the nearest planned rail transit stop is Pearl Highlands Station approximately 9.4 miles away. The site is about 18 miles away from the existing OCCC while the First Circuit Court is approximately 20 miles away. This site is within Mililani Technology Park whose tenants include warehouses, storage facilities, a church, and a preschool. Several residential neighborhoods are located south of the site.

2.5.5 Women's Community Correctional Center

WCCC is located at 42-477 Kalanianaole Highway near the Hawaii Youth Correctional Facility, the Pohakupu Subdivision, Kailua High School and Maunawili Elementary School. The fee simple estate for the WCCC property is controlled by the State of Hawaii, which has owned the property for many years. WCCC is under study because female inmates housed in the existing OCCC are slated for relocation to WCCC in order to gain access to rehabilitation programs and improve family visitation.

WCCC is the only all-female facility in Hawaii, providing for the long-term care and custody of female sentenced felons. Located on the site of the former Hawaii Youth Correctional Facility, the original housing buildings, (Kaala, Maunawili, and Olomana Cottages) along with most of the support infrastructure were constructed in 1952 and adapted with minor renovations to house the female sentenced population from 1992 to 1994. An additional cottage – Ahiki – was constructed specifically to house female offenders in 1999.

The site can be accessed from Kalanianaole and is near major bus routes. It is located 14 miles away from the existing OCCC and 11 miles away from the First Circuit Court. Surrounding land uses include Hawaii Youth Correctional Facility, Maunawili Elementary School, Kailua High School, HECO baseyard, the Olomana Fire Station, and residential subdivisions.

2.6 Study Objectives

This purpose of this report is to quantify probable economic impacts which would result from the actualization of the OCCC project; from ground-breaking (and pre-planning) through completion of construction and to stabilized operations. Estimates are based on the current project plans regarding the design, construction, and operation of the proposed facilities as analyzed through the context of the State of Hawaii Department of Business, Economic Development and Tourism (DBEDT) "input-output" model.

The regularly updated DBEDT input/output model provides a series of multipliers for measuring the specific impacts associated with construction and operations of a project regarding economic activity, job creation, income/earnings, and the generation of state tax revenues.

The information, indications and outcomes produced through model application and presented in this report are intended to provide a sound basis for evaluating the nature, scale, and scope of economic impacts that would result from the construction and operation of the proposed OCCC redevelopment and WCCC expansion projects even though decisions regarding specific design and operational aspects of the proposed facilities are in the preliminary planning stages.

2.7 Organization of Report

This summary report is organized around seven informational chapters:

1. Executive Summary
2. Introduction
3. Economic and Social Environment
4. Impact Assessment Methodology
5. Economic Impact of Construction Activities
6. Economic Impact of Operating Phase
7. Fiscal Considerations

Chapter 3 serves to describe the economic and social environment on Oahu to provide a baseline for the impact assessment. For purposes of this report the terms Oahu, City and County of Honolulu, Honolulu, and Honolulu County are considered interchangeable.

Chapter 4 briefly describes the methodology used for our impact assessment. Chapter 5 applies the methodology to the OCCC and WCCC construction activities, focusing on expenditures, employment, incomes, and tax revenues.

Chapter 6 applies the methodology to the operation of the redeveloped/relocated OCCC facility addressing some major economic and socio-economic impacts. The economic impacts associated with the expansion of WCCC are not included due to the lack of firm planning/operating data and projections.

Chapter 7 addresses the potential fiscal impacts associated with the proposed projects. Supplementary documentation supporting the analysis is also provided as appendices.

3. ECONOMIC AND SOCIAL ENVIRONMENT

3.1 Introduction

This chapter describes the demographic and socio-economic environments within which the proposed OCCC project would be located. The predominant demographic and economic effects of constructing and operating the proposed OCCC project would occur within the City/County of Honolulu (i.e., the County), with some spill-over effects accruing to the rest of the State. Accordingly, the economic impact analysis will focus upon the County and State levels. The purpose of presenting demographic and economic data for the County and the State is to establish a baseline from which project impacts can be measured against and hence, the overall magnitude of impacts assessed relative to the regional (i.e., County) and State economies.

3.2 Economic Overview

3.2.1 Economic Output of Hawaii and the City and County of Honolulu

Hawaii experienced a severe economic slowdown during the financial crisis and economic recession which began in 2008. The State's visitor industry, the major driver of the economy was hit especially hard with key tourism and hotel indicators dropping by 15 to 30 percent by the end of 2009. The economic recovery began in mid-2010, started gaining momentum in 2011, and moved into a strong growth cycle in 2012, primarily a result of resurgent tourism, construction, and retail activity.

The upward trend has continued since, although there was short-term instability in the International visitor demographic in 2014-15 due to currency fluctuations. Virtually all major economic factors and sectors continue at a vibrant pace, though some are showing signs of stabilization, with 2017 poised to set numerous all-time economic and tourism records with favorable 2018 conditions.

The following figures demonstrate the recent and projected continuing health of the Oahu and State of Hawaii economies as provided in forecasts from the two leading economic forecasting sources in the islands.

The University of Hawaii Economic Research Organization (UHERO) forecasts a healthy and stabilizing Honolulu economy with every factor showing growth in every year through 2019, excepting some instability in the Japanese visitor market.

Figure 1: University of Hawaii Economic Research Organization Projections for Honolulu, May 2017

COUNTY MAJOR ECONOMIC INDICATORS
YEAR-OVER-YEAR % CHANGE

	2014	2015	2016	2017	2018	2019
HONOLULU						
Visitor Arrivals	2.9	2.8	2.3	1.2	0.4	1.0
U.S. Visitor Arrivals	1.4	4.8	2.3	1.4	0.8	0.9
Japan Visitor Arrivals	0.8	-2.2	0.4	1.7	-1.0	1.1
Other Visitor Arrivals	9.1	4.8	4.4	0.4	0.8	1.1
Payroll Jobs	1.2	1.7	1.3	0.9	0.6	0.5
Real Personal Income	3.4	3.5	2.2	1.4	1.2	1.2

The DBEDT Third Quarter 2017 forecasts are similarly bullish with gains forecast for 2017 through 2020 for every economic indicator analyzed.

Figure 2: DBEDT Economic Projections for the State of Hawaii, Third Quarter 2017

ACTUAL AND FORECAST OF KEY ECONOMIC INDICATORS FOR HAWAII: 2015 TO 2020						
	2015	2016	2017	2018	2019	2020
Economic Indicators	Actual		Forecast			
Annual Percentage Change						
Total population	0.6	0.2	0.5	0.8	0.8	0.8
Visitor arrivals [1]	4.3	3.0	3.2	1.4	1.5	1.5
Visitor days [1]	3.5	2.2	3.4	1.2	1.5	1.5
Visitor expenditures [1]	0.9	4.2	6.5	2.2	3.6	3.6
Honolulu CPI-U	1.0	2.0	2.5	2.3	2.3	2.3
Personal income	4.8	4.3	3.5	3.4	3.3	3.3
Real personal income [2]	3.9	2.2	1.7	1.5	1.4	1.4
Non-agricultural wage & salary jobs	1.8	1.4	1.0	0.9	1.0	0.8
Civilian unemployment rate [3]	-0.8	-0.6	-0.1	0.2	0.1	0.2
Gross domestic product	4.9	4.1	3.2	3.3	3.2	3.2
Real gross domestic product	2.3	2.1	1.4	1.5	1.4	1.3
Gross domestic product deflator (2009=100)	2.5	1.9	1.7	1.8	1.8	1.9

3.2.2 Government Revenues

Government revenues in the State also declined during the economic recession, falling 13 percent from about $5.5 billion in 2007 to $4.8 billion in 2009 (in current dollars).[1] With the initial onset of recovery in 2010, State and City & County of Honolulu revenues began to show growth, gaining momentum over the next several years.

As shown in Table 1, the trend in State revenues has been positive since 2012, with strong year-on-year growth through 2017 (excepting 2014) at a rate of 5.75 percent compounded annually with total gains of 32.2 percent.

City & County of Honolulu revenues were also strong, albeit slightly more subdued that the State, and more erratic during the study period. County revenues escalated at a compounded annual growth of 4.08 percent between 2012 and 2017 with total gains of 22.1 percent.

TABLE 1

HISTORICAL STATE OF HAWAII AND CITY AND COUNTY OF HONOLULU GENERAL REVENUES (IN THOUSANDS OF DOLLARS)

	2012	2013	2014	2015	2016	2017 (1)
State of Hawaii	$8,264,770	$9,024,894	$9,125,004	$9,737,152	$10,309,851	$10,928,442
Percent Annual Change		9.2%	1.1%	6.7%	5.9%	6.0%
City and County of Honolulu	$1,821,392	$1,856,383	$2,053,242	$2,028,582	$2,163,613	$2,224,538
Percent Annual Change		1.9%	10.6%	-1.2%	6.7%	2.8%

(1) Estimated year-end based on data through third quarter.

Source: DBEDT State Data book Table 9.26, and City and County of Honolulu Budget Bills FY 2011-12 through 2016-17 (Honolulu.gov)

The primary sources of State revenue in Hawaii are excise and general use taxes and fees, personal income tax, and transient accommodation tax. Together these sources generate about three-quarters of State revenues. The County is primarily dependent upon property taxes which account for more than half of total Oahu government revenues each year.

3.2.3 Commercial Activities

The City/County of Honolulu dominates Hawaii’s economy and typically accounts for between 75 and 82 percent of the State’s gross domestic product. While the neighbor islands will gain in economic activity and self-sufficiency as the continue their evolution from an agrarian to urban society, Oahu will always serve as the governmental, tourism, military defense, business, manufacturing, shipping, and research and development hub of the State. The primary source of revenue for both the County and State is tourism. Honolulu also hosts the main port of Hawaii, which handles cargo for multiple international steamship companies. Major goods produced in the County include jewelry, clothing, food and beverages, rubber products, construction materials, and electronics and computer equipment.[2]

3.2.4 Tourism

In 2016, Oahu tourism reached all-time highs in Total Visitor Arrivals and Total Visitor Days, with Total Visitor Expenditures reaching the second-best figure of all-time. As of May 2017, the industry was again on track towards strong gains in all three of these critical indicators and record-setting marks for the year projected across the board.

A record Average Daily Rate (ADR) for registered lodging units was also achieved in 2016, with occupancy at the highest level in a quarter century.

Overall, last year evidenced the vitality and sustainability of the industry and its continuing ability to weather and rapidly recover from negative external influences as were minimally experienced in 2013-14 due to foreign currency devaluation in some of Oahu's primary guest markets. In general, tourism's post-recession recovery and growth up-cycle is now entering its eight-consecutive year and appears to be sustaining upward trending into the short to mid-term.

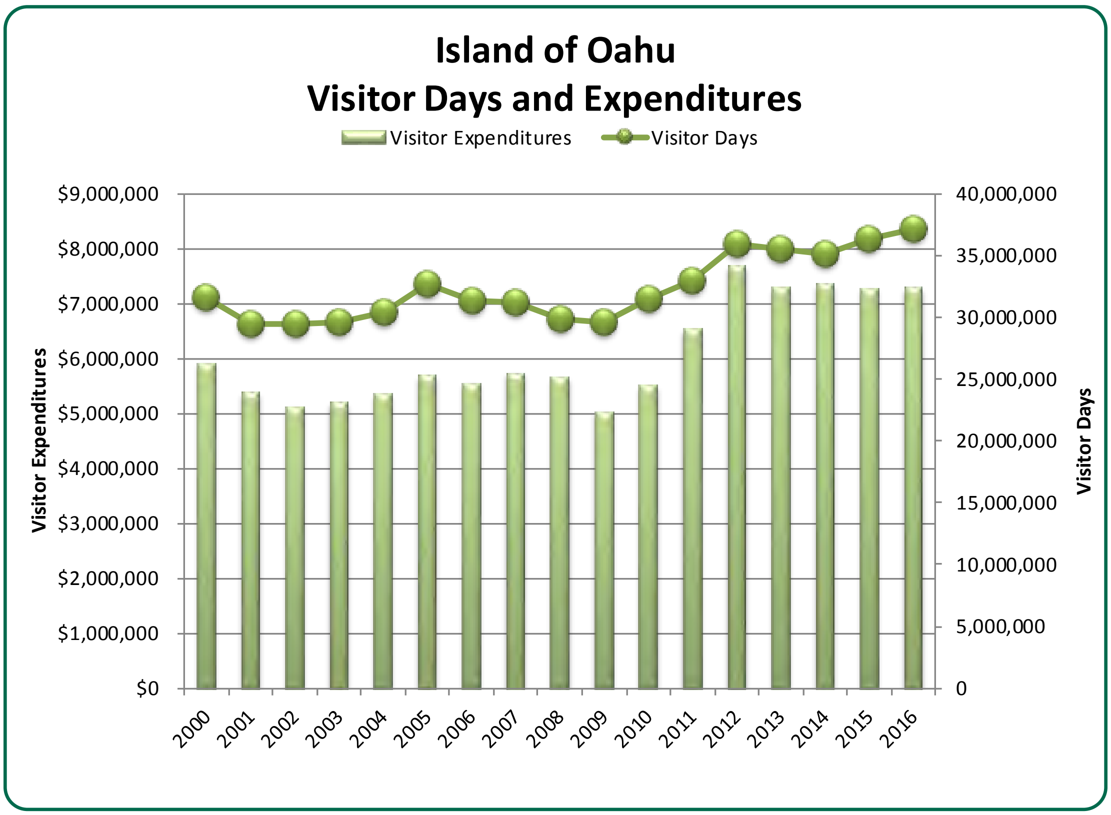
Early indicators for 2017 (year-to-date through May) point to a continuation of market expansion, with Oahu arrivals up 3.4 percent, total visitor days up 4.3 percent, and total expenditures up 7.7 percent from the same period in 2016.

Following several successive years of strong post-recessionary growth from 2010 to mid-2013, marking a complete recovery from the recessionary downturn, the Oahu tourism and hotel industries showed nominal signs of slowing in late 2013 due to major currency devaluation negatively impacting the critical Japanese, Australian and Canadian visitor segments. Despite these external issues affecting some indicators (notably Total Visitor Spending) the market continued within an up-cycle, and 2013-16 were overall still among the top four all-time years for tourism though representing a slowing of the upward post-recessionary trend.

From the depth of the recession in late-2009 to the end of 2016, the number of Total Arrivals is up 35 percent, Total Visitor Days are up 25 percent, and Total Visitor Expenditures are up 45 percent. All the "lost ground" during the recession has been fully recovered and well-surpassed.

Figure 3 graphs the two most critical indicators for the Oahu tourism industry from 2000 through year-end 2016; Total Visitor Days and Total Visitor Expenditures. For if tourists are spending more time and money on the island the industry is healthy and growing as has been the general case since the depth of the recession in 2009.

Figure 3: Historical Visitor Days and Expenditure Trends, Oahu



Source: DBEDT Monthly Visitor Statistics, through December 2016.

3.2.5 Hotel Industry

The hotel industry is the leading and most insightful indicator of the real property market. The Oahu economy is typically expanding if hotel operating statistics are growing, investor interest and trade activity is high, and there are ongoing renovations and capital expenditures in the sector.

The primary Oahu hotel operating statistics (ADR, occupancy and RevPAR), are show on Table 2. Since the post-recession recovery began in 2010, the Revenue per Available Room has increased from $108.49 in

2009 to $185.96 through mid-2017, a gain of 71.4 percent and a growth rate of 6.97 percent compounded annually. Waikiki is enjoying extended occupancy in the low to mid-80s percentile (among the highest for any destination in the country), and Average Daily Rates have increased for nine straight years. Being primary employers on the island and the source of significant tax revenues, a continuing strong hotel industry is indicative of a healthy Oahu economy.

TABLE 2

ISLAND OF OAHU HOTEL INDUSTRY TRENDS

YEAR	ROOM RENTAL RATE	Annual Pct. Change	AVERAGE OCCUPANCY RATE	Annual Pct. Change	REVENUE Per Available Room (RevPAR)	Annual Pct. Change
2007	$168.36	35.82%	76.80%	-7.00%	$129.30	26.31%
2008	$169.92	0.93%	74.90%	-2.47%	$127.27	-1.57%
2009	$150.06	-11.69%	72.30%	-3.47%	$108.49	-14.75%
2010	$149.67	-0.26%	78.20%	8.16%	$117.04	7.88%
2011	$165.05	10.28%	80.90%	3.45%	$133.53	14.08%
2012	$183.51	11.18%	84.70%	4.70%	$155.43	16.41%
2013	$209.01	13.90%	83.70%	-1.18%	$174.94	12.55%
2014	$213.22	2.01%	84.40%	0.84%	$179.96	2.87%
2015	$219.53	2.96%	85.30%	1.07%	$187.26	4.06%
2016	$225.86	2.88%	85.80%	0.59%	$193.79	3.49%
2017 *	$227.58	5.50%	81.71%	-1.70%	$185.96	3.52%

*Data through first half of 2017. Percent change is relative to first six months of 2016.

Source: PKF Hawaii, Hospitality Advisors, and The Hallstrom Team/CBRE.

3.3 Economic and Social Characteristics

3.3.1 Population Size and Growth

As of mid-2017, the State of Hawaii population was estimated at 1,436,000 persons, up 18.5 percent since the turn of the century, growing at a compounded annual rate of 1.0 percent, and showing gains each year. Most of Hawaii's population resides in Honolulu County, which presently accounts for about 69.5 percent of the State's total population, or some 997,700 persons.

Oahu's population has increased by 13.8 percent since 2000, at a rate of about .7 percent annually, with gains recorded each year; although, it has fallen as a portion of total state residents. For comparative purposes, the U.S. population grew at an average annual rate of 1.15 percent during a similar period (2005-2015).

These figures do not include the 220,000 and 101,000 visitors in the State and on Oahu daily on average.

3.3.2 Population Characteristics

Table 3 presents U.S. Census Bureau estimates of the demographic composition of Hawaii and Honolulu County as of 2015. As shown in the table, Asians (alone, not in combination with other races) accounted for approximately 37.7 percent of the State's total population.

TABLE 3

DEMOGRAPHIC CHARACTERISTICS FOR CITY & COUNTY OF HONOLULU AND STATE OF HAWAII, 2015

Category	City & County of Honolulu	State of Hawaii
Population, total	984,178	1,406,299
Population, by sex		
Male	50.60%	50.50%
Female	49.40%	49.50%
Median age (years)	36.9	38
Population, by age		
Under 5 years	6.60%	6.50%
5 to 19 years	17.50%	17.70%
20 to 64 years	60.40%	60.10%
Over 64 years	15.50%	15.60%
Population, by race		
One race	77.30%	76.30%
White	21.70%	25.40%
Black or African American	2.60%	2.00%
American Indian and Alaskan Native	0.20%	0.20%
Asian	42.60%	37.70%
Native Hawaiian and other Pacific Islander	9.20%	9.90%
Some other race	0.90%	1.10%
Two or more races	22.70%	23.70%
Population, by place of birth		
Native born, Hawaii	53.80%	53.40%
Native born, other State	25.40%	23.90%
Born in Puerto Rico, U.S. Islands, or abroad to US parents	3.10%	3.60%
Foreign born	17.70%	19.10%

Source: U.S. Census Bureau, 2015 American Community Survey.

In Honolulu County, Asians accounted for approximately 42.6 percent of the population that year. Residents classified as White (alone) accounted for 25.4 percent of the total State population and 21.7 percent of the Honolulu County population. The median age of Hawaii's population in 2015 was 38.0 years, compared to 36.9 years in Honolulu County.

3.3.3 Labor Force and Employment

The Hawaiian economy as well as the regional economy of Honolulu County is heavily dependent on the "Arts, entertainment, recreation, accommodation, and food service" and "Educational services, and health care and social assistance" sectors as sources of employment. Employment in the private sector accounted for the majority (72.2 percent) of civilian employment in the State of Hawaii with an additional 20.6 percent in government and 6.9 percent self-employed (Table 4). Approximately 21 percent of the civilian workforce in Hawaii in 2015 was employed in the "Educational services, and health care and social assistance" sector, while roughly 16 percent were in the "Arts, entertainment, recreation, accommodation, and food service" sector and 12 percent were in "Retail trade." The construction sector contributed over 7 percent of State jobs, while agricultural employment accounted for less than two percent of State employment. The state's unemployment rate in 2015 averaged 6.1 percent.

In Honolulu County, the employment profile was similar to that of the state of Hawaii with private sector employment accounting for 72 percent of all civilian employment and 22.1 percent in government and 5.7 percent self-employed. Employment by industry at the county level also mirrored that of the state, with employment in the "Educational services, and health care and social assistance"; "Arts, entertainment, recreation, accommodation, and food service"; and "Retail trade" sectors comprising 22 percent, 14 percent and 12 percent, respectively. The construction sector contributed just under 7 percent of county jobs, while agricultural employment accounted for less than one percent of county employment. The county's unemployment rate in 2015 averaged 5.6 percent.

TABLE 4

LABOR FORCE AND EMPLOYMENT CHARACTERISTICS FOR THE CITY & COUNTY OF HONOLULU AND STATE OF HAWAII - 2015		
Category	City & County of Honolulu	State of Hawaii
Population 16 years and over	792,760	1,130,491
In labor force	523,197	736,939
Civilian labor force	**482,523**	**695,572**
Employed	455,481	653,284
Unemployed	27,042	42,288
Armed forces	40,674	41,367
Not in labor force	269,563	393,552
Percent unemployed	5.60%	6.10%
Civilian employment (total)	**455,481**	**653,285**
Civilian employment by type of employer		
Private company	72.00%	72.20%
Government	22.10%	20.60%
Self-employed	5.70%	6.90%
Unpaid family workers	0.10%	0.20%
Civilian employment by industry		
Agriculture, forestry, fishing and hunting, mining	0.70%	1.60%
Construction	6.80%	7.10%
Manufacturing	3.30%	3.00%
Wholesale trade	2.40%	2.30%
Retail trade	11.60%	11.80%
Transportation and warehousing, and utilities	6.20%	5.90%
Information	1.70%	1.60%
Finance and insurance, real estate, rental & leasing	6.60%	6.40%
Professional, scientific, and mgmt., admin., and waste mgmt. services	10.00%	10.20%
Educational services, and health care and social assistance	21.50%	20.50%
Arts, entertainment, recreation, accommodation, and food service	14.40%	16.30%
Other service, except public administration	4.40%	4.50%
Public administration	10.30%	8.90%
Civilian Employment, by occupation		
Management, business, science, and arts occupations	35.80%	34.00%
Service occupations	21.20%	22.80%
Sales and office occupations	25.10%	24.80%
Natural resources, construction, and maintenance occupations	9.10%	9.70%
Production, transportation, and material moving occupations	8.80%	8.70%

Source: U.S. Census Bureau, American Community Survey, Five-Year Estimates 2011-2015.

The number of civilian jobs in Hawaii is estimated to increase by 0.9 percent or 4,500 jobs in 2017 compared to the previous year (Table 5).

3.3.4 Employment in the Construction Sector

Historically, construction has been a major contributor to job growth on Oahu and gains in construction employment averaged approximately 8 percent per year during the pre-recession upcycle from 2002 to 2007. However, the impact of the recession seriously affected the construction sector and construction job growth was negative in 2008 and 2009. Recovery first began in 2010 and progressed slowly through 2012 before commencing a four-year surge in jobs from 2013-2016 as projects throughout the island (but primarily in Kakaako and Waikiki) were undertaken.

As shown on Table 5, expansion in the job count has slowed this year, but continues to represent 5.9 percent of all FTE employment in the County; the highest mark in our survey period. The State of Hawaii forecasts employment will increase by some 12.3 percent between 2014 and 2024 making it the second-fastest expanding sector in the islands behind "Health and Social Assistance."

TABLE 5

SEASONALLY ADJUSTED JOBCOUNT IN THE OAHU CONSTRUCTION INDUSTRY 2010 TO 2017

Year	2010	2011	2012	2013	2014	2015	2016	Estimated 2017
Total Non-Agricultural Wage & Salary Jobs on Oahu	**434,400**	**439,600**	**448,400**	**456,000**	**462,300**	**470,100**	**476,000**	**480,500**
Percent Annual Change		1.2%	2.0%	1.7%	1.4%	1.7%	1.3%	0.9%
Total Natural Resources, Mining & Construction	**21,500**	**21,900**	**22,100**	**23,100**	**23,900**	**25,800**	**28,100**	**28,400**
Percent Annual Change		1.9%	0.9%	4.5%	3.5%	7.9%	8.9%	1.1%
Percent of Island Total Jobs	4.9%	5.0%	4.9%	5.1%	5.2%	5.5%	5.9%	5.9%
Special Trade Contractors	**11,900**	**12,200**	**12,500**	**13,100**	**13,400**	**14,500**	**16,400**	**16,600**
Percent Annual Change		2.5%	2.5%	4.8%	2.3%	8.2%	13.1%	1.2%

Note: The State of Hawaii Department of Labor forecasts employment in the Hawaii construction industry will increase by 12.35 percent between 2014 and 2024, the second fastest growth rate of any employment sector (trailing only "Health and Social Assistance".

Source: Hawaii Workforce Infonet Table "LFR-CES-JC-2010S"

3.3.5 Income

Household income for both the State of Hawaii and Honolulu County are considerably higher than the national average. Median household income in 2015 was $69,515 for Hawaii and $74,460 for Honolulu County compared to $53,889 for the U.S. as a whole. In 2015, Hawaii ranked 11th and Honolulu 109th among the 50 states and 3,142 counties in terms of median household income (Table 6).

Per capita income for Honolulu County and the State of Hawaii were $31,041 and $29,822, respectively; also, higher than the U.S. Poverty rates in 2015 were also lower than the national average, with Hawaii and Honolulu County experiencing rates of 11.2 percent and 9.7 percent, respectively, compared to the national poverty rate of 15.5 percent.

TABLE 6

INCOME AND POVERTY INDICATORS FOR THE CITY & COUNTY OF HONOLULU, STATE OF HAWAII AND US			
Indicator	City & County of Honolulu	State of Hawaii	U.S.
Median household income	$74,460	$69,515	$53,889
Mean household income	$92,649	$87,329	$75,558
Per capita income	$31,041	$29,822	$28,930
2015 median household income rank (out of 3,142 counties and 50 states)	109	11	N/A
Percentage of people whose income in the past 12 months is below the poverty level.	9.70%	11.20%	15.50%

Sources: U.S. Census Bureau, 2015 American Community Survey (ACS), 5-Year Estimates 2011-2015.

STATS Indiana, USA States in Profile, 2015 Hawaii's Income & Taxes http://www.stats.indiana.edu/

STATS America, USA Counties in Profile, 2015 Income & Poverty for Honolulu, HI http://www.stasamerica.org/uscp/

Table 7 displays the historic and projected total income and gross domestic product for the State from 2015 through 2020, in both inflating and constant (2009) dollars. In every year there have been or are projected to be gains in both income and domestic product.

TABLE 7

HISTORIC AND PROJECTED TOTAL INCOME AND GROSS DOMESTIC PRODUCT FOR THE STATE OF HAWAII, 2014 THROUGH 2020
All Amounts Expressed in Millions of Dollars

Economic Indicator	2015	2016	2017	2018	2019	2020
Personal Income	**$69,129**	**$72,100**	**$74,623**	**$77,160**	**$79,707**	**$82,337**
Percent Annual Change		4.3%	3.5%	3.4%	3.3%	3.3%
Real Personal Income (in Constant 2009 Dollars)	**$53,212**	**$54,382**	**$55,307**	**$56,136**	**$56,922**	**$57,719**
Percent Annual Change		2.2%	1.7%	1.5%	1.4%	1.4%
Gross Domestic Product	**$80,599**	**$83,917**	**$86,570**	**$89,427**	**$92,289**	**$95,242**
Percent Annual Change		4.1%	3.2%	3.3%	3.2%	3.2%
Real Gross Domestic Product (in Constant 2009 Dollars)	**$71,714**	**$73,252**	**$74,305**	**$75,419**	**$76,475**	**$77,469**
Percent Annual Change		2.1%	1.4%	1.5%	1.4%	1.3%

Source: DBEDT "Outlook for the Economy" 3rd Quarter 2017.

3.3.6 Housing Characteristics

Based on census data through 2015, there were a total of 527,388 housing units and 341,239 housing units in Hawaii and Honolulu County, respectively. Based on estimates from the 2015 American Community Survey (ACS), housing unit vacancy rates were 14.6 percent statewide and 9.3 percent for Honolulu County. Approximately 25.1 percent of the vacant units in Hawaii and 23.2 percent in Honolulu County were available to rent, while an additional 43.7 percent and 37.3 percent, respectively, were available for seasonal, recreational, or occasional use. Of the 450,572 occupied housing units in Hawaii and 309,602 units in Honolulu County, 56.9 percent and 54.4 percent, respectively, were owner-occupied, while the remaining units were renter-occupied.

The average household size in Hawaii in 2015 was 3.2 people among home-owners and 2.8 among renters. In Honolulu County for the same year, the average household comprised 3.3 people among home-owners and 2.8 among renters. The median 2015 owner-occupied home value was $515,300 in Hawaii and $580,200 in Honolulu County, while median monthly rental prices were $1,438 and $1,569, respectively (Table 8).

Table 8

Housing Characteristics for Honolulu County and State of Hawaii, 2015

Category	City and County of Honolulu	State of Hawaii
Total housing units	341,239	527,388
Occupied units	309,602	450,572
Owner-occupied	54.4%	56.9%
Renter-occupied	45.6%	43.1%
Vacant units	31,637	76,816
For rent	23.2%	25.1%
Rented, not occupied	4.2%	3.0%
For sale only	6.0%	4.9%
Sold, not occupied	2.4%	2.9%
For seasonal, recreational, or occasional use	37.3%	43.7%
For migrant workers	0.0%	0.1%
Other vacant	26.9%	20.3%
Percent Vacant	9.3%	14.6%
Rental vacancy rate	4.9%	8.9%
Owner vacancy rate	1.1%	1.4%
Average household size-owner-occupied unit	3.3	3.2
Average household size-rental unit	2.8	2.8
Median value, owner-occupied units	$580,200	$515,300
Median gross rent (monthly)	$1,569	$1,438

Source: U.S. Census Bureau, American Community Survey (ACS), 5-Year Estimates 2011–2015.

3.3.7 Educational Attainment

Educational attainment among residents of Honolulu County is similar to that among all Hawaii residents. In 2015, 26.4 percent of Honolulu County residents over the age of 25 had received a high school diploma (or equivalency), those who held a Bachelor's degree comprised 21.6 percent of the county population, while those holding Graduate or professional degrees accounted for 11.1 percent of the county population (Table 9). Honolulu County residents who attained some college, but no degree accounted for 21.5 percent of the county population, while residents who attained an Associate's degree accounted for 10.3 percent.

By comparison, slightly more, 27.9 percent, of the statewide population over the age of 25 in 2015 had attained a high school diploma (or equivalency). Those who held a Bachelor's degree comprised 20.4 percent, while those who held a Graduate degree or professional degree accounted for 10.5 percent. Hawaii residents who attained some college, but no degree accounted for 22 percent of the population, while residents who attained an Associate's degree accounted for 10.3 percent. College enrollment for Honolulu County and across the state was approximately 30 percent.

Honolulu County showed slightly improved English language skills than the State as a whole, with 10.1 percent of residents speaking English "less than very well," whereas the State's average was 12.5 percent. Approximately 73 percent of County residents spoke English only, while 19.2 percent spoke a language other than English. By comparison, approximately 75 percent of state residents spoke English only, while 25.2 percent spoke a language other than English.

TABLE 9

EDUCATIONAL ATTAINMENT FOR THE CITY & COUNTY OF HONOLULU AND STATE OF HAWAII, 2015

Category	City & County of Honolulu	State of Hawaii
Total population, age 25 and older	667,370	962,052
Less than 9th grade	4.40%	4.10%
Grades 9 to 12, no diploma	4.8%%	4.90%
High school graduate (includes	26.40%	27.90%
Some college, no degree	21.50%	22.00%
Associate's degree	10.30%	10.30%
Bachelor's degree	21.60%	20.40%
Graduate or professional degree	11.10%	10.50%
Enrolled in school		
Nursery school, preschools	5.90%	6.20%
Kindergarten	4.90%	5.10%
Elementary school (grades 1-8)	37.50%	38.90%
High School (grades 9-12)	18.70%	19.60%
College or graduate school	33.10%	30.10%
Population 5 years and over		
English only	72.60%	74.80%
Language other than English	19.20%	25.20%
Speak English less than "very well"	10.10%	12.50%

Source: U.S. Census Bureau, 2015 American Community Survey.

3.3.8 Market Outlook

DBEDT estimates positive economic growth for Honolulu County through 2040 with tourism arrivals and expenditures, personal income, per capita income, and the total number of civilian jobs all showing steady annual increases. Table 10 presents select DBEDT population and economic projections through 2040.

TABLE 10

POPULATION AND ECONOMIC PROJECTIONS FOR THE CITY & COUNTY OF HONOLULU 2020 THROUGH 2040

Category	2020	2025	2030	2035	2040
Population	1,003,710	1,029,410	1,052,130	1,071,220	1,086,710
Tourism					
Visitor arrivals	4,910	5,070	5,220	5,390	5,570
Visitor days	35,970	37,100	38,260	39,490	40,760
Visitor units	34,760	35,950	37,070	38,270	39,390
Hotel occupancy rate	86.30%	86.30%	86.30%	86.30%	86.30%
Visitor expenditures (million 2005$)	$5,819	$6,010	$6,206	$6,408	$6,616
Income					
Personal income (million 2005$)	$43,180	$46,730	$50,290	$53,700	$56,870
Per-capita income (million 2005$)	$43,020	$45,395	$47,798	$50,130	$52,332
Total civilian jobs	489,040	501,690	513,850	524,250	534,120

Source: DBEDT Long Range Projections 2040 Series.

4. IMPACT ASSESSMENT METHODOLOGY

4.1 Introduction

Constructing and operating the proposed OCCC/WCCC project(s) will generate economic impacts in the City and County of Honolulu and statewide communities well beyond the actual expenditures of creating the facilities. In addition to "direct" effects on construction levels, economic activity, output, employment, personal income and taxes on Oahu there will be substantial "Indirect" and "induced" benefits of the same types as the secondary activity from project suppliers, facility workers and their families, spreads throughout all the islands.

The economic and financial impacts generated by the project will be short-term (construction) and long-term (operations). This chapter describes the methodology used to estimate economic impacts associated with development and operation of the proposed OCCC/WCCC project with the assessment outcomes resulting from their application within the State Input/Output models as presented in Chapters 5 and 6.

4.2 Methodology

The economic impacts of constructing and operating the proposed OCCC /WCCC project(s) were estimated using Hawaii's Department of Business, Economic Development, and Tourism (DBEDT) input-output model. The most recent (and 10th) version of the DBEDT model which is used in this analysis was developed using 2012 data inputs. Where relevant, a three percent inflation rate was applied to monetary variables used in the model (e.g., wages, income and earnings per job) to produce output estimates in 2017 dollars. Short-term and long-term impacts were estimated at both the County and State levels.

The primary purpose a tool such as the DBEDT model is to estimate the "ripple" effects of building and operating the new OCCC/WCCC projects on the economies of the City & County of Honolulu and throughout Hawaii. The first step is in-putting the known "direct effects" into the model which are the capital investment and resulting employment, income, and output associated with building and operating the new OCCC/ WCCC projects. Direct employment, for example, would include the workers hired to construct the facilities and to manage the facilities once operational.

The next step is to place the various DBEDT input/output multipliers into the model which quantify the indirect and induced effects. Indirect effects, in example, result when a firm contracted to help build the facilities purchase materials and services such as steel, lumber, and cement from other establishments. These "other establishments" then must increase their output and procure more materials and services from their own suppliers to meet the new demand.

Induced effects are the increases in economic activity attributable to further/additional spending by suppliers, businesses, workers and their families who were directly or indirectly hired due to the project.

Together these three categories comprise the "total effects" which are model outcome objectives. For purposes of this analysis, the terms "effects" and "benefits" are interchangeable because all of the calculated effects represent a positive change to the local and State economies. Use of the DBEDT input/output model is a primary, accepted method for determining the economic impacts of projects in Hawaii.

The multipliers used to measure these different effects are presented in Appendix A. Given that the large majority (some 98 percent) of the economic activity and impact resulting from construction and operation of the redeveloped OCCC and expanded WCCC will take place on Oahu, the analysis relies upon input-output multipliers developed by DBEDT for "Oahu" as taken from the "2012 Hawaii Inter-County Input-Output Study," specifically from table "2012-County-I-O-Condensed."

The estimated economic effects of the proposed OCCC project were generated using the DBEDT model based on the following assumptions:

- Total Direct Construction cost for the proposed OCCC/WCCC project (before construction loan interest) is estimated to be $557 million, plus an estimated $64.7 million for professional services, bonds and insurance, for a total of $621.7 million.[i] These expenditures will generate some $39.6 million in State taxes.
- Construction of all OCCC/WCCC-related project facilities would be completed in 24 months[ii] with 50 percent of construction expenditures allocated to each of the two years in the development period.
- Stabilized OCCC project operation will directly generate economic activity (cost) of some $61.6 million annually and create 458 FTE employment positions. These respective indicators do not represent significant changes from the current OCCC baseline operating costs and employment levels.[iii]

The economic benefits arising from the construction phase would be temporary and would cease at the end of the construction period. In contrast, the benefits arising from the operation and maintenance phase would continue for the entire life of the facility. However, because the new facility is intended to replace an existing OCCC facility and expand Pre-release and WCCC facilities, only the incremental economic benefits of operating the new/expanded facilities (above the operating costs of the existing facilities) are worthy of consideration. This study assumes that the current OCCC workforce would transfer to the new/expanded facilities and benefits would derive only from economic activities generated by any new (net) employees that would be hired to meet the additional mission requirements of the new/expanded facilities as well as from increases in expenditures associated with their operating requirements.

The DBEDT model does not capture generated economic activity that "leaks" out of the State of Hawaii. For example, if the proposed OCCC and expanded Pre-release and WCCC facilities were to purchase equipment or materials produced in California, none of the resulting employment, income, or output generated by those purchases would be accounted for in this analysis. Hence, there would likely be benefits from the proposed OCCC project that are received by businesses and individuals outside of Hawaii, but which are not included in the calculation of total effects.

[i] Inputs may not add up to total construction costs due to rounding. This figure is the average construction cost of the four identified alternative locations.
[ii] The construction schedule used in this analysis represents a 24-month period.
[iii] Staffing and operating figures for the new OCCC facility were based on the January 9, 2017, Estimated Staffing and Operating Costs report.

5. ECONOMIC IMPACTS OF CONSTRUCTION ACTIVITIES

5.1 Introduction

The proposed OCCC project consists of the development of a replacement to the existing OCCC, provision of sufficient pre-release facilities to accommodate future populations, and relocation of OCCC female inmates to the WCCC and its subsequent improvements. Construction of the proposed OCCC project would generate economic activity that would occur primarily in the City/County of Honolulu, but would also benefit other parts of the State. This chapter describes the estimated impacts to employment, output, income, and taxes during the construction phase using the DBEDT model. The economic benefits generated from the construction phase of the project would be temporary and would end once construction of the facilities is completed.

5.2 Duration and Estimated Construction Expenditures

Construction of the proposed OCCC project is expected to take 24 months to complete with 50 percent of construction expenditures for OCCC allocated to both Year 1 and Year 2. Total construction expenditures were estimated at $621.7 million, which is the average "all-in" costs for the four alternative sites before financing. This including $64.7 million for professional services, insurance and bonds (Table 11).

The direct expenditures would go primarily towards the hiring of contractors and subcontractors to design and build the facilities and for the services and materials used to prepare and develop the various project sites (OCCC, Pre-release and WCCC facilities). As the commercial and financial center of Hawaii, all or most of the direct construction activity and related procurements would occur within the City/County of Honolulu.

Further detail on the construction costs is presented on tables comprising Appendix B.

5.3 Impacts on Employment

Construction of the proposed OCCC project would generate direct employment in a variety of building and trade sectors, with jobs ranging from masons, electricians, plumbers and other tradesmen to equipment operators and laborers. The job count is expressed in FTE worker-years, or 2,080 hours of worker activity, although many positions ay be comprised of several workers competing various tasks.

As summarized on Table 12, application of the DBEDT model to proposed OCCC project indicates it will generate some 3,071 direct years of employment evenly split between Years 1 and 2 of the development effort. Approximately 2,532 of which will be construction jobs and 539 professional services positions.

Indirect and induced employment will total another 3,637 worker-years during development, 3,319 flowing from the construction expenditures and 318 from professional services costs.

TABLE 11

CONSTRUCTION EXPENDITURES AND KEY ASSUMPTIONS

Category	Projected OCCC Relocation and WCCC Expansion	
Construction Cost	$541,749,569	(1)
Finance, Insurance, Business & Professional Services	$64,733,381	(2)
Other / Non-Allocated Costs	$15,227,157	
Total Construction Cost	**$621,710,107**	
Percent of Direct Impacts Assumed in County	98.26%	
Percent of Direct Impacts Assumed on Neighbor Islands	1.74%	
Construction Schedule	24 months	
Percent Expenditures in Year 1	50%	
Percent Expenditures in Year 2	50%	

Note The average estimated construction cost of the four alternatives being considered for the relocation of OCCC is $576.5 million (before construction loan interest) and the estimated expansion cost of the WCCC expansion project is $45 million (before interest).

(1) Includes Contractor's Fees, Project Management and General Excise Taxes (2.5%).
(2) Includes bonds and subguard costs.

Source: Cumming and other consultant analyses, and CBRE/Hallstrom Team.

TABLE 12

ESTIMATE OF DIRECT, INDIRECT AND INDUCED EMPLOYMENT CREATION BY INDUSTRY DURING CONSTRUCTION OF REPLACEMENT OCCC AND EXPANSION OF WCCC

Expressed in Full-Time Equivalent "Worker-Years"

	Construction Trades	Finance, Insurance, Business and Professional Services	Totals
Direct Worker-Years	**2,532**	**539**	**3,071**
Indirect and Induced Worker-Years	**3,319**	**318**	**3,637**
Total Direct, Indirect & Induced	**5,851**	**858**	**6,709**

Source: DBEDT "State" and "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom Team.

Table 13A displays a break-down of the projected construction-related employment by year, whether a direct or indirect/induced position, and whether it is created on Oahu or a neighbor island. Table 13B shows the same indicators related with professional services employment.

Excepting a handful of specialty construction jobs using neighbor island tradesmen (estimated at two percent of the total positions) it is considered likely virtually all construction work will go to in-place Oahu workers. It is expected that 100 percent of professional service opportunities will go to Oahu workers.

TABLE 13A

ESTIMATED CONSTRUCTION EMPLOYMENT GENERATED BY REPLACEMENT OF OCCC AND EXPANSION OF WCCC

Expressed in Full-Time Equivalent "Worker-Years"

	Type of Employment	Oahu (1)	Neighbor Islands (2)	Total State
Year 1	Direct (3)	1,241	25	1,266
	Indirect and Induced (4)	1,626	33	1,659
	Total for Year	**2,867**	**59**	**2,925**
Year 2	Direct	1,241	25	1,266
	Indirect and Induced	1,626	33	1,659
	Total for Year	**2,867**	**59**	**2,925**
Project Totals	Direct	2,481	51	2,532
	Indirect and Induced	3,252	66	3,319
	Total for Construction Period	**5,734**	**117**	**5,851**

Note: Assumes 50% of total work and cost during each year of the two year construction period.

Based on average OCCC Total Construction Costs (less financial, insurance, business and professional fees, and other non-allocated costs) estimated at $502.5 million plus $39.2 million for WCCC Expansion costs. Cumulative costs or both projects is $541.7 million.

(1) Oahu (City and County of Honolulu) is estimated to capture 98% of all construction jobs created by projects.
(2) Neighbor Islands estimated to capture 2% of all construction jobs created by projects.
(3) Worker-years directly related to on-site building, comprised of construction trades, contractor administration, architectural and engineering and others. Based on updating of DBEDT State I/O model Table 2.1 "Mining and Construction' column to 2017.

(4) Indirect jobs include material and service suppliers and warehousing in support of the construction effort a worker-year may be comprised of many individuals in less than full-time capacity. Induced employment is created by spending associated with the project and direct workers for goods and services as it flows through the Oahu and Statewide economy. Based on Table "2012-County-I-O-Condensed" County input/output model "Final Demand Multipliers, Total Job, Type II, 2017".

Source: DBEDT "State" and "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom Team.

TABLE 13B

ESTIMATED PROFESSIONAL SERVICES EMPLOYMENT GENERATED BY REPLACEMENT OCCC AND EXPANSION OF WCCC Expressed in Full-Time Equivalent "Worker-Years"				
	Type of Employment	Oahu (1)	Neighbor Islands (2)	Total State
Year 1	Direct (3)	270	0	270
	Indirect and Induced (4)	159	0	159
	Total for Year	**429**	**0**	**429**
Year 2	Direct	270	0	270
	Indirect and Induced	159	0	159
	Total for Year	**429**	**0**	**429**
Project Totals	Direct	539	0	539
	Indirect and Induced	318	0	318
	Total for Construction Period	**858**	**0**	**858**

Note: Assumes 50% of total work and cost during each year of the two year construction period.

Based on financial, insurance, business and professional services estimated at $64.7 million for the total projects.

(1) Oahu (City and County of Honolulu) is estimated to capture 100% of all professional services jobs created by projects.
(2) Neighbor Islands estimated to capture 0% of all professional services jobs created by projects.

(3) Direct worker years of Architectural & Engineering, Legal, and Business and Finance services committed to project.

(4) Indirect jobs include material and service suppliers and warehousing in support of the construction effort a worker-year may be comprised of many individuals in less than full-time capacity. Induced employment is created by spending associated with the project and direct workers for goods and services as it flows through the Oahu and Statewide economy. Based on Table "2012-County-I-O-Condensed" County input/output model "Final Demand Multipliers, Total Job, Type II, 2017".

Source: DBEDT "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom Team.

In terms of total impact on the Honolulu County economy, the total direct job creation based on the DBEDT model would represent a 0.64 percent increase in employment over the County's 2017 baseline total non-farm employment of 480,500. Such an increase would represent a short-term but measurable boost to the local economy. Total direct, indirect and induced job creation would represent 1.40 percent of the workforce.

The Oahu workforce is of sufficient size to complete the project development tasks, particularly as many major constructions in urban Honolulu are nearing or have been completed freeing up contractors, tradesmen and suppliers.

The project's short-term impact on the construction sector would be substantial. As was presented on Table 5 there are approximately 26,400 persons employed in the construction sector in Honolulu County. Using direct annualized construction job estimates (1,241 per project year) from the DBEDT model, the analysis indicates a 4.7 percent increase in jobs for the construction sector in Honolulu County.

It should be noted that additional economic activity would likely be generated outside the State of Hawaii as a result of the proposed OCCC project. For example, some specialty equipment might need to be imported from firms based in the mainland or elsewhere. This economic activity is not captured in the DBEDT model, and therefore the total number of jobs generated by the model could underestimate the employment impact of the construction project on the U.S. economy as a whole.

5.3.1 Types of Jobs Generated by Construction Expenditures

Construction jobs resulting from the building of the proposed OCCC project would include electricians, heavy-equipment operators, carpenters, plumbers, roofers, metal workers, window installers, carpet and tile layers, painters, masons, landscapers, etc. Professional services jobs supported by the project would include architects, engineers, attorneys, and inspectors, among others. Indirect jobs would include those related to the supply of materials (cement, lumber, roofing materials, electrical equipment, hardware supplies, lighting, flooring, etc.), equipment rental, equipment repair, warehouse services, etc. These construction and construction-related jobs would vary from entry-level to highly-skilled managerial positions.

5.3.2 Location of Jobs

A majority of the total construction activity would be located at the site where the new OCCC would be developed. The large majority, 98 percent, of the direct construction jobs and 100 percent of the professional services employment are expected to be filled by residents of Honolulu County with most construction and other supplies being purchased from businesses with operations located in Honolulu County. Indirect and induced jobs would be generated primarily in Honolulu County, with some expected spill-over to other parts of the State.

5.4 Economic Output

Construction of the proposed OCCC project would require the input of goods and services that would increase the overall economic output of the County by approximately $1.27 billion over the 24-month construction period. This represents an annual average increase of 1.47 percent over the 2017 baseline economic activity of $86.6 billion for the State. Table 14 presents DBEDT model estimates of the increased annual economic output for Honolulu County and Hawaii over the 24-month construction period.

TABLE 14

ESTIMATED ECONOMIC OUTPUT DURING CONSTRUCTION OF REPLACEMENT OCCC AND EXPANSION OF WCCC Expressed in Constant 2017 Dollars	Type of Economic Output	Oahu (1)	Neighbor Islands (2)	Total State
Year 1	Direct	$305,446,176	$5,408,878	$310,855,053
	Indirect and Induced (3)	$317,664,023	$5,699,064	$323,363,087
	Total for Year	**$623,110,198**	**$11,107,942**	**$634,218,140**
Year 2	Direct	$305,446,176	$5,408,878	$310,855,053
	Indirect and Induced	$317,664,023	$5,699,064	$323,363,087
	Total for Year	**$623,110,198**	**$11,107,942**	**$634,218,140**
Project Totals	Direct	$610,892,351	$10,817,756	$621,710,107
	Indirect and Induced	$635,328,045	$11,398,128	$646,726,174
	Total for Construction Period	**$1,246,220,396**	**$22,215,884**	**$1,268,436,280**

Note: Assumes 50% of total work and cost during each year of the two year construction period.

Based on average OCCC Total Construction/Development Costs (all inclusive except construction loan interest) estimated at $576.7 million plus $45 million for WCCC Expansion costs. Cumulative costs for both projects is $621.7 million.

(1) Oahu (City and County of Honolulu) is estimated to capture 98.26% of all economic output created by projects.
(2) Neighbor Islands estimated to capture 1.74% of all economic output created by projects.
(3) From DBEDT Hawaii County Input/Output Model, Table "2012-County-I-O-Condensed Final Demand Output Multipliers - Type I and Type II'" weighted between the construction output multiplier of 2.04 representing 89.5 percent of economic activity and finance and insurance/professional services multiplier of 2.17 which represents 10.5 percent of economic activity; with concluded multiplier of 2.05.

Source: DBEDT "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom Team.

5.5 Incomes and Salaries

Using the DBEDT model, direct construction activities are estimated to generate a 24-month total of $212.2 million in personal income within the Honolulu County and $3.5 million in the rest of the State, for a state-wide total of approximately $215.6 million. This equates to a State-wide average of $107.8 million in personal income annually, and a small, but perceptible increase over the estimated $74.6 billion in total personal income in the state estimated for 2017.

Indirect and induced income generated is forecast to total some $184.5 million during the two-year construction period; half each year.

It is estimated 98 percent of total construction wages (direct and indirect/induced) will be paid to Oahu and 2 percent to neighbor island workers. It is expected that 100 percent of the total professional service wages will be paid to Oahu residents. Overall, it is estimated that 98.3 percent of all income (direct and indirect/induced) will remain on Oahu, with about 1.7 percent flowing to the neighbor islands.

Results of the analysis are presented on Table 15A (combined income), 15B (construction worker income) and 15C (professional services income).

TABLE 15A

ESTIMATED ANNUAL INCOME GENERATED DURING CONSTRUCTION OF REPLACEMENT OCCC AND EXPANSION OF WCCC

Expressed in Constant 2017 Dollars

	Type of Income	Oahu (1)	Neighbor Islands (2)	Total State
Year 1	Direct	$106,101,250	$1,729,427	$107,830,677
	Indirect and Induced	$90,571,674	$1,683,596	$92,255,270
	Total for Year	**$196,672,925**	**$3,413,022**	**$200,085,947**
Year 2	Direct	$106,101,250	$1,729,427	$107,830,677
	Indirect and Induced	$90,571,674	$1,683,596	$92,255,270
	Total for Year	**$196,672,925**	**$3,413,022**	**$200,085,947**
Project Totals	Direct	$212,202,501	$3,458,853	$215,661,354
	Indirect and Induced	$181,143,349	$3,367,191	$184,510,540
	Total for Construction Period	**$393,345,849**	**$6,826,045**	**$400,171,894**

Note: Assumes 50% of total work and cost during each year of the two year construction period.

Based on average OCCC Total Construction/Development Costs (all inclusive except construction loan interest) estimated at $576.7 million plus $45 million for WCCC Expansion costs. Cumulative costs for both projects is $621.7 million.

(1) Oahu (City and County of Honolulu) is estimated to capture 98.26% of all economic output created by projects.
(2) Neighbor Islands estimated to capture 1.74% of all economic output created by projects.

Source: DBEDT "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom Team.

TABLE 15B

ESTIMATED CONSTRUCTION WAGES PAID DURING REPLACEMENT OF OCCC AND EXPANSION OF WCCC Expressed in Constant 2017 Dollars				
	Type of Employment	Oahu	Neighbor Islands	Total State
Year 1	Direct (1)	$84,741,905	$1,729,427	$86,471,331
	Indirect and Induced (2)	$82,496,187	$1,683,596	$84,179,783
	Total for Year	**$167,238,092**	**$3,413,022**	**$170,651,114**
Year 2	Direct	$84,741,905	$1,729,427	$86,471,331
	Indirect and Induced	$82,496,187	$1,683,596	$84,179,783
	Total for Year	**$167,238,092**	**$3,413,022**	**$170,651,114**
Project Totals	Direct	$169,483,809	$3,458,853	$172,942,662
	Indirect and Induced	$164,992,375	$3,367,191	$168,359,566
	Total for Construction Period	**$334,476,184**	**$6,826,045**	**$341,302,228**

Note: Assumes 50% of total work and cost during each year of the two year construction period.

Based on average OCCC Total Construction/Development Costs (excluding F,F&E, Utilities During Construction, Any Land Acquisition, Start-Up/Working Capital, and Pre-Opening Supplies) estimated at $562.6 million plus $45 million for WCCC Expansion costs. Cumulative costs for both projects is $607.6 million.

(1) From "Occupational Employment and Wage Data - Honolulu MSA", State Department of Labor and Industrial Relations, 2016. Mean Annual wage for "Construction and Extraction Occupations" of $66,300, escalated to 2017 at 3% for current mean annual wage of $68,300.
(2) From DBEDT Hawaii County Input/Output Model, Table "2012-County-I-O-Condensed Final Demand Earnings Multipliers - Type I and Type II'", with resulting average annual wage of $50,735 per worker-year.

Source: DBEDT "State" and "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom

TABLE 15C

ESTIMATED PROFESSIONAL SERVICES WAGES PAID DURING REPLACEMENT OF OCCC AND EXPANSION OF WCCC Expressed in Constant 2017 Dollars				
	Type of Employment	Oahu	Neighbor Islands	Total State
Year 1	Direct (1)	$21,359,346	$0	$21,359,346
	Indirect and Induced (2)	$8,075,487	$0	$8,075,487
	Total for Year	**$29,434,833**	**$0**	**$29,434,833**
Year 2	Direct	$21,359,346	$0	$21,359,346
	Indirect and Induced	$8,075,487	$0	$8,075,487
	Total for Year	**$29,434,833**	**$0**	**$29,434,833**
Project Totals	Direct	$42,718,692	$0	$42,718,692
	Indirect and Induced	$16,150,974	$0	$16,150,974
	Total for Construction Period	**$58,869,665**	**$0**	**$58,869,665**

Note: Assumes 50% of total work and cost during each year of the two year construction period.

Based on financial, insurance, business and professional services estimated at $64.7 million for the total projects.

(1) From "Occupational Employment and Wage Data - Honolulu MSA", State Department of Labor and Industrial Relations, 2016. Averaged Mean Annual wage for Architectural & Engineering, Legal, and Business & FInancial of $76,800, escalated to 2017 at 3% for current mean annual wage of $79,200.

(2) Estimated average wages of $50,735 per worker-year in conformance with Construction wages indirect/induced pay estimates. See footnote # 2 on Table 14.

Source: DBEDT "State" and "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom

Based on extrapolation of 2016 data for Honolulu County compiled by the State Department of Labor & Industrial Relations, salaries for workers engaged in construction of the proposed OCCC project would average $68,300 per year and $79,100 annually for professional services positions. Indirect/induced workers are estimated to have an average annual wage of $50,735.

5.6 Tax Revenues

Construction activities, including the procurement of materials and labor, would generate additional revenues to the State through income and general excise taxes and other fees. Tax revenues were estimated using the DBEDT model tax multipliers. The DBEDT model captures tax revenues generated through general excise taxes (GET), transient accommodations taxes (TAT), fuel taxes, and other fees for both the construction and operation phases of the facility. Because tax revenues primarily flow to the State government, the model uses the DBEDT tax multipliers for the County.

Tax revenues were estimated by applying the DBEDT Oahu tax multipliers to the total annual construction cost estimates as displayed on Table 16. Using this method, the DBEDT model estimates that tax revenues would total $80.2 million over the 24 months of construction, or an annual average of approximately $40.1 million. Although small relative to the $10.9 billion that the State of Hawaii is expected to receive in 2017 and the $2.2 billion in taxes and fees collected by Honolulu County during the same year (as was shown on Table 1), it is nonetheless a positive contribution to government revenue generation.

TABLE 16

ESTIMATED ANNUAL STATE TAX REVENUES GENERATED DURING CONSTRUCTION OF REPLACEMENT OCCC AND EXPANSION OF WCCC

Expressed in Constant 2017 Dollars

	Type of Tax Revenue	Total State Tax Revenues (1)
Year 1	Direct	$19,823,363
	Indirect and Induced	$20,275,385
	Total for Year	**$40,098,748**
Year 2	Direct	$19,823,363
	Indirect and Induced	$20,275,385
	Total for Year	**$40,098,748**
Project Totals	Direct	$39,646,725
	Indirect and Induced	$40,550,770
	Total for Construction Period	**$80,197,495**

Note: Assumes 50% of total work and cost during each year of the two year construction period.

Based on average OCCC Total Construction/Development Costs (all inclusive except construction loan interest) estimated at $576.7 million plus $45 million for WCCC Expansion costs. Cumulative costs for both projects is $621.7 million.

(1) From DBEDT Hawaii County Input/Output Model, Table "2012-County-I-O-Condensed Final Demand State Tax Multipliers - Type I and Type II"' weighted between the construction output multiplier of .1291 representing 89.5 percent of economic activity and finance and insurance/professional services multiplier of .1281 which represents 10.5 percent of economic activity; with concluded multiplier of 2.05.

Source: DBEDT "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom Team.

5.7 Impact on Population and Demographics

Because the construction phase would be temporary, construction of the proposed OCCC project is not expected to result in any long-term impacts on population growth or demographics in Honolulu County or Hawaii and any short-term changes to the baseline population and demographic composition of the County would be minor.

Unemployment in the construction sector declined during the construction activity surge from 2013 through 2016, as the job count grew meaningfully on an annual basis. The sector appears to now be stabilizing and unemployment is expected grow or show nominal change as the wave of projects in recent years are completed and fewer break-ground. It is anticipated that most of construction jobs required to build the facilities would be filled by currently employed, unemployed or underutilized construction workers whose permanent residence is within Honolulu County and will not require any substantial in-migration of tradespersons.

5.8 Impact on Housing Market

Due to the abundant skilled labor force available on the island, virtually the entire construction workforce is expected to come from Honolulu County. For this reason, and because construction jobs would be temporary, construction of additional housing to accommodate the incoming workers is not expected. For any workers that do relocate, there are residential properties available for purchase or lease given their anticipated income levels. As indicated in Chapter 3 (Economic and Social Environment), Honolulu County reported more than 7,340 non-vacation rental units available for lease in 2015. While the market has tightened slightly since then, there would still be supply available to meet any housing needs resulting from relocating construction workers and no or negligible adverse impact on the supply or prices of rental units or on the overall housing market in Honolulu County.

5.9 Impact on Agriculture/Food Services

A total of 6,526 direct, indirect, and induced jobs is expected to be created state-wide (primarily in Honolulu County) during the 24-month construction phase. As virtually all these jobs are expected to be filled by existing residents of the County there would be no additional impact on demand for agricultural products grown locally as it is already in-place. There could be a small increase in food demand through employment of previously unemployed or underemployed workers. However, this increased demand would be minor and could be met through local production.

6. ECONOMIC IMPACTS OF OPERATING PHASE

6.1 Introduction

Operation and maintenance of the facilities comprising the proposed OCCC project would generate direct economic activity, permanent FTE employment, and income/earnings exclusively in Honolulu County. Because the annual operating cost of the new facility is estimated to be "only" $61.6 million the economic impacts will be generally less than the existing OCCC which costs $67.2 million to operate (or $65.9 million when adjusted for crowding). The net economic and spillover effects to Oahu and other parts of the State will be nominal to non-existent.

Therefore, the focus is on only on the economic impacts from the new facility operations without comparison to the existing OCCC operations apart from the initial table in this section. The operational impacts are again estimated using multipliers from DBEDT's "County Government" sector.

Operational impacts associated with the proposed expansion of WCCC have not been included because sufficiently detailed plans and projected operating data were not available as of the study date.

6.2 Operating Expenditures and Staffing Requirements

The total annual operating and maintenance costs of the proposed OCCC are estimated at approximately $61.6 million, compared to $67.3 million to $65.9 million at the existing OCCC. Further, due to the larger capacity and/or modern design of the proposed facilities, operational costs per inmate per day are expected to increase/decrease by approximately 35 percent compared to the existing OCCC. Table 17A provides a comparison of operating expenditures, employment, operating capacity, and cost per inmate per day between the current and proposed facilities. Table 17B summarizes staffing requirement.

TABLE 17A

COMPARISON OF OPERATING COSTS FOR THE EXISTING AND REPLACEMENT OCCC

	Operating Costs		Difference Between Facilities	
Category	Existing OCCC for Fiscal Year 2016	Replacement OCCC Projected for 2017 (1)	Dollars/Beds	Percent
Operating Costs				
"As Is" - With Crowding	$67,255,489			
Adjusted - Without Crowding	$65,888,603	$61,582,949	($4,305,654)	-6.5%
Number of Beds (Capacity in Persons)	954	1,380	426	44.7%
Annual Cost per Bed (w/o crowding)	$69,066	$44,625	($24,440)	-35.4%
Daily Cost per Bed (w/o crowding)	$189	$122	($67)	-35.4%

(1) Based on mid-point between the two identified alternatives "Low -Rise Facility" and "Multilevel Facility".

Source: "Estimated Staffing and Operating Costs Report - Oahu Community Corrrectional Center", Criminal Justice Planning Services, January 2017, and CBRE/Hallstrom Team.

TABLE 17B

COMPARISON OF FULL-TIME EQUVALENT EMPLOYMENT POSITIONS FOR THE EXISTING AND REPLACEMENT OCCC

	FTE Positions		Difference Between Facilities	
Section	Existing OCCC for Fiscal Year 2016	Projected for Replacement OCCC (1, 2)	Positions	Percent
Administration & Records	9	9	0	0.0%
Security	415	370	-45	-10.9%
Office Services	15	15	0	0.0%
Residency	18	18	0	0.0%
Community Base Section	23	23	0	0.0%
Facility Operations	23	23	0	0.0%
Total Positions	**503**	**458**	-45	-9.0%

(1) Based on mid-point between the two identified alternatives "Low -Rise Facility" and "Multilevel Facility".
(2) Non-Security positions assumed to be same in existing and replacement OCCC; thee is no indication otherwise in Criminal Justice Planning report.

Source: "Estimated Staffing and Operating Costs Report - Oahu Community Corrrectional Center", Criminal Justice Planning Services, January 2017, and CBRE/Hallstrom Team.

6.2.1 Transportation Expenditures

The existing OCCC facility is centrally located in the City of Honolulu and about two miles from the district and circuit courthouses, hospitals and specialty medical facilities. On average, an estimated 55 trips per week are taken between the existing OCCC and courthouses and medical facilities. Travel to and from courthouses accounts for about 73 percent of the total inmate trips; the remainder represent trips to medical facilities. For purposes of this analysis it is assumed that the proposed OCCC would be located at the Mililani Technology Park which is the alternative site located furthest away from courthouses and medical facilities located in downtown Honolulu at approximately 20 miles or 55 minutes travel time (one-way). While expenditures required to transport inmates to and from the new facility are therefore expected to increase, the increases will be modest (Tables 18 and 19). Details of this transportation analysis are provided in Appendix C.

TABLE 18

TRAVEL TIME TO COMMON DESTINATIONS FROM EXISTING OCCC AND PROPOSED OCCC ASSUMING OCCC IS RELOCATED TO MILILANI TECH PARK

	Stabilized Hours per Year		
Destination	Existing OCCC	Relocated OCCC	Difference
Courthouse	693	3,813	3,120
Hospital/Medical Facilities	260	1,430	1,170
Total	**953**	**5,243**	**4,290**

Notes:

The Mililani Tech Park site was selected for comparison as it is the most remote of the four sites being considered for relocating OCCC, making this a "worst case" comparison scenario.

Travel time calculated by multiplying the number of trips by 2 (return trip), by the approximate time taken for each trip (10 minutes for the existing OCCC for both courthouses and hospital, and 55 minutes for the proposed facility) by the number of weeks (52) in a year, divided by 60 minutes in order to determine the number of hours. The new OCCC-to-courthouse travel time would be: 2 x 55 x 40 x 52/60 = 3,813.3 hours.

TABLE 19

TRAVEL COSTS TO COMMON DESTINATIONS FROM EXISTING OCCC AND PROPOSED OCCC ASSUMING OCCC IS RELOCATED TO MILILANI TECH PARK

	Stabilized Hours per Year		
Destination	Existing OCCC	Relocated OCCC	Difference
Courthouse	$8,320	$83,200	$74,880
Hospital/Medical Facilities	$3,120	$31,200	$28,080
Total	**$11,440**	**$114,400**	**$102,960**

Notes:

The Mililani Tech Park site was selected for comparison as it is the most remote of the four sites being considered for relocating OCCC, making this a "worst case" comparison scenario.

Cost calculated by multiplying the distance by the operating cost per mile ($1) by the number of trips by 2 (return trip) by the number of weeks in a year (52). For the current OCCC it would be: $1 x 2 x 40 x 2 x 52 = $8,320 per year.

6.3 Impacts on Employment

As shown on Table 20, at stabilized operation, the proposed redeveloped/relocated OCCC project is expected to employ approximately 458 staff members or about 45 less than the 503 currently employed at the existing OCCC. Direct employment would be generated in a variety of occupations, with the additional jobs ranging from corrections officers to administrative, treatment, counseling, and managerial positions. Using the direct effects multipliers established by the DBEDT County model yields an estimated 705 total jobs (i.e., direct, indirect, and induced) created in Honolulu County. Because the facilities would be operated and managed within Honolulu County, it is expected that no direct jobs would flow elsewhere in the state, but that some 12 indirect/induced positions would flow to the neighbor islands.

As noted earlier, indirect and induced employment results from increased spending by firms participating in the project and from increased household spending. In this case, it is PSD, through its purchases of goods and services that would be responsible for stimulating indirect employment.

TABLE 20

ESTIMATED OPERATING FULL-TIME EQUIVALENT EMPLOYMENT POSITIONS OF REPLACEMENT OCCC

Expressed in Constant 2017 Dollars

	Type of Employment	Oahu (1)	Neighbor Islands (2)	Total State
Stabilized Year	Direct	458	0	458
	Indirect and Induced (3)	235	12	247
	Total Annual Employment	**692**	**12**	**705**

(1) Oahu (City and County of Honolulu) is estimated to capture 100.0% of all direct employment created by project operations.
(2) Oahu is estimated to capture 95% of all indirect & induced employment created by project operations and the neighbor islands 5%.

(3) From DBEDT Hawaii County Input/Output Model, Table "2012-County-I-O-Condensed County Job Direct Effect Total Jobs Multipliers - Type I and Type II'" equally weighted between the government total jobs multiplier of 1.49 and other services multiplier of 1.58; with concluded multiplier of 1.54.

Source: DBEDT "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom Team.

6.3.1 Types of Jobs

Jobs at the new facilities would range from entry-level positions with few qualification requirements to skilled professional positions requiring higher levels of educational attainment and work experience. In general, these jobs include:

Program Services

- Education and Library: librarian and education specialists.
- Counseling: substance abuse specialists, volunteer coordinator, office assistant.

Health Care Services

- Physician, psychiatrist, registered nurses, social workers, nurse supervisors, nurse administrator, medical records technician, clerk, pharmacist.

Corrections and Facility Operations

- Corrections: managers, supervisors, adult corrections officers (including the Chief of Security, Captains, Lieutenants, Sergeants, and officers), etc.
- Office Management and Support: managers, supervisors, office assistants, and clerks.
- Building and Grounds: building maintenance supervisor, plumbers, electricians, groundskeepers, laundry manager, etc.

6.3.2 Sources of Workers

All the anticipated jobs needed to operate the new facilities could be filled by workers currently employed at OCCC, LWFC and WCCC. Any remaining positions are expected to be filled by residents of Honolulu County. Few, if any, of the additional jobs created would require skills or work experience not currently available in the resident labor force.

6.3.3 Advantages of Hiring Local Workers

As mentioned above, most or all the direct positions would be filled by Honolulu County residents. Hiring from within the County, and to a lesser degree from within the State, offers a number of advantages, most notably the avoidance of employee relocation costs and that workers are available for immediate training and employment. Hiring local workers also serves to reduce County unemployment levels and leaves the demand for public services unchanged.

6.4 Economic Output

Operation of the proposed OCCC project would require the on-going purchase of goods and services that contribute to the economic output of the County. Table 21 presents the DBEDT Oahu model estimates of the increased annual economic output for Honolulu County during the operating phase. The annual increase in output for Honolulu County is projected to be $116.8 million, with a total annual increase in State economic output of about $126.5 million.

TABLE 21

ESTIMATED OPERATING ECONOMIC OUTPUT OF REPLACEMENT OCCC

Expressed in Constant 2017 Dollars

	Type of Economic Output	Oahu (1)	Neighbor Islands (2)	Total State
Stabilized Year	Direct	$61,582,949	$0	$61,582,949
	Indirect and Induced (3)	$55,224,510	$9,745,502	$64,970,011
	Total Annual Economic Output	**$116,807,459**	**$9,745,502**	**$126,552,960**

Based on Mid-Point Estimated Operating Costs for Replacement OCCC Facility of $61.5 Million Annually.

(1) Oahu (City and County of Honolulu) is estimated to capture 100.0% of all direct economic output created by project operations
(2) Oahu is estimated to capture 85% of all direct economic output created by project operations and the neighbor islands 15%.

(3) From DBEDT Hawaii County Input/Output Model, Table "2012-County-I-O-Condensed Final Demand Output Multipliers - Type I and Type II" equally weighted between the government total jobs multiplier of 1.81 and other services multiplier of 2.30; with concluded multiplier of 2.06.

Source: DBEDT "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom Team.

6.5 Income and Salaries

Annual operation of the proposed OCCC project is forecasted to generate about $53.9 million of direct income within Honolulu County. Indirect and induced income will add another $31 million in income, of which $29.4 million would remain on Oahu and $1.5 million flowing to the neighbor islands resulting in a statewide total of income from all sources of approximately $84.7 million (Table 22).

TABLE 22

ESTIMATED OPERATING ANNUAL INCOME GENERATED BY REPLACEMENT OCCC

Expressed in Constant 2017 Dollars

	Type of Income	Oahu (1)	Neighbor Islands (2)	Total State
Stabilized Year	Direct	$53,885,080	$0	$53,885,080
	Indirect and Induced (3)	$29,434,725	$1,549,196	$30,983,921
	Total Annual Income	**$83,319,806**	**$1,549,196**	**$84,869,002**

Based on Criminal Justice Planning Services Estimate of staffing costs constituting 87.5 percent of facility operating costs, with mid-point of two alternative replacement OCCC options staffing costs of $49.2 million annually.

(1) Oahu (City and County of Honolulu) is estimated to capture 100.0% of all direct Annual Income created by project operations.
(2) Oahu is estimated to capture 95% of all indirect & induced Annual Income created by project operations and the neighbor islands 5%.

(3) From DBEDT Hawaii County Input/Output Model, Table "2012-County-I-O-Condensed Direct Effect Earnings Multipliers - Type I and Type II'" equally weighted between the government earningss multiplier of 1.39 and other services multiplier of 1.76; with concluded multiplier of 1.58.

Source: DBEDT "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom Team.

6.6 Tax Revenues

Operation and maintenance activities including the purchases of labor and goods would result in additional income and GET revenues to the State government. Tax revenues were estimated based on generated earnings and induced output. Using this method, the DBEDT County model estimates $5.5 million in direct annual tax revenues accruing primarily to the State government and about $950,000 in indirect and induced taxes, cumulatively totaling $6.4 million (Table 23).

TABLE 23

ESTIMATED ANNUAL STATE TAX REVENUES GENERATED DURING OPERATION OF REPLACEMENT OCCC Expressed in Constant 2017 Dollars	Type of Tax Revenue	Total State Tax Revenues (1)
Stabilized Year	Direct	$5,488,272
	Indirect and Induced	$953,304
	Total Annual State Tax Revenue	**$6,441,576**

Based on estimated stabilized annual operating costs of $61.6 million, the mid-point between the two replacement facility options.

(1) From DBEDT Hawaii County Input/Output Model, Table "2012-County-I-O-Condensed Final Demand State Tax Multipliers - Type I and Type II"" equally weighted between the government state tax multiplier of 0.0876 and other services multiplier of 0.1216; with concluded multiplier of .1046.

Source: DBEDT "Hawaii Inter-County" Input/Output Economic Models (2012), Cumming, and CBRE/Hallstrom Team.

6.7 Impact on Population and Demographics

Given the nature and scale of the Honolulu County economy, it can be expected the labor requirements necessary to operate the proposed OCCC facility would be met by the local labor force. Most of the staffing needs would be met by existing OCCC employees with any additional openings requiring skills or experience already available in Honolulu County. There would be no significant adverse impact to the County's population growth or demographic composition.

6.8 Impact of Operations on Agriculture

6.8.1 Oahu Community Correctional Center Employees

As reported earlier, approximately 458 direct and 284 indirect and induced jobs are expected to be created from the operation of the proposed OCCC project. Because most or all these jobs would be filled by existing Honolulu County residents, the project would have no impact on agricultural production.

6.8.2 Oahu Community Correctional Center Inmates and their Families

Because the proposed facilities would be able to accommodate more inmates than the existing facilities, total food expenditures would be higher in the future. The increased expenditures on food and food services could be largely supplied by growers and farmers in Honolulu County, including meat, dairy, fruit, and vegetables products. However, because a majority of these inmates and their families are already residents of the County, the overall impact of the new/expanded facilities on agricultural production would be minimal. Nonetheless, the following instances would lead to slight increases in food and food service demand in the region:

- Increased purchases of food and food services by previously unemployed residents now employed as a direct or indirect result of the project; and
- Increased County population resulting from non-residents relocating to Honolulu due to increased job opportunities.

While these particular circumstances could increase food demand in the County, their overall impact on agricultural production would be minimal.

6.9 Impact of Operations on Housing

6.9.1 Oahu Community Correctional Center Employees

The proposed redeveloped/relocated OCCC facility will have employment at or below the levels of the existing OCCC operations positions by employees who already live on-island. Any additional open positions would be filled by residents of Honolulu County. Without a significant increase in population attributable to operating and maintaining the proposed OCCC project, there would be no significant impact to the housing market.

6.9.2 Oahu Community Correctional Center Inmates and Families

Inmates of the OCCC are already residents of Honolulu County and as such, would have minimal impact on the housing market. Family members would already be established in the community and so the need for additional housing, schooling, and/or other such facilities and services would not be necessary. As indicated in Chapter 3 (Economic and Social Environment), more than 7,340 non-vacation rental units were available for rent in Honolulu County in 2015. Hence, there would be ample supply available to meet any housing needs and there would be no or negligible adverse impact on the supply or prices of rental units or on the overall housing market in the County.

6.10 Other Economic Impacts

It currently costs the State of Hawaii $189 per bed per day to house inmates at the existing OCCC facility. The new redeveloped/relocated OCCC is estimated to have operating costs equivalent to $122 per bed per day. The State will experience a net savings of $67 per bed per day or $4.3 million per year.

The State of Hawaii currently houses a portion of its prison population in privately-owned and operated correctional facilities on the U.S. mainland. This arrangement is unrelated to housing OCCC, LWFC and WCCC inmates on Oahu and has no bearing on the economics of housing such inmates under the proposed project.

7. FISCAL CONSIDERATIONS

7.1 Introduction

Fiscal considerations are those having to do with the public treasury or revenues. Potential fiscal impacts could include removal of the lands comprising the project sites from the public tax rolls, acquisition of the project site through the use of public funds, and other public expenditures related to the proposed action such as infrastructure extensions and improvements. Fiscal considerations associated with state actions, such as the proposed development of a new OCCC and expansion to WCCC, are of particular interest to local governments due to the potential loss of property tax revenues since state agencies typically do not pay property taxes or make similar payments to local governments for state institutions or facilities.

7.2 Current Conditions

7.2.1 Existing OCCC Site

The existing OCCC site (TMK: 12013002) is located in the Kalihi Ahupua'a, Kona District on approximately 16 acres of land within which the proposed OCCC development site would encompass approximately 8 acres of the overall property. In the case of the existing OCCC site, the entire property has been under State of Hawaii ownership for many years and, therefore, is exempt from property tax payments.

7.2.2 Animal Quarantine Station Site

The Animal Quarantine Station site (TMK: 99010058; 99010057; 99010054; 99010046; 99010006) is located in the Halawa Ahupua'a, 'Ewa District on approximately 35 acres of land bisected by H-3. The proposed OCCC development site would encompass approximately 25 acres located within the eastern portion of the overall property with the remaining 10 acres located west of H-3 to be used for development of a new Animal Quarantine Station to replace that lost to OCCC development (a requirement to developing a new OCCC at this site). In the case of the Animal Quarantine Station site, the entire property has been under Federal Government and State of Hawaii ownership for many years and, therefore, is exempt from property tax payments.

7.2.3 Halawa Correctional Facility Site

The Halawa Correctional Facility site (TMK: 99010030) is also located in the Halawa Ahupua'a, 'Ewa District. The entire Halawa Correctional Facility encompasses approximately 31 acres of land, within which the proposed OCCC development site encompasses approximately 5 acres located within the northeastern portion of the overall property. In the case of the Halawa Correctional Facility site, the entire property has been under State of Hawaii ownership since the correctional facility was developed many years ago and, therefore, is exempt from property tax payments.

7.2.4 Mililani Technology Park, Lot 17 Site

The Mililani Technology Park, Lot 17 site (TMK: 95046041; 95046042) is located in the Waikele Ahupua'a, 'Ewa District on approximately 40 acres of undisturbed land bordered to the west, south and east by the Waikakalaua and Kipapa gulches. Given the size and location of the gulches, only approximately 19 acres are suitable for OCCC development with the balance to remain undeveloped as buffer between the site and neighboring properties. In the case of the Mililani Technology Park site, the property has been under private ownership (Castle & Cooke) for many years and, therefore, contributes property tax payments of approximately $117,023 annually to the City and County of Honolulu.

7.2.5 WCCC

WCCC (TMK: 42003004; 42003026; 42003025; 42003024) is located in the Kailua Ahupua'a, Ko'olaupoko District on approximately 122 acres of land situated north of the Kalanianaole Highway. In the case of WCCC, the entire property has been under State of Hawaii ownership for many years and, therefore, is exempt from property tax payments.

7.3 Potential Impacts and Mitigation

Potential fiscal impacts could include removal of the lands comprising the project sites from the public tax rolls, acquisition of the project site through the use of public funds, and other public expenditures related to the proposed action such as infrastructure extensions and improvements. Fiscal considerations associated with state actions, such as the proposed development of a new OCCC and expansion to WCCC, are of particular interest to local governments due to the potential loss of property tax revenues associated with development of new state institutions or facilities.

7.3.1 Existing OCCC Site

Development of the proposed OCCC would encompass approximately 8 acres of the overall 16-acre OCCC property. In the case of the existing OCCC site, the entire property has been under State of Hawaii ownership for many years and is exempt from property tax payments. Therefore, development of the proposed OCCC at the existing OCCC site will result in no direct loss of property tax revenue to the City and County of Honolulu.

Positive fiscal impacts will result from the economic benefits derived from the new OCCC's construction and operational phases, as well as from multiplier effects caused by the economic activity generated by the new facility and its employees. Expenditures for utility services and related expenses are recouped through the state's payment of user fees and, therefore, have no net impact. It must be noted that as a replacement for the existing OCCC, operation of the new OCCC will not generate additional economic activities that would derive if it was an additional facility.

Utilizing approximately 8 acres of the 16-acre existing OCCC property for development of the new OCCC will also result in the eventual redevelopment of some or all of the 8 acres of state-owned land in Kalihi. The nature, scale, scope, and timing of any redevelopment will be determined by the State of Hawaii as the property owner and the City and County of Honolulu which has land use planning and development approval authority. While it can be expected redevelopment of the 8 acres will generate additional tax revenues to the state and contribute property tax payments to the City and County of Honolulu, the amount of such payments and whether the payments will offset the costs associated with redevelopment cannot be determined at this time.

Given that no significant adverse fiscal impacts are expected as a result of developing the proposed OCCC project at the existing OCCC site, no mitigating measures are required.

7.3.2 Animal Quarantine Station Site

Development of the proposed OCCC would encompass approximately 25 acres of the overall 35-acre Animal Quarantine Station property. In the case of the Animal Quarantine Station site, the entire property has been under Federal Government and State of Hawaii ownership for many years and is exempt from property tax payments. Therefore, development of the proposed OCCC at the Animal Quarantine Station site will result in no direct loss of property tax revenue to the City and County of Honolulu.

Positive fiscal impacts will result from the economic benefits derived from the new OCCC's construction and operational phases, as well as from multiplier effects caused by the economic activity generated by the new facility and its employees. Expenditures for utility services and related expenses are recouped through the state's payment of user fees and, therefore, have no net impact. It must be noted that as a replacement for the existing OCCC, operation of the new OCCC will not generate additional economic activities that would derive if it was an additional facility.

Positive fiscal impacts will also result from the economic benefits derived from developing a new facility to replace the existing Animal Quarantine Station (a requirement to developing a new OCCC at this site.) These benefits are associated with the new Animal Quarantine Station's construction and operational phases, as well as from multiplier effects caused by the economic activity generated by the new facility and its employees. It must be noted that as a replacement for the existing Animal Quarantine Station, operation of the new Animal Quarantine Station will not generate additional economic activities that would derive if it was an additional facility.

Relocating the new OCCC from its current location to the Animal Quarantine Station site will also result in the eventual redevelopment of some or all of the 16 acres of state-owned land in Kalihi. The nature, scale, scope, and timing of any redevelopment will be determined by the State of Hawaii as the property owner and the City and County of Honolulu which has land use planning and development approval authority. While it can be expected such redevelopment will generate additional tax revenues to the state and contribute property tax payments to the City and County of Honolulu, the amount of such payments and whether the payments will offset the costs associated with redevelopment cannot be determined at this time.

Given that no significant adverse fiscal impacts are expected as a result of developing the proposed OCCC project at the Animal Quarantine Station site, no mitigating measures are required.

7.3.3 Halawa Correctional Facility Site

Development of the proposed OCCC would encompass approximately 5 acres of the overall 31-acre Halawa Correctional Facility property. In the case of the Halawa Correctional Facility site, the entire property has been under State of Hawaii ownership for many years and is exempt from property tax payments. Therefore, development of the proposed OCCC at the Halawa Correctional Facility site will result in no direct loss of property tax revenue to the City and County of Honolulu.

Positive fiscal impacts will result from the economic benefits derived from the new OCCC's construction and operational phases, as well as from multiplier effects caused by the economic activity generated by the new facility and its employees. Expenditures for utility services and related expenses are recouped through the state's payment of user fees and, therefore, have no net impact. It must be noted that as a replacement for the existing OCCC, operation of the new OCCC will not generate additional economic activities that would derive if it was an additional facility.

Relocating the new OCCC from its current location to the Halawa Correctional Facility site will also result in the eventual redevelopment of some or all of the 16 acres of state-owned land in Kalihi. The nature, scale, scope, and timing of any redevelopment will be determined by the State of Hawaii as the property owner and the City and County of Honolulu which has land use planning and development approval authority. While it can be expected such redevelopment will generate additional tax revenues to the state and contribute property tax payments to the City and County of Honolulu, the amount of such payments and whether the payments will offset the costs associated with redevelopment cannot be determined at this time.

Given that no significant adverse fiscal impacts are expected as a result of developing the proposed OCCC project at the Halawa Correctional Facility site, no mitigating measures are required.

7.3.4 Mililani Technology Park, Lot 17 Site

Development of the proposed OCCC would encompass approximately 19 acres of the overall 40-acre Mililani Technology Park site. In the case of the Mililani Technology Park site, the entire property has been in private ownership (Castle & Cooke) for many years and contributes approximately $117,023 annually in property tax payments to the City and County of Honolulu. Therefore, acquisition of the property by the State of Hawaii and development of the proposed OCCC at the Mililani Technology Park site will result in the direct loss of $117,023 in annual property tax revenue to the City and County of Honolulu. The amount of the tax revenue lost represents less than 0.007 percent of the total revenues collected annually by the City and County of Honolulu.

Positive fiscal impacts will result from the economic benefits derived from the new OCCC's construction and operational phases, as well as from multiplier effects caused by the economic activity generated by the new facility and its employees. Expenditures for utility services and related expenses are recouped through the state's payment of user fees and, therefore, have no net impact. It must be noted that as a replacement for the existing OCCC, operation of the new OCCC will not generate additional economic activities that would derive if it was an additional facility.

Relocating the new OCCC from its current location to the Mililani Technology Park site will also result in the eventual redevelopment of some or all of the 16 acres of state-owned land in Kalihi. The nature, scale, scope, and timing of any redevelopment will be determined by the State of Hawaii as the property owner and the City and County of Honolulu which has land use planning and development approval authority. While it can be expected such redevelopment will generate additional tax revenues to the state and contribute property tax payments to the City and County of Honolulu, the amount of such payments and whether the payments will offset the costs associated with redevelopment cannot be determined at this time.

Given that no significant adverse fiscal impacts are expected as a result of developing the proposed OCCC project at the Mililani Technology Park site, no mitigating measures are required.

7.3.5 WCCC

Development of the proposed improvements at WCCC would encompass approximately 5-10 acres of the overall 122-acre property. In the case of WCCC, the entire property has been under State of Hawaii ownership for many years and is exempt from property tax payments. Therefore, development of the proposed improvements at WCCC will result in no direct loss of property tax revenue to the City and County of Honolulu.

Positive fiscal impacts will result from the economic benefits derived from construction of the proposed improvements at WCCC and its operational phase, as well as from multiplier effects caused by the economic activity generated by the expanded facility and its employees. Expenditures for utility services and related expenses are recouped through the state's payment of user fees and, therefore, have no net impact.

Given that no significant adverse fiscal impacts are expected as a result of developing the proposed improvements at WCCC, no mitigating measures are required.

APPENDIX A: DBEDT MODEL DEMAND DEFINITIONS AND MULTIPLIERS

Definitions

As used in the State of Hawaii, DBEDT, Research and Economic Analysis Division's "The Hawaii State Input-Output Study: 2012 Benchmark Report" and the "The 2012 Hawaii Inter-County Input-Output Study" the three types of economic effects (or impacts) are identified as:[iv]

- Direct Effect: measures the initial effect attributable to the exogenous change.
- Indirect Effect: measures the subsequent intra- and inter-industry purchases of inputs resulting from the initial change in output of the directly affected industry.
- Induced Effect: is the effect of this change on earnings and personal consumption expenditures (PCEs); it is considered an endogenous sector generated by the new inputs.

These effects are quantified and converted into two types of multipliers in the DBEDT model:

- Type I: Impacts are calculated to include both Direct and Indirect Impacts.
- Type II: Impacts are calculated to include Direct, Indirect, and Induced Impacts

Our focus is on Type II multipliers which potentially identify the entirety of the island and statewide impacts of an economic activity.

According to DBEDT, the two most popular multipliers are "final-demand" and "direct-effect" multipliers. The final-demand multiplier for an industry measures the total change in a variable (e.g. output, earnings, state taxes, wage and salary jobs, or total jobs) that results from a change in that industry's final demand. An industry's direct-effect multiplier measures the total change in a variable that results from an additional unit change in the same variable in that industry.

Within the "construction phase" of the redevelopment of OCCC and the expansion of WCCC, only final-demand multipliers have been used. In the "operation phase" use of final-demand and direct-effect multipliers are used where appropriate.

As an estimated 98.26 percent of the total economic impacts resulting from the construction and operation of the OCCC and WCCC projects will occur on Oahu, the analysis has exclusively employed DBEDT "Oahu" multipliers as extracted from "The 2012 Hawaii Inter-County Input-Output Study", as shown on Table A1.

[iv] The 2012 State Input-Output Study for Hawaii. Research and Economic Analysis Division, Department of Business, Economic Development, and Tourism, August 2016.

Appendix A - TABLE A1

FINAL-DEMAND ECONOMIC IMPACT MULTIPLIERS FOR OAHU (1)

Construction Phase

Basis	Final Demand Multipliers							
Category	Output (2012)		Earnings (2012)		Total Jobs (2017)		State Tax (2012)	
Multiplier Type	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
Construction County Category: O-S2	1.45	2.04	0.47	0.63	6.30	10.80	0.0981	0.1291
Finance and Insurance/ Professional Services (2) County Categories: O-S10 and O-S12	1.52	2.17	0.52	0.70	11.30	13.25	0.0938	0.1281

Operations Phase

Basis	Final Demand		Direct Effect		Direct Effect		Final Demand	
Category	Output (2012)		Earnings (2012)		Total Jobs (2012)		State Tax (2012)	
Multiplier Type	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
Government County Category: O-S20	1.07	1.81	1.03	1.39	1.04	1.49	0.0485	0.0876
Other Services County Category: O-S19	1.55	2.30	1.31	1.76	1.24	1.58	0.0823	0.1216
Mid-Point Multiplier (3)		**2.06**		**1.58**		**1.54**		**0.1046**

(1) All multipliers taken from DBEDT "2012 Hawaii Inter-County Input-Output Tables - Condensed" from their website at http://dbedt.hawaii.gov/economic/reports_studies/2012-inter-county-io/. As an estimated 98.26% of the total economic impacts resulting from the construction and operation of the redeveloped OCCC and expansion of WCCC will occur on Oahu, we have exclusively employed Oahu multipliers, which may vary from statewide and neighbor island multipliers.

(2) Multiplier shown is mid-point between the multipliers for the "Finance and Insurance" and "Professional Services" categories.

(3) The mutiplier used on our model application is the mid-point between the Type II "Government" and Other Services" categories.

Source: DBEDT and CBRE/Hallstrom Team.

APPENDIX B: ESTIMATED OCCC REDEVELOPMENT AND WCCC EXPANSION CONSTRUCTION COSTS

The basic construction costs for each of the four proposed OCCC redevelopment alternatives were quantified by the Cumming Corporation in a series of analyses dated August 30, 2017. The summary pages from their estimates is presented on the following pages.

1. OCC Site 1—Animal Quarantine Station Site
2. OCCC Site 2—Kalihi
3. OCCC Site 3—Halawa
4. OCCC Site 4—Mililani Tech Park

The subsequent table (Appendix B, Table B1) prepared by CBRE/Hallstrom Team incorporates our estimates for the cost items excluded from the Cumming analyses based on costs for similar scope items in recent major Oahu construction products or calculated according to industry standards. The result is the effective "all in" construction/development cost for a redeveloped OCCC at each of the four identified sites, excluding financing/construction loan interest costs.

The final table (Appendix B, Table B2) incorporates the estimated $45 million in costs to complete the proposed expansion of WCCC, and allocates the average OCCC replacement cost and WCCC expansion cost into three categories "Construction Cost," "Finance, Insurance, Business and Professional Services" and "Other Non-Allocated Costs."

APPENDIX C: INMATE TRANSPORTATION COSTS FROM RELOCATED OCCC

Transportation costs associated with operation of the existing and the proposed OCCC project were estimated using 2008 OCCC data. An analysis of the number and type of trips undertaken by inmates during a given week in 2008 to and from OCCC is shown in Tables C-1and C-2. Travel from OCCC to the Honolulu District and Circuit courthouses account for about 75 percent of the total trips made by inmates; the rest are trips to medical facilities.

Table C-1: Average Number of Weekly Trips from Existing OCCC (FY2008)

Destination	Number of Trips	Distance from Existing OCCC (miles)	Duration (minutes)
Courthouse	40	2	10
Hospital/medical facilities	15	2	10
Total	55		
Source: Consultant analysis using data from PSD, 2017.			

Table C-2: Distance to Common Destinations to and from Existing OCCC and Proposed OCCC Facility

Destination	Existing OCCC	Proposed OCCC
Courthouse	2 miles	20 miles
Hospital/medical facilities	2 miles	20 miles
Source: Consultant analysis, October 2017.		

For purposes of this analysis it is assumed that the proposed OCCC would be located at the Mililani Technology Park which is the alternative site located furthest away from downtown Honolulu at approximately 20 miles or 55 minutes travel time (one-way). This is particularly relevant since, on average, there are 55 trips per week to courthouses and medical facilities. The time required to travel to court and for medical treatment is illustrated in Table C-3.

Table C-3: Travel Time to Common Destinations from Existing OCCC and Proposed OCCC (Hours per Year)

Destination	Existing OCCC	Proposed OCCC
Courthouse	693.3	3,813.3
Hospital/medical facilities	260.0	1,430.0
Total	953.3	5,243.3
Additional hours per year		**4,290.0**

Note: Travel time calculated by multiplying the number of trips by 2 (return trip), by the approximate time taken for each trip (10 minutes for the existing OCCC for both courthouses and hospital, and 55 minutes for the proposed facility assuming a location at the Mililani Technology Park) by the number of weeks (52) in a year, divided by 60 minutes in order to determine the number of hours. Therefore, the new OCCC-to-courthouse travel time would be: 2 x 55 x 52 x 40/60 = 3,813.3 hours.

Source: Consultant analysis, October 2017.

Table C-4 illustrates the travel costs associated with the proposed facility location at the Mililani Technology Park (the alternative site located furthest away from downtown Honolulu). The difference in travel cost for the proposed facility site is considerably higher than the current OCCC location but relatively small in context of the overall OCCC operations and maintenance costs.

Table C-4: Travel Cost to Common Destinations from Existing OCCC and Proposed OCCC (Dollars per Year)

Destination	Existing OCCC	Proposed OCCC
Courthouse	$8,320	$83,200
Hospital/medical facilities	$3,120	$31,200
Total	$11,440	$114,400
Additional cost per year		**$102,960**

Note: The cost is calculated by multiplying the distance by the operating cost per mile ($1) by the number of trips by 2 (return trip) by the number of weeks in a year (52). For the current OCCC-to-courthouse cost, it would be: $1 x 2 x 40 x 2 x 52 = $8,320 per year. For the proposed OCCC-to-courthouse cost, it would be: $1 x 20 x 40 x 2 x 52 = $83,200 per year.

Source: Consultant analysis, October 2017.

Appendix S: Estimated Staffing and Operating Costs Report

Oahu Community Correctional Center

October 27, 2017

Reprinted from January 9, 2017

Prepared for:

State of Hawaii
Department of Accounting and General Services
Department of Public Safety

Prepared by:

Criminal Justice Planning Services
Olympia, Washington

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SUMMARY

The report predicts staffing efficiencies and operational savings will be achieved through modern jail design, technology and best practices in staffing. It begins by providing a national perspective on modern jail design and approaches to staffing for low-rise and multilevel facilities. As explained, modern jails include the use of contemporary technology to augment staffing while increasing public safety. Examples include video visiting, video surveillance, electronic records and limited video court. Today's housing units are generally larger than at OCCC and supervisory sergeants are assigned to broad areas of the facility versus each housing unit. Single officers work in general population housing units with an open work station. The officers are supported with the aforementioned technology as wells as a cadre of roving officers that respond when needed. In contrast to modern jails, the layout of OCCC forces the facility to operate like a state prison. Walking from building to building via sidewalks lined with recreation yards not connected to the housing units creates the need for additional staffing, as do separate program and visiting buildings. Additionally, it is highly unusual to see guard towers at today's jails.

In a separate report, the Interim Architectural (IA) Space Program estimates the spaces needed to meet the 10-year OCCC population forecast for males.[1] It serves as the source document of the housing unit requirements for the replacement facility. The detention forecast is almost flat while the pre-release forecast applies a two percent growth rate to the eligible pool of candidates.[2] Thus, the growth is entirely pre-release which is known throughout the corrections industry to be cost beneficial and reduce crime via reduced recidivism. The IA Space Program assumes the facility will be in a single location including pre-trial, sentenced and pre-release inmates. Changing that dynamic such as separating the pre-trial population by any significant amount of geography will likely require a duplication of services in areas such as administration, food service and health care.

OCCC's current staffing represents 87.5 percent of its operating cost. Therefore staffing immediately becomes the focus of the operating cost analysis. Security staffing represents 82.2 percent of all staffing and within security staffing, correctional sergeants and officers represent 94.2 percent. Since the IA Space Program defines the housing units, the heart of the analysis focuses on estimating security staffing for housing units as well as rover staffing and then comparing it to OCCC's current staffing. Other factors such as the location and floor plans of the replacement facility are unknown at this time, so it is not possible to adjust all of the remaining staffing. In order to develop a general staffing scenario for the replacement facility, the revised security staffing is added to OCCC's current non-security staffing.

A comparison of OCCC's current security staffing to those estimated for the IA Space Program conservatively estimates an annual savings of up to 51.2 full-time equivalencies (FTEs) for a single level facility and 39.6 FTEs for a multilevel facility. For a low-rise replacement facility, this translates to savings of $4.8 million annually or $143 million over a 30-year life cycle of the facility compared to the existing OCCC facility. A multilevel facility reduces the staff savings to $3.8 million annually or $115 million over 30 years comparatively.

In addition to saving FTEs and dollars, the replacement facility serves more people. In FY16, OCCC had 1,004 beds. The number of beds provided in the IA Space Program is 1,522.[3] This provides 518 additional beds,

1 Females will receive in-take services at the new OCCC, but will not reside there.

2 PSD reports there are currently 216 pre-release beds with about 300 inmates eligible at any given time.

3 See the Interim Architectural Space Program Housing Configuration section on page 12 for details.

most of which are low cost pre-release beds. The reason why pre-release beds cost less to operate is because the inmates are in minimum security which requires less staffing. This changes the adjusted operating cost per bed from $65,626 to $ 40,153 (-39 percent) for a low-rise facility and from $65,626 to about $40,770 (-38 percent) for a multilevel facility.[4] The current ratio of inmates to housing unit security staffing will change from 4.6 to 8.6. These results are similar to those in the 2009 DLR Group study referenced in the full report. There are likely to be other efficiencies once the layout of the facility and buildings are fully designed. For example, it is assumed there will be no guard towers at the replacement facility which currently represents ten positions at OCCC. However, at least some of these efficiencies will be off-set by non-staffing costs of the additional population.[5] Further study is required after a site is selected and after the buildings are designed for that site.

OCCC is Hawaii's largest and oldest community correction center. Failing to replace it will mean a lost opportunity to increase safety as well as take advantage of efficiencies gained through modern jail design and electronics that produce operational savings. It will also mean the continued maintenance of a facility that appears to be past its useful life cycle.

4 Parking and elevator maintenance costs are additional and may be significant. They cannot be estimated at this time.

5 Non-staffing costs represent 12.5 percent of the per capita cost.

1.0 INTRODUCTION

1.1 Scope

The consultant was asked to estimate future OCCC staffing and operating costs based on the space designs contained within the draft Interim Architectural (IA) Space Program.[6] The program addresses all spaces required for detention and pre-release beds. Examples include housing units, administration, health care, intake services, food service and maintenance.

It should be noted that females will receive intake services, but will not reside at the new OCCC. Furthermore, the program provides space proximities, but does not include the actual building design. This report is intended to inform decision-makers about various staffing and operating cost options of a replacement facility as compared to current OCCC operations. It is not intended to be a final staffing plan for future budget allocations.

1.2 Project Approach

Applying OCCC's current staffing patterns to the IA Space Program would not reflect the advantages of modern jail design and advances in technology. Therefore, the consultant worked with materials and professionals from the National Institute of Corrections to document best practices and apply them to the IA Space Program. Two individual jail managers were also contacted to provide examples of best practices.

Next data were gathered from PSD representatives regarding current staffing and operating costs of OCCC. The data were analyzed for determining the order of magnitude in terms of which items represent the greatest expenses. This served as a baseline for comparing two staffing and operating cost scenarios. The first option is a low-rise replacement facility and the second option is a multilevel replacement facility.

2.0 NATIONAL PERSPECTIVE ON JAIL STAFFING

2.1 National Institute of Corrections

The National Institute of Corrections (NIC) library provides many resources about types of jails, how to plan jails and how to staff them. The following information summarizes some of the information that is pertinent to the replacement of OCCC.

2.1.1 Three Primary Types of Jails

In a video available for downloading, NIC explains the three primary designs of jail housing units in the United States as:

1. Linear Intermittent Surveillance- Cells are lined up in rows at right angles to a staff corridor (similar to the segregation unit at OCCC.) Staff cannot see into the cell fronts without walking by. Staff observe inmates only at intervals, usually every 30 minutes, or so.
2. Podular Remote Supervision- Cells are arranged in a semi-circle so that officers can see into them, but the officers are in a locked control booth. The primary form of contact is via an intercom system. If there is a fight or other form of distress, officers usually find out about it after the fact.

[6] Draft Interim Architectural Program, Integrus Architecture, and August 31, 2016.

3. Podular Direct Supervision- Staff continuously interacts with inmates who are usually in a common day room versus locked cells. The officer can see into the cells from the day room and there is no physical barrier between the officer and the day room.[7] (This is similar to the general population modules at OCCC.)

Podular direct supervision works well for general population housing units because the officer can often intervene in behavior problems prior to their escalation. Exclusive podular direct supervision does not work well in maximum security housing units where inmates need more physical control.

2.1.2 Jail Design Guide

The Jail Design Guide provides extensive information on needs assessments, site selection, staffing considerations and more.[8] Key discussions on staffing include:

- Facility Location—When the jail is located some distance from the courts, full-time positions are often required to transport inmates to and from court. If the new OCCC is not collocated with the courts, use of video appearances and/or on-site courtrooms will mitigate the need for transport officers. Similarly, a facility located away from community medical services will require transport officers. [9]
- Single Level versus Multilevel Design—Moving people and services (food service and laundry, for example) becomes more time consuming and complicated in a multilevel facility. Required stairways and elevators present additional surveillance problems and security risks during the course of normal operations and during emergencies. Maintenance of elevators also drives staffing and costs. Finally, multilevel facilities reduce the ability to create direct sightlines between posts unless there is some sort of vertical connection such as a caged stairway. Direct sightlines allow staff from one unit to observe and at times support staff from another unit.
- Inmate Separation—The extent to which inmates are separated in the facility (gender, classification, legal status and special needs, for example) and the manner in which separation is achieved can translate into staffing requirements. Generally, the greater the number of distinct housing units a facility has driven up the number of staff positions needed to supervise the units.
- Surveillance/Supervision Methods—Remote observation and direct supervision methods require constant staffing and clear sightlines from established staff positions. It is not necessarily true that remote observation requires fewer staff positions than direct supervision because the officer in an enclosed booth cannot leave the booth. If the goal is to manage the behavior of inmates, there is still a need to provide sufficient staff to make continuous and frequent contact with the inmates. Remote observation adds a layer of surveillance, but it does not take the place of managing inmate behavior. On the other hand, video surveillance can allow for low risk inmates to move between designated areas without staff escort.

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7 Jails in America: A Report on Podular Direct Supervision, National Institute of Corrections, 2015.http://nicic.gov/library/030135

8 Jail Design Guide, Third Edition, NIC, Kimme, Bowker and Deichman, March 2011.

9 It may also be possible to use tele-medicine to reduce outside transports.

- Circulation and Movement—The design of the facility can either enhance or inhibit effective movement control and will influence the number of staff positions needed. Given the number of modules and the campus style layout of the current OCCC, staffing efficiencies can be gained through modern jail design that is more compact. Circulation patterns will be simple, corridors will be at least eight feet wide, adjacencies will be well planned to minimize travel distances within the jail, and routine services will be provided in housing units to minimize inmates having to travel to other buildings. Examples include food service, some health care, recreation, video visiting and offender change programs.
- Emergency Response—A constant minimal level of staffing is required to accomplish three key activities during an emergency:
  - Respond to the scene and implement intervention and/or suppression procedures (e.g. break up a disturbance or put out fire).
  - Possibly evacuate the housing area or the entire facility promptly and safely.
  - Provide containment and inmate supervision after suppression/evacuation.

2.1.3 Staffing Analysis Workbook for Jails

The Staffing Analysis Workbook for jails is in its third edition and provides a methodology for jail planners to achieve staffing that is based on the design of the facility and supervision requirements of inmates at various security levels. It provides a method for developing relief factors to fill-in for staff during their absences.[10]

Some elements of the workbook are used in this study including listing required housing and rover posts by shift and translating posts to full-time equivalencies based on PSD's relief factors. It is not possible to conduct a full staffing analysis until the facility is designed and its operating procedures for that design are known. A staffing analysis will require a team of people who document the various inmate supervision requirements throughout the facility.

The consultant contacted the author of the Staffing Analysis Workbook who agreed that best practices for staffing of new jails requires one officer per podular housing unit of approximately 72 general population inmates. This officer is supported by rovers who assist with inmate movement within the facility and respond to the units when needed. Sergeants are posted in zones throughout the facility, not in individual housing units.

The Staffing Analysis Workbook also addresses why staffing by ratio is generally considered poor practice among jail planners. Reasons include differences in facility mission, local practices, housing unit size and overall design. For example, a single story jail with ten general population housing units of 72 inmates each will require fewer officers than a multi-story jail with the same population. A more detailed discussion of the problems with staffing by ratio is included in this report as Appendix A.[11]

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10 Staffing Analysis Workbook for Jails. First two editions published by the National Institute for Corrections. Third edition published by Community Resource Services in June, 2016. Rod Miller is an author of all three editions.

11 Ratios can be useful when comparing the efficiency of current staffing to future staffing, but should not be the basis of determining how many positions are required.

2.2 The Role of Staffing in Operating Costs

It is well known throughout the corrections industry that roughly three-fourths of the total operating budget can be attributed to staffing. As explained by the National Institute of Corrections, "Staff are the most costly and important resource in operating a jail. In many jails, staffing costs make up 70 to 80 percent of the annual budget. Without adequate staffing, jail security and the safety of staff, inmates, and the community are directly threatened and the possibility of costly litigation against the jail increases significantly."[12]Therefore, the efficiency of operating costs is highly dependent on staffing. Since the largest component of jail staffing is custody staffing, the focus of staffing efficiency centers on housing units and rovers that support the units and internal movement.

2.3 Specific Examples

The consultant contacted the following two jails in order to provide a couple of examples of security staffing of modern jails.

2.3.1 Scott County Jail in Davenport, Iowa

The Scott County Jail is featured in the aforementioned NIC video and in a number of other NIC publications. This mid-sized direct supervision jail (about 350 beds) opened in 2007 and is known for its efficiency with podular direct supervision housing units that range from 64 to 76 beds each.

The units are staffed with one officer on each shift. There are no sergeants assigned to housing units. This facility is an example of how the cost per inmate is less in the larger housing unit because the staffing patterns are the same for each. For example, if the officer costs per year for one unit are roughly $500,000 the housing security cost per inmate in the 64-bed unit is $7,813 annually ($500,000÷64=$7,813). Adding 12 inmates brings the housing unit security cost per inmate down to $6,579 annually ($500,000÷76=$6,579) which is a 19 percent less. The rule of thumb for any staffing scenario is: The larger the housing unit with one officer, the lower the cost per inmate.

[12] http://nicic.gov/training/nicwbt26, e-Training Module-Staffing Analysis for Jails, June 9, 2016.

2.3.2 Regional Justice Center, Kent, Washington

Although the Regional Justice Center (RJC) opened almost 20 years ago, it achieved many of the goals still considered to be best practices of modern jails. This includes 64-bed general population podular housing units with direct supervision by one officer.[13] The RJC does not publish interior photos. The photo below is of a similar housing unit.

There are no sergeants assigned to the units. Additionally, the 896-bed capacity jail has an open booking station, video visiting and sophisticated electronics that show the exact location of every officer in the facility at all times. The open booking station is similar to the photos below.

[13] The Federal Detention Center in Honolulu also has this housing unit staffing pattern.

The RJC is low-rise, so there is no need for elevators. It is commanded by a captain with two sergeants on day and swing shifts, and one sergeant on graveyard. Including relief officers to fill in when absences occur, sergeants assigned to the housing unit zone totals 10 FTEs. There are also four day shift sergeants assigned to booking, administration, maintenance/supply and court transportation detail. The total number of sergeants for the facility is 14. There are 152 officers for housing and booking with 16 more for court transportation detail.

3.0 CURRENT OCCC OPERATING COSTS AND STAFFING

It is the consultant's opinion that the layout of OCCC forces the facility to operate more like a state prison than a modern jail. Walking from building to building via sidewalks lined with recreation yards not connected to the housing units creates the need for additional staffing. Additionally, it is highly unusual to see guard towers at a jail. The following section starts with the big picture of OCCC and goes through several steps to determine where the focus should be in terms of efficient staffing and operating costs of the replacement facility.

3.1 Total Facility

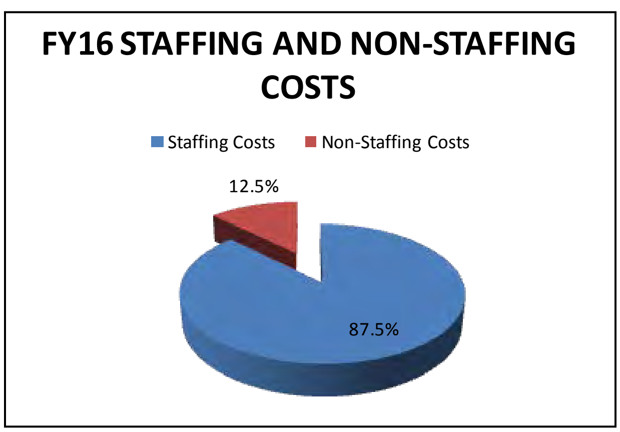
The estimated operating cost for OCCC in FY16 was $67.3 million.[14] The following table shows the amounts by division.

The first item is the direct expenditure from the Institutions Division. The remaining four items are proportioned from statewide allocations that can be attributed to OCCC based on average daily population.

FY16 OCCC OPERATING COSTS	
Institutions- OCCC	$46,216,391
Corrections Prog Svcs	$3,460,359
Food Service	$3,894,037
Health Care	$8,933,553
Administration	$4,751,150
TOTAL	**$67,255,489**

The PSD budget office reports an end of month average of 1,199 inmates for FY16. The daily per capita cost is $153.68 ($67,255,489 ÷ 1,199 inmates ÷ 365 days = $153.68 per day).

Staffing represents 87.5 percent of the cost with 12.5 percent being non-staffing costs.[15]



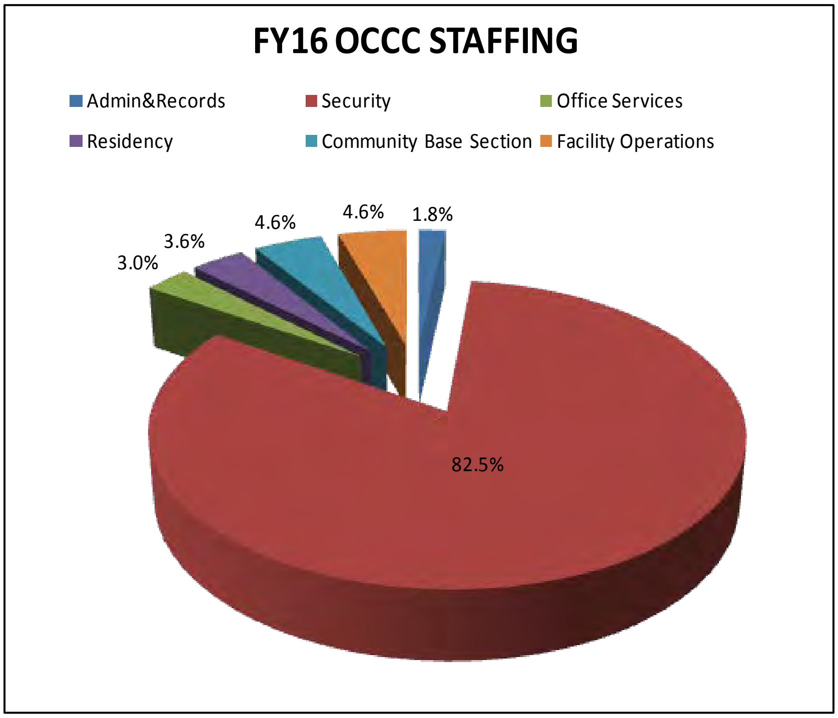
[14] The estimate is based on OCCC direct expenditures from the Institutions Division and per capita rates for CPS, Food Service, Health Care and Administration. Total per capita cost is $56,077.

[15] PSD Budget Office

This reinforces the notion that if efficiencies are to be gained, the focus should be on staffing. As shown in the table below, OCCC currently has 503 approved positions spread over six sections.

FY16 OCCC STAFFING	
SECTION	**POSITIONS**
Admin&Records	9
Security	415
Office Services	15
Residency	18
Community Base Section	23
Facility Operations	23
TOTAL	**503**

The pie chart shows the percentage each section represents.



A list of all positions is shown in Appendix B. By far, the majority of the staffing is security staffing, representing 82.5 percent of all staffing (415 ÷ 503 = 82.5 percent).

3.2 Security Staffing

The following table summarizes all security staffing positions. Of the 415 security positions, 391 or 94.2 percent of the total are sergeants and officers.

FY16 OCCC SECURITY STAFFING		
JOB CLASS	**POSITIONS**	**PERCENTAGE**
Adult Corrections Officer (ACO)VII (Chief of Security)	1	0.2%
Secretary 1	1	0.2%
OA III	2	0.5%
ACO VI-Captain	6	1.4%
ACO V- Lieutenant	14	3.4%
ACO IV- Sergeant	68	16.4%
ACO III- Officer	323	77.8%
Subtotal	**415**	**100%**

3.3 Housing Units and Rovers

To refine it further, a total of 59.4 sergeants (87 percent of all sergeants) and 163.4 officers (51 percent of all officers) are posted in housing units and rovers that support internal movement of inmates. These equals222.8positions.The specific assignments are shown below.

DETENTION BEDS			SERGEANTS (ACO IV)				OFFICERS (ACO III)				TOTAL FTEs
			POSTS			FTEs	POSTS			FTEs	
Module	Type	Capacity*	Shift 1	Shift 2	Shift 3		Shift 1	Shift 2	Shift 3		
1	Ment Hlth	42	1.0	1.0	1.0	5.0	1.0	1.0	1.0	5.0	9.9
2	Ment Hlth/Me	48	0.0	1.0	1.0	3.3	1.0	1.0	1.0	5.0	8.3
3	General	59	0.0	1.0	1.0	3.3	1.0	2.0	2.0	8.3	11.6
4	General	60	0.0	1.0	1.0	3.3	1.0	2.0	2.0	8.3	11.6
7	General	24	0.0	0.0	0.0	0.0	1.0	2.0	2.0	8.3	8.3
8	Ment Hlth	24	0.0	1.0	1.0	3.3	1.0	1.0	1.0	5.0	8.3
11	General	48	0.0	1.0	1.0	3.3	1.0	1.0	1.0	5.0	8.3
13	General	48	0.0	1.0	1.0	3.3	1.0	1.0	1.0	5.0	8.3
17	General	48	0.0	1.0	1.0	3.3	1.0	1.0	1.0	5.0	8.3
18	General	72	0.0	1.0	1.0	3.3	2.0	2.0	2.0	9.9	13.2
19	General	72	0.0	1.0	1.0	3.3	2.0	2.0	2.0	9.9	13.2
Annex-1	General	84	1.0	1.0	1.0	5.0	1.0	2.0	2.0	8.3	13.2
Mauka	General	36	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
Makai	General	36	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
Annex-2	General	84	1.0	1.0	1.0	5.0	2.0	3.0	3.0	13.2	18.2
Max/Holding	Short-term	36	1.0	1.0	1.0	5.0	2.0	3.0	3.0	13.2	18.2
Infirmary	Short-term	3	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
Rovers	Multi-purpos	0	0.0	0.0	0.0	0.0	3.0	4.0	3.0	16.5	16.5
	Subtotal	824	4.0	13.0	13.0	49.5	24.0	31.0	30.0	140.3	189.8
PRE-RELEASE BEDS											
Laumaka	Pre-Release	96	1.0	1.0	1.0	5.0	1.0	2.0	2.0	8.3	13.2
20	Pre-Release	84	1.0	1.0	1.0	5.0	3.0	3.0	3.0	14.9	19.8
	Subtotal	180	2.0	2.0	2.0	9.9	4.0	5.0	5.0	23.1	33.0
GRAND TOTAL		**1004**	**6.0**	**15.0**	**15.0**	**59.4**	**28.0**	**36.0**	**35.0**	**163.4**	**222.8**

* The total design capacity is 964 beds as stated by the Corrections Population Management Commission. The above total includes 40 temporary assignment beds for the infirmary and maximum security segregation cells.

3.4 Cost of Housing Unit and Rover Security Staffing

As shown in the table below, the cost of these positions is $18.9 million. This translates to a per bed cost of $18,863 annually for this portion of staffing ($18.9 million ÷ 1,004 beds = $18,863).[16] Also, a total of 222.8 uniformed positions with a capacity of 1,004 beds yields a ratio of 4.5 beds per custody officer (1,004 ÷ 222.8 = 4.5). These numbers become important when comparing the staffing efficiency of OCCC replacement facility options.[17]

ESTIMATED COST OF CURRENT OCCC HOUSING UNIT AND ROVER STAFFING			
TITLE	**PER FTE**	**FTEs**	**COST**
Sergeants	$95,154	59.4	$ 5,652,153
Officers	$81,336	163.4	$ 13,286,201
TOTAL		**222.8**	**$ 18,938,354**

Lieutenants typically serve in the role of assisting a captain and supervising sergeants. Although they are not attached to specific housing units, the number of lieutenants required is related to the number of sergeants being supervised. This also becomes important when comparing current OCCC costs to those of the replacement facility options. When adding the cost of the lieutenants, the above costs change to the following:

ESTIMATED SECURITY STAFFING COST OF CURRENT OCCC HOUSING UNITS, ROVERS AND LIEUTENANTS			
TITLE	**PER FTE**	**FTEs**	**COST**
Lieutenants	$107,770	14	$ 1,508,773
Sergeants	$95,154	59.4	$ 5,652,153
Officers	$81,336	163.4	$ 13,286,201
TOTAL	**N/A**	**236.8**	**$ 20,447,127**

16 Per bed costs are shown rather than per capita costs because all beds must be staffed and represent a cost. Per capita costs are shown later in the analysis.

17 FTE costs are estimates based on salary plus a fringe benefit rate of 49.54 percent as approved by the Department of Budget and Finance (B&F).

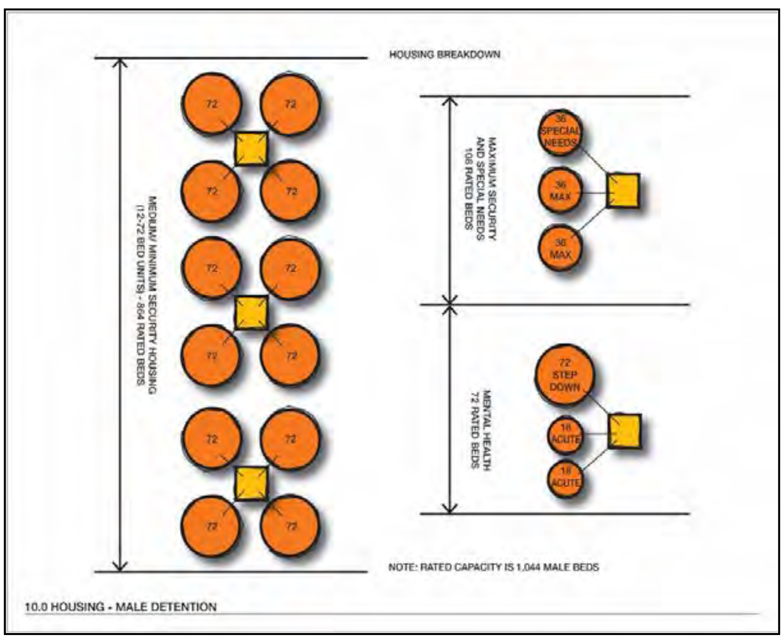
4.0 INTERIM ARCHITECTURAL SPACE PROGRAM HOUSING CONFIGURATION

The replacement facility is slated to have 1,044 rated detention beds. In addition to this, there are 46 non-capacity beds for temporary housing assignments that include infirmary, acute mental health, and segregation; although not rated beds, these require supervision therefore they are factored into the staffing estimate.[18] There are also 432 pre-release beds (96 existing pre-release beds at LWFC plus 336 new beds); this brings the total number of beds to be staffed to 1,522 (1,044 + 46 + 432).

4.1 Detention Housing

As shown in the diagram below, there will be three clusters of general population housing pods. Each cluster will have four 72-bed pods. Each pod will include a dayroom, outdoor recreation yard, and program spaces. In most cases meals will be prepared in the kitchen, transported to the units in carts, and served in dayrooms. The option of eating in the cell will be possible, if necessary. Other spaces will include showers, staff toilet, an officer's station, unit team offices, and storage. Medical screening and medication distribution will occur in a dedicated room adjacent to the dayroom. If more detailed medical services are required, the inmate will be moved to the Clinic. Library and video visitation will occur in the dayroom; video visitation will be the primary means of visiting. The squares shown below that adjoin the four pods will share a common control room, security electronics, staff toilet, and storage area.

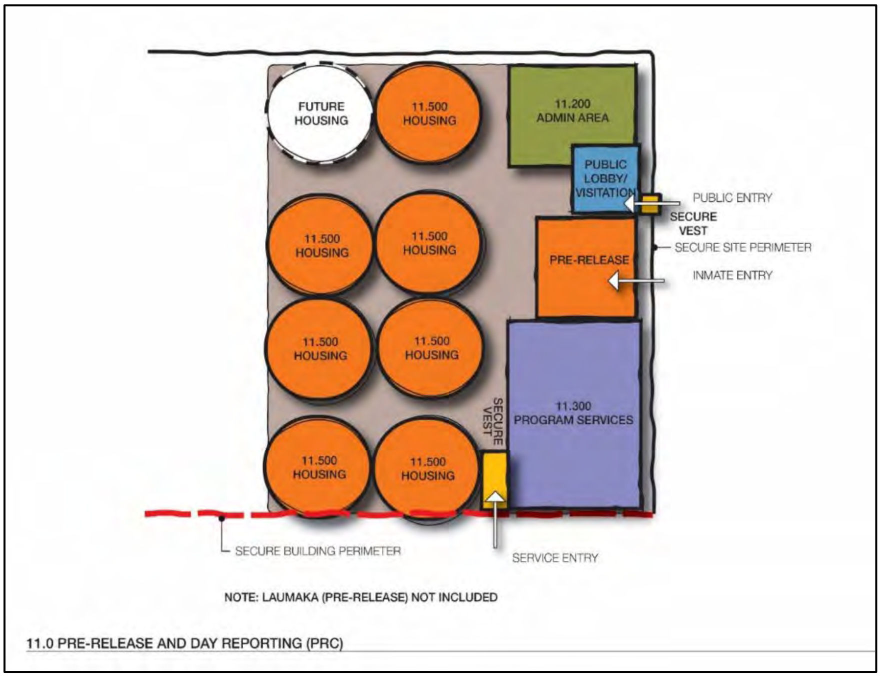
Specialized housing will include two clusters of units. The first will have a 36-bed Special Needs Unit and two 36-bed maximum security units. The second will have two 18-bed acute mental health care units and one mental health step-down unit. Each of the two clusters will have a shared common control room, security electronics, staff toilet and storage area.



18 Non-capacity beds are temporary housing assignments for inmates needing specialized treatment and/or increased security.

4.2 Pre-Release Housing

The space program calls for seven 48-bed pre-release units for a total 336 new pre-release beds. There is also a placeholder for an additional unit, as shown in the following diagram.



As mentioned, the existing 96 pre-release beds at LWFC will continue to function. The total pre-release capacity will be 432 beds.

5.0 REPLACEMENT FACILITY STAFFING AND OPERATING COSTS

As the planning progresses for the replacement of OCCC, there are a number of alternatives to be considered for the site or sites. The three basic populations of OCCC include pre-trial, short-term sentenced and pre-release inmates. If all three are collocated on the same site, they would share basic support functions. Conversely, if the three are separated, each will require support functions which could lead to internal operational inefficiencies and duplication such as administration, food service and health care. The IA Space Program assumes collocation.[19]

19 The Laumaka pre-release facility may be the exception.

A major difference between OCCC's current staffing and the best practices of staffing a modern jail pertains to the use of sergeants. OCCC currently posts sergeants alongside of a single officer for two shifts in general population housing units. It is reasonable to have two staff positions in an old facility where the housing units are physically separated and do not have the benefits of increased surveillance and control through the use of modern electronics. However, a modern jail with clustered housing units and programming space within those housing units is typically staffed with one officer and a sergeant that supports multiple units or in some cases, all units. The Scott County Jail and RJC facilities described above are two examples of the many throughout the country.

5.1 Comparative Analysis

Placing facilities in close relationship allows for efficiency in some program areas such as food service and health care. If they are distant from one another, travel distance could lead to two kitchens or two clinics. Construction and staffing are likely to cost more. The following options assume all services are in close enough proximity to function as a single facility. In this case, it can be assumed there will be one administration and shared services throughout.

The following analysis compares current OCCC staffing and operating costs to a low-rise replacement facility and a multilevel replacement facility according to the housing unit configuration contained in the IA Space Program. It should be noted that without a specific site and detailed building designs, the numbers below are estimates that are likely to change as buildings become further defined.

5.1.1 Option 1—Low-Rise Replacement Facility

A low-rise jail functions on a single level and the secure perimeter is typically the building exterior. The most efficient low-rise jails are a single building which limits travel time between housing units and the number of times staff and visitors pass through a secure perimeter. The use of fencing is limited to enclosing vehicle sally ports and exterior recreation areas. There is no fence surrounding the entire building and there are no guard towers.

The following table estimates required security staffing for housing and rovers according to the IA Space Program and best practices described above.

DETENTION BEDS			SERGEANT POSTS (ACO IV)				OFFICERS (ACO III)				TOTAL FTEs
			POSTS			FTEs	POSTS			FTEs	
Module	Type	Capacity	Shift 1	Shift 2	Shift 3		Shift 1	Shift 2	Shift 3		
1	Special Needs	36	1.0	1.0	1.0	5.0	1.0	1.0	1.0	5.0	9.9
2	Max	36	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
3	Max	36	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
4	Step-Down	72	1.0	1.0	1.0	5.0	1.0	1.0	1.0	5.0	9.9
5	Acute	18	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
6	Acute	18	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
7	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
8	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
9	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
10	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
11	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
12	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
13	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
14	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
15	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
16	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
17	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
18	General	72	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
	Infirmary	10	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
	Rovers		0.0	0.0	0.0	0.0	6.0	8.0	6.0	33.0	33.0
	Shift Sgt		1.0	1.0	1.0	5.0					5.0
	Subtotal	1090	3.0	3.0	3.0	14.9	25.0	27.0	25.0	127.1	141.9
PRE-RELEASE BEDS											
19	Laumaka	96	1.0	1.0	1.0	5.0	1.0	2.0	2.0	8.3	13.2
20	P R	48	1.0	1.0	1.0	5.0	1.0	1.0	1.0	5.0	9.9
21	P R	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	P R	48	0.0	0.0	0.0	0.0	0.0	1.0	1.0	3.3	3.3
23	P R	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	P R	48	0.0	0.0	0.0	0.0	1.0	1.0	1.0	5.0	5.0
25	P R	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	P R	48	0.0	0.0	0.0	0.0	0.0	1.0	1.0	3.3	3.3
	Subtotal	432	2.0	2.0	2.0	9.9	3.0	6.0	6.0	24.8	34.7
GRAND TOTAL		**1,522**	**5.0**	**5.0**	**5.0**	**24.8**	**28.0**	**33.0**	**31.0**	**151.8**	**176.6**

For the detention population, sergeants are assigned to three zones: each of the two high security unit clusters and the general population units. The number of sergeants for detention would be 14.9 as opposed to the current 49.5. Rovers have been doubled from existing staffing to provide additional support to housing units and account for the increase in population. The number of rovers changes from 16.5 FTEs to 33 FTEs.[20]

Since the location of the replacement facility may be at a separate location from the existing Laumaka facility, shift sergeants are provided at Laumaka and the new pre-release compound at the replacement facility. In this case the number of sergeants is the same as the current number for OCCC pre-release at 9.9 FTEs. However, if all pre-release beds are at a single location, the required number of sergeant FTEs would be 5.0.

20 Video surveillance will also provide additional support to housing units.

Translating the above positions into costs, shows the following:[21]

ESTIMATED COST OF LOW-RISE HOUSING UNIT AND ROVER SECURITY STAFFING			
TITLE	**COST PER FTE**	**FTEs**	**COST**
Sergeants	$95,154	24.8	$2,355,064
Officers	$81,336	151.8	$12,346,773
TOTAL		**176.6**	**$14,701,836**

Staffing Efficiency

The 176.6 uniformed staff working as housing unit and rover officers with a total of 1,522 beds produces a ratio of 8.6 beds per custody officer (1522/176.6=8.6), almost double the current housing unit efficiency of 4.5 noted earlier.[22] Finding a comparison on a national level is difficult due to differences in design, population mix, crowding, operating procedures and reporting of numbers. The Federal Bureau of Prisons reports its detention facility ratio of 6.5 to one correctional officer.[23] It does not account for the above factors, and it should be assumed that a new facility will be more efficient than the combination of existing facilities.

Cost Efficiency

The current cost for these positions at OCCC was previously noted as $18,863 annually per bed. The cost for these positions at a low-rise replacement facility of 1,522 beds is $9,660 per bed annually ($14.7 million ÷1,522= $9,660), which is roughly 50 percent more efficient.

Potential Savings

There is also the likelihood of needing fewer lieutenants since there will be fewer sergeants for them to supervise. At an annual cost of roughly $108,000 per lieutenant and the need for five positions to cover one post on a 24/7 basis, potential savings are close to a million dollars annually when lieutenants are reduced by one 24/7 post. The following table includes the cost of lieutenants when one 24/7 post has been eliminated. The lieutenant FTEs change from the current 14 to 9.

ESTIMATED SECURITY STAFFING COST OF LOW-RISE REPLACEMENT FOR HOUSING UNITS, ROVERS AND LIEUTENANTS			
TITLE	**COST PER FTE**	**FTEs**	**COST**
Lieutenants	$107,770	9	$969,926
Sergeants	$95,154	24.8	$2,355,064
Officers	$81,336	151.8	$12,346,773
TOTAL	**N/A**	**185.6**	**$15,671,762**

21 Sergeant costs would be about $500,000 less annually if pre-release units were at a single location.

22 The Project Development Report and Site Selection Study for OCCC, AHL and DLR Group, June 2009 also showed a doubling of the inmate to officer ratio.

23 Census of Jails: Population Changes, 1999-2013, Todd Minton and colleagues, U.S. Department of Justice, December 2015, NCJ 248627.

When comparing this sub-set of staffing to OCCC's current staffing, the low-rise replacement facility shows significant potential savings while staffing an additional 518 beds most of which are pre-release beds. The following table shows annual savings of $4.8 million or $143.3 million over a 30-year life cycle.[24]

COMPARISON OF CURRENT AND LOW-RISE HOUSING UNIT AND ROVER SECURITY STAFFING		
FACILITY	**PER YEAR**	**30 YEARS**
Current OCCC	$20,447,127	$613,413,824
Low-Rise	$15,671,762	$470,152,866
Difference	**-$4,775,365**	**-$143,260,958**

Total Staffing of a Low-rise Replacement Facility

Security Staffing: The revised security staffing changes the FY16 security FTEs from 415 to 363.8.

LOW-RISE SECURITY STAFFING	
JOB CLASS	**POSITIONS**
Adult Corrections Officer (ACO)VII (Chief of Security)	1
Secretary 1	1
OA III	2
ACO VI-Captain	6
ACO V- Lieutenant	9
ACO IV- Sergeant	33.4
ACO III- Officer	311.5
Total	**363.8**

The net savings are 51.2 FTEs (415 – 363.8 = 51.2).

COMPARISON OF SECURITY STAFFING FTEs	
Current OCCC (FY16)	415
Low-Rise Replacement	363.8
Difference	**51.2**

Total Staffing: When applying the staffing above to the total facility staffing, the FTEs change from 503 to 452. (503 – 51 = 452) A list of all positions is shown in Appendix C.

There are likely to be additional staffing efficiencies in a modern jail simply because it will have electronics that off-set staffing through enhanced surveillance, electronic records systems throughout the facility, video visiting and to some extent video court hearings. Additionally, services brought to the inmates will not only save on internal movement of inmates, it will save on officer posts that are currently needed in separate buildings at OCCC. However, quantifying those savings is not possible without a specific facility design. A specific facility design

24 Life cycle costs/savings are expressed in 2016 dollars and do not account for inflation and other financial considerations. A 30-year life cycle is referenced in the NIC Jail Design Guide.

cannot be developed without a specific site. A conservative approach is to under-estimate savings rather than over-estimate them. It can be assumed that the increased population may off-set further staffing efficiencies.

5.1.2 Option 2—Multilevel Replacement Facility

The primary difference between a single level and multilevel jail is the need for elevators. Once elevators are added, additional staff are needed operate and observe them.[25] Elevators need to be operational 24/7. It is estimated there would be an additional officer in central control on shifts 2 and 3. (Day and swing shifts) Similarly, there would also need to be one additional officer on shift 1 (graveyard) and two additional officers on shifts 2 and 3 to accommodate vertical inmate movement. This is a total of seven posts. Using a shift relief factor of 1.65 (for covering weekends and personal time off), the addition of seven posts requires 11.6 FTEs (1.65 x 7 = 11.6)

STAFFING IMPACT OF ELEVATORS					
Officers (AO III)	Shift 1	Shift 2	Shift 3	Total Posts	FTE's
Central Control	0	1	1	2	3.3
Escort	1	2	2	5	8.3
				7	**11.6**

At a cost of $81,336 per officer the total annual cost in 2016 dollars is an additional $939,438 (11.6*$81,336 = $939,438). The annual amount multiplied over a 30-year life cycle of the building equals $28.2 million without accounting for inflation and other financial factors.

Total Staffing of a Multilevel Replacement Facility

Security Staffing: The addition of 11.6 FTEs shown above changes the security staffing to the following configuration.

MULTILEVEL SECURITY STAFFING	
JOB CLASS	**POSITIONS**
Adult Corrections Officer (ACO)VII	1
Secretary 1	1
OA III	2
ACO VI-Captain	6
ACO V- Lieutenant	9
ACO IV- Sergeant	33.4
ACO III- Officer	323.0
Total	**375.4**

Total Staffing: When applying this to the total facility staffing of the low-rise replacement facility, the FTEs change from 452 to 463.4. A list of all positions is shown in Appendix D.

25 City of Seattle, Comparative Study of the Cost of Low and High-Rise Jails, Carter Goble Lee, August 2008.

6.0 TOTAL OPERATING COST COMPARISON

It is important to develop apples to apples comparisons when comparing current costs to future costs. In order to do so, per bed cost comparisons must be made rather than by average daily population. There are several reasons.

1. The average daily population within any facility varies from year to year and it is unknown for the replacement facility.
2. Over the life cycle of the building, the jail may be crowded some years and under-filled other years. Unless the jail has enough empty beds to close one or more housing units, there is a cost to operating the beds. Because of this, a lower ADP does not necessarily equal fewer staff.
3. Crowding creates a built-in economy of scale particularly if no staff positions are added to a housing unit. Comparing a crowded facility to an un-crowded facility would not be an even comparison.

Therefore, the comparison of current costs to replacement facility costs is based on beds in operation, not ADP.

6.1 Cost per Bed at OCCC

As mentioned in Section 3.1, the budget office reports an end of month average of 1,199 inmates for FY16 which equates to a daily cost per inmate of $153.68 ($67,255,489 total OCCC cost ÷ 1,199 inmates ÷ 365 days = $153.68).

In order to achieve apples to apples comparisons to the new facility, the current operating cost must be adjusted to account for crowding. OCCC's capacity is 1,004 beds. This means it was crowded by 195 inmates (1,199 – 1,004 = 195). As noted earlier, the non-staffing costs at OCCC represent 12.5 percent of the total cost. The following table removes the cost of crowding from the FY16 cost which provides an estimated per bed cost when the facility is at capacity.

FY16 OCCC COST PER BED WITHOUT CROWDING	
FY16 per Capita Cost	$56,077
Non-Staffing Percentage	12.5%
Non-Staffing Cost per Inmate	$7,010
Inmates Over Capacity	195
FY16 Cost of Crowding	$1,366,887
FY16 OCCC Operating Cost	$67,255,489
Cost without Crowding	$65,888,603
Capacity	1004
Annual per Bed Cost	**$65,626**
Daily per Bed Cost	**$179.80**

6.2 Future Operating costs

This section applies the potential savings in security staffing calculated previously to the adjusted operating cost at OCCC. As mentioned, there are likely to be additional savings once a site is selected and the specific facility floor plan is designed. To avoid over-stating savings, it is best to be conservative at this point in time.

6.2.1 Low-Rise Facility

ESTIMATED LOW-RISE OPERATING COSTS	
Adjusted FY16 OCCC Operating Cost	$65,888,603
Estimated Staff Savings of Replacement Facility	-$4,775,365
Estimated Low-Rise Operating Cost	$61,113,238
Beds at Replacement Facility	1522
Annual Cost per Bed	$40,153
Daily per Bed	$110.01

6.2.2 Comparison of Current to Future costs

The following table compares OCCC's current costs to the annual and daily costs shown in the table for low-rise facility operating costs. This is a 39 percent reduction.[26]

DIFFERENCE BETWEEN CURRENT OCCC AND LOW-RISE FACILITY	
Annual Cost per Bed	**Dollars**
Adjusted FY16 Annual per Bed at OCCC	$65,626
Estimated Low-Rise Annual Cost per Bed	$40,153
Change in Annual Cost per Bed	**-$25,473**
Daily Cost per Bed	**Dollars**
Adjusted FY16 Daily Cost per Bed at OCCC	$179.80
Estimated Low-Rise Daily Cost per Bed	$110.01
Change in Daily Cost per Bed	**-$69.79**

26 The Project Development Report and Site Selection Study for OCCC, AHL and DLR Group, June 2009 showed similar results at a 35 percent reduction.

6.2.3 Multilevel Facility

The following table shows the staffing cost impact of adding elevators to the replacement facility. In addition to staffing, there would be some additional inspection and maintenance costs that cannot be quantified at this time.

ESTIMATED MULTILEVEL OPERATING COSTS	
Operating Cost of Low-Rise	$61,113,238
Staffing Impact of Multilevel	$939,428
Operating Cost of Multilevel	$62,052,666
Beds at Replacement Facility	1,522
Annual Cost per Bed	**$40,770**
Daily per Bed	**$111.70**

When comparing the cost of the current OCCC to a multilevel replacement facility, savings are $3.8 million annually or $115 million over 30 years.

COST DIFFERENCE BETWEEN CURRENT OCCC AND MULTILEVEL REPLACEMENT FACILITY	
Adjusted FY16 OCCC Operating Cost	$65,888,603
Operating Cost of Multilevel	$62,052,666
Annual Cost Difference	-$3,835,937
30-Year Life Cycle	-$115,078,107

As shown in the following table, the multilevel replacement facility has a small impact on the overall percentage of cost. However, depending on the selected site, there are likely to be additional financial impacts such as increased land, site development and parking costs.

DIFFERENCE BETWEEN LOW-RISE AND MULTILEVEL REPLACEMENT FACILITY		
Annual Cost per Bed	**Dollars**	**% Change**
Low-Rise	$40,153	N/A
Multilevel	$40,770	N/A
Change in Annual Cost per Bed	**$617**	**1.5%**
Daily Cost per Bed		
Low-Rise	$110.01	N/A
Multilevel	$111.70	N/A
Change in Daily Cost per Bed	**$1.69**	**1.5%**

7.0 CONCLUSION

OCCC is Hawaii's largest and oldest community correction center. It is staffing and cost inefficient compared to today's newly designed jails. A replacement facility, as described above, will increase safety of staff, inmates and the public while producing significant savings in operating costs. It is not possible to calculate the full savings until the location is determined and the building design is complete. However, since most of the operating costs are in security staffing, and most of the security staffing is related to the housing module configuration, savings of at least between $3.8 million and $4.8 million annually are very likely. This translates to between $115 million and $143 million over a 30-year facility life cycle.

Failing to replace OCCC will mean a lost opportunity to increase safety as well as take advantage of modern jail design and electronics that produce operational savings. It will also mean the continued maintenance of a facility that appears to be past its useful life cycle.

Appendix A: The Myth of Staff to Inmate Ratios[27]

[27] Staffing Analysis Workbook for Jails, National Institute of Corrections, 2nd Edition, Liebert and Miller, March 2003.

Using a staffing ratio to compare one facility with another or to determine a staffing level for a facility produces inaccurate results. Many factors differ and cannot be accurately compared:

- Is the number of inmates used for the calculation the actual number, or the rated capacity of the facility?
- Which positions go into the calculation—security only, or all positions?
- Are contractual employees considered?
- Are hours worked by part-time employees considered?
- Are hours worked by full-time staff as overtime considered?
- Are some staff (such as maintenance or nursing) supplied by other county agencies (such as public works or public health)?

In addition to these factors, the characteristics of each jail need to be considered before applying figures from one facility to another:

- Type of inmates housed (level of security, gender, age, etc.).
- Design capacity versus actual population.
- Activities and programs, such as work release, work programs, education.
- Facility design.
- Facility condition.
- Staff qualifications and experience.

Staffing is based on operational philosophy and facility design. The most efficient staffing is possible when a facility is designed based on an operational philosophy. A facility with a program-oriented philosophy will have counselors, program, and recreation staff, in addition to custody and security staff. A facility with a philosophy of "warehousing" inmates may have only custody and security staff. If a facility's design is inadequate for its philosophy, staff may be used to compensate for facility shortcomings. Many design and operational factors will affect staffing, including:

- Whether the facility is designed for direct supervision, indirect supervision, or intermittent supervision.
- The types and size of housing units (cells versus dormitories).
- Facility sightlines.
- The types of security control systems and security perimeter.
- Whether inmates are escorted through the corridors.
- Whether programs and services are centralized or decentralized.
- Whether the facility is single-story or high-rise.
- Whether acceptable backup is available.

If people say they can build a 250-bed facility and already know how many staff it will take to operate it, do not believe them. Until a facility is adapted to the unique population and practices of a locality, staffing cannot be accurately determined. Forget the words "staff-to-inmate ratios"; they only confuse the issues.

Appendix B: FY16 OCCC Staffing

APPROVED STAFFING FOR OCCC-2016			
	SECTION	POSITION TITLE	POSITION
1	N/A	Corrections Manager(CM) IV (Warden)	1
		Secretary III	1
		Subtotal	**2**
2	N/A	CM II (Deputy Warden)	1
		Secretary III	1
		Office Assistant (OA) IIII	1
	Inmate Records	Clerical Supv II	1
		OA IV	3
		Subtotal	**7**
3	Security	Adult Corrections Officer (ACO)VII (Chief of Security-Major)	1
		Secretary 1	1
		OA III	2
		ACO VI-Captain	6
		ACO V- Lieutenant	14
		ACO IV- Sergeant	68
		ACO III- Officer	323
		Subtotal	**415**
4	Office Services	Business Manager V	1
		Receptionist	1
		Accountant III	1
		Account Clerk IV	2
		Account Clerk III	3
		Purchasing Technician I	1
		Human Resources(HR) Specialist IV	1
		HR Assistant IV	1
		OA V	1
		OA IV	3
		Subtotal	**15**
5	Residency	Corrections Supervisor (CS) II	1
		Secretary 1	1
		OA III	2
		CS I	2
		Human Services Professional (HSP)/Soc	9
		Social Services Assistant (SSA) V	1
		Corrections Recreation (CR) Specialist IV	1
		CR Specialist III	1
		Subtotal	**18**
6	Community Base Section	CS II	1
		Secretary II	1
		OA III	3
		CS II	2
		HSP/SW IV	9
		SSA V	6
		Substance Abuse Specialist III	1
		Subtotal	**23**
7	Facility Operations	Institution Facilities Supt II	1
		OA III	1
		General Constr & Maint Supv II	1
		Bldg Maint (BM) Supv I	1
		BM Worker II	3
		BM Helper	2
		A/C Mechanic II	1
		Automotive Mechanic II	1
		Maint Mechanic II	1
		Groundskeeper II	1
		Janitor Supervisor (JS) II	1
		JS I	4
		Laundry Manager	1
		Laundry Worker II	2
		Property & Services Supv	1
		Storekeeper I	1
		Subtotal	**23**
		GRAND TOTAL	**503**

Appendix C: Low-rise Replacement Facility Staffing

LOW-RISE REPLACEMENT FACILITY STAFFING			
	SECTION	POSITION TITLE	POSITIONS
1	N/A	Corrections Manager(CM) IV (Warden	1
		Secretary III	1
		Subtotal	**2**
2	N/A	CM II (Deputy Warden)	1
		Secretary III	1
		Office Assistant (OA) IIII	1
	Inmate Records	Clerical Supv II	1
		OA IV	3
		Subtotal	**7**
3	Security	Adult Corrections Officer (ACO)VII	1
		Secretary 1	1
		OA III	2
		ACO VI-Captain	6
		ACO V- Lieutenant	9
		ACO IV- Sergeant	33
		ACO III- Officer	311
		Subtotal	**364**
4	Office Services	Business Manager V	1
		Receptionist	1
		Accountant III	1
		Account Clerk IV	2
		Account Clerk III	3
		Purchasing Technician I	1
		Human Resources(HR) Specialist IV	1
		HR Assistant IV	1
		OA V	1
		OA IV	3
		Subtotal	**15**
5	Residency	Corrections Supervisor (CS) II	1
		Secretary 1	1
		OA III	2
		CS I	2
		Human Services Professional (HSP)	9
		Social Services Assistant (SSA) V	1
		Corrections Recreation (CR) Specialis	1
		CR Specialist III	1
		Subtotal	**18**
6	Community Base Section	CS II	1
		Secretary II	1
		OA III	3
		CS II	2
		HSP/SW IV	9
		SSA V	6
		Substance Abuse Specialist III	1
		Subtotal	**23**
7	Facility Operations	Institution Facilities Supt II	1
		OA III	1
		General Constr & Maint Supv II	1
		Bldg Maint (BM) Supv I	1
		BM Worker II	3
		BM Helper	2
		A/C Mechanic II	1
		Automotive Mechanic II	1
		Maint Mechanic II	1
		Groundskeeper II	1
		Janitor Supervisor (JS) II	1
		JS I	4
		Laundry Manager	1
		Laundry Worker II	2
		Property & Services Supv	1
		Storekeeper I	1
		Subtotal	**23**
		GRAND TOTAL	**452**

Appendix D: Multilevel Replacement Facility Staffing

MULTILEVEL REPLACEMENT FACILITY STAFFING			
	SECTION	POSITION TITLE	POSITIONS
1	N/A	Corrections Manager(CM) IV (Warden	1
		Secretary III	1
		Subtotal	**2**
2	N/A	CM II (Deputy Warden)	1
		Secretary III	1
		Office Assistant (OA) IIII	1
	Inmate Records	Clerical Supv II	1
		OA IV	3
		Subtotal	**7**
3	Security	Adult Corrections Officer (ACO)VII	1
		Secretary 1	1
		OA III	2
		ACO VI-Captain	6
		ACO V- Lieutenant	9
		ACO IV- Sergeant	33.4
		ACO III- Officer	323.0
		Subtotal	**375.4**
4	Office Services	Business Manager V	1
		Receptionist	1
		Accountant III	1
		Account Clerk IV	2
		Account Clerk III	3
		Purchasing Technician I	1
		Human Resources(HR) Specialist IV	1
		HR Assistant IV	1
		OA V	1
		OA IV	3
		Subtotal	**15**
5	Residency	Corrections Supervisor (CS) II	1
		Secretary 1	1
		OA III	2
		CS I	2
		Human Services Professional (HSP)	9
		Social Services Assistant (SSA) V	1
		Corrections Recreation (CR) Specialis	1
		CR Specialist III	1
		Subtotal	**18**
6	Community Base Section	CS II	1
		Secretary II	1
		OA III	3
		CS II	2
		HSP/SW IV	9
		SSA V	6
		Substance Abuse Specialist III	1
		Subtotal	**23**
7	Facility Operations	Institution Facilities Supt II	1
		OA III	1
		General Constr & Maint Supv II	1
		Bldg Maint (BM) Supv I	1
		BM Worker II	3
		BM Helper	2
		A/C Mechanic II	1
		Automotive Mechanic II	1
		Maint Mechanic II	1
		Groundskeeper II	1
		Janitor Supervisor (JS) II	1
		JS I	4
		Laundry Manager	1
		Laundry Worker II	2
		Property & Services Supv	1
		Storekeeper I	1
		Subtotal	**23**
		GRAND TOTAL	**463.4**

Appendix T: Traffic Impact Report

Oahu Community Correctional Center

October 27, 2017

Prepared for:

State of Hawaii
Department of Accounting and General Services
Department of Public Safety

Prepared by:

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

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1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this study is to identify and assess the traffic impacts resulting from the proposed relocation of the existing Oahu Community Correctional Center (hereinafter referred to as "OCCC") in Kalihi on the island of Oahu. Four alternative sites are currently being considered as potential replacement locations for the new correctional facility. This study includes an assessment of each of the four alternative sites under consideration.

1.2 Scope of Study

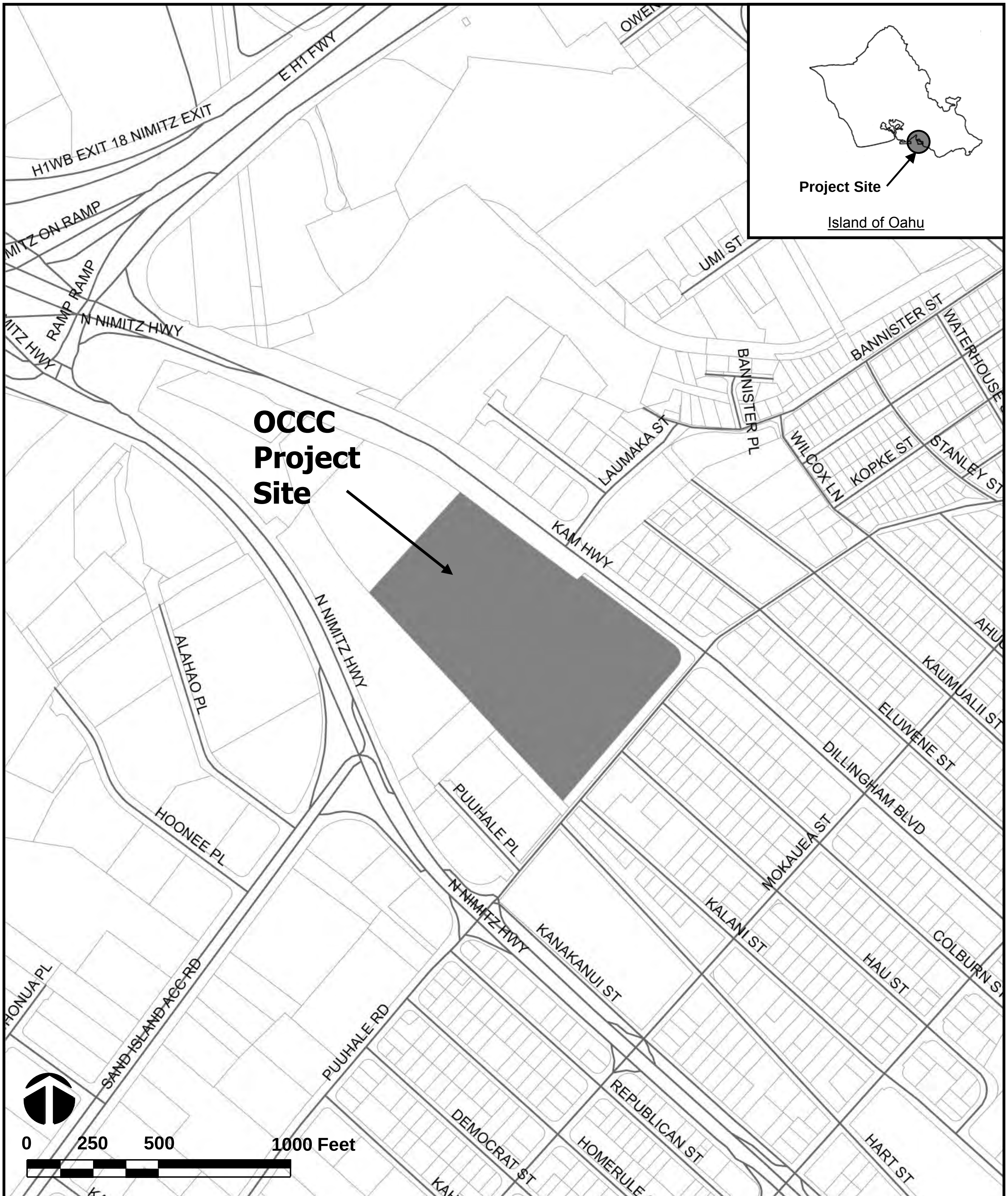
This report presents the findings and conclusions of the traffic study, the scope of which includes:

1. Description of the proposed project.
2. Evaluation of existing roadway and traffic operations in the vicinity.
3. Analysis of future roadway and traffic conditions without the proposed project.
4. Analysis and development of trip generation characteristics for the proposed project.
5. Superimposing site-generated traffic over future traffic conditions.
6. The identification and analysis of traffic impacts resulting from the proposed project.
7. Recommendations of improvements, if appropriate, that would mitigate the traffic impacts resulting from the proposed project.

2.0 PROJECT DESCRIPTION

2.1 Location

The existing OCCC facility is located adjacent to Kamehameha Highway in Kalihi and is bounded by Kamehameha Highway to the north, Puuhale Road to the east, and industrial uses to the south and west (see Figure 1). The existing project site is further identified as Tax Map Keys (TMKs): 1-2-013: por. 002. The four alternative site locations under consideration include the existing OCCC facility; the Mililani Technology Park (hereinafter referred to as "MTP") in Mililani; the Halawa Correctional Facility (hereinafter referred to as "HCF"); and the Animal Quarantine Station both located in Aiea. The project site at the MTP location is adjacent to Kahelu Avenue in Mililani and is bounded by Kahelu Avenue to the north with industrial uses to the west (see Figure 2). This project site is further identified as Tax Map



OAHU COMMUNITY CORRECTIONAL CENTER

LOCATION MAP AND VICINITY MAP

FIGURE
1

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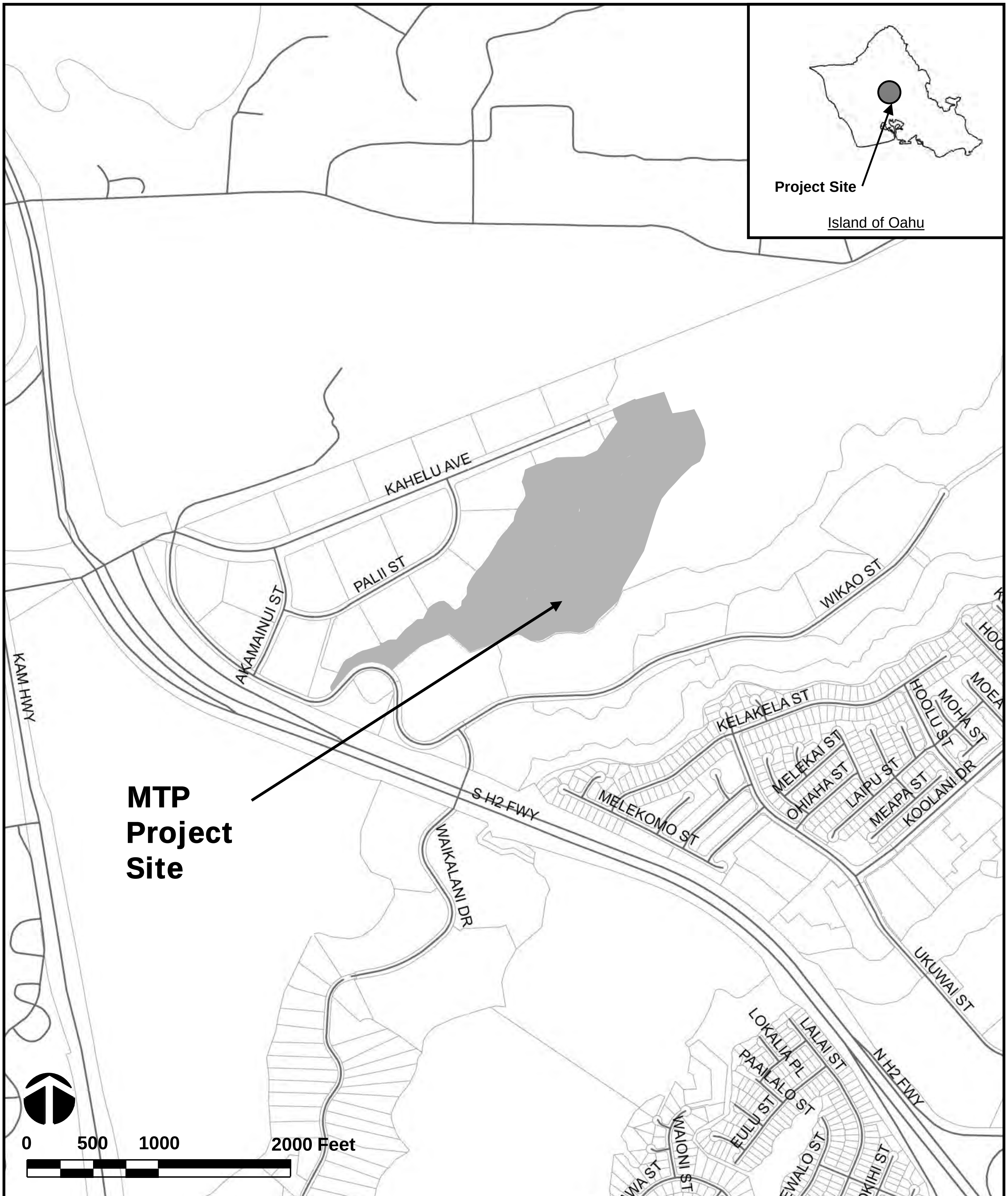

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OAHU COMMUNITY CORRECTIONAL CENTER

LOCATION MAP AND VICINITY MAP

FIGURE 2

Keys (TMKs): 9-5-046: 042. The project sites at the HCF and Animal Quarantine Station are both adjacent to Halawa Valley Street in Aiea (see Figures 3 and 4). The proposed site near HCF is expected to be located east of the existing prison and is identified as Tax Map Keys (TMKs): 9-9-010: por. 030, while the proposed site near the Animal Quarantine Station is bounded by Halawa Valley Street to the north, the Interstate H-3 Freeway to the west, and industrial uses to the south and east. That project site is further identified as Tax Map Keys (TMKs): 9-9-010: por. 006, 046, 057, and 058. In addition, it should be noted that a portion of inmates from the existing OCCC facility are expected to be transferred to the Women's Community Correctional Center (hereinafter referred to as "WCCC") regardless of which alternative site is selected. The existing WCCC facility is located adjacent to Kalanianaole Highway in Kailua and is bounded by Kalanianaole Highway to the south and residential uses to the west (see Figure 5). This project site is further identified as Tax Map Keys (TMKs): 4-2-003: 004.

2.2 Project Characteristics

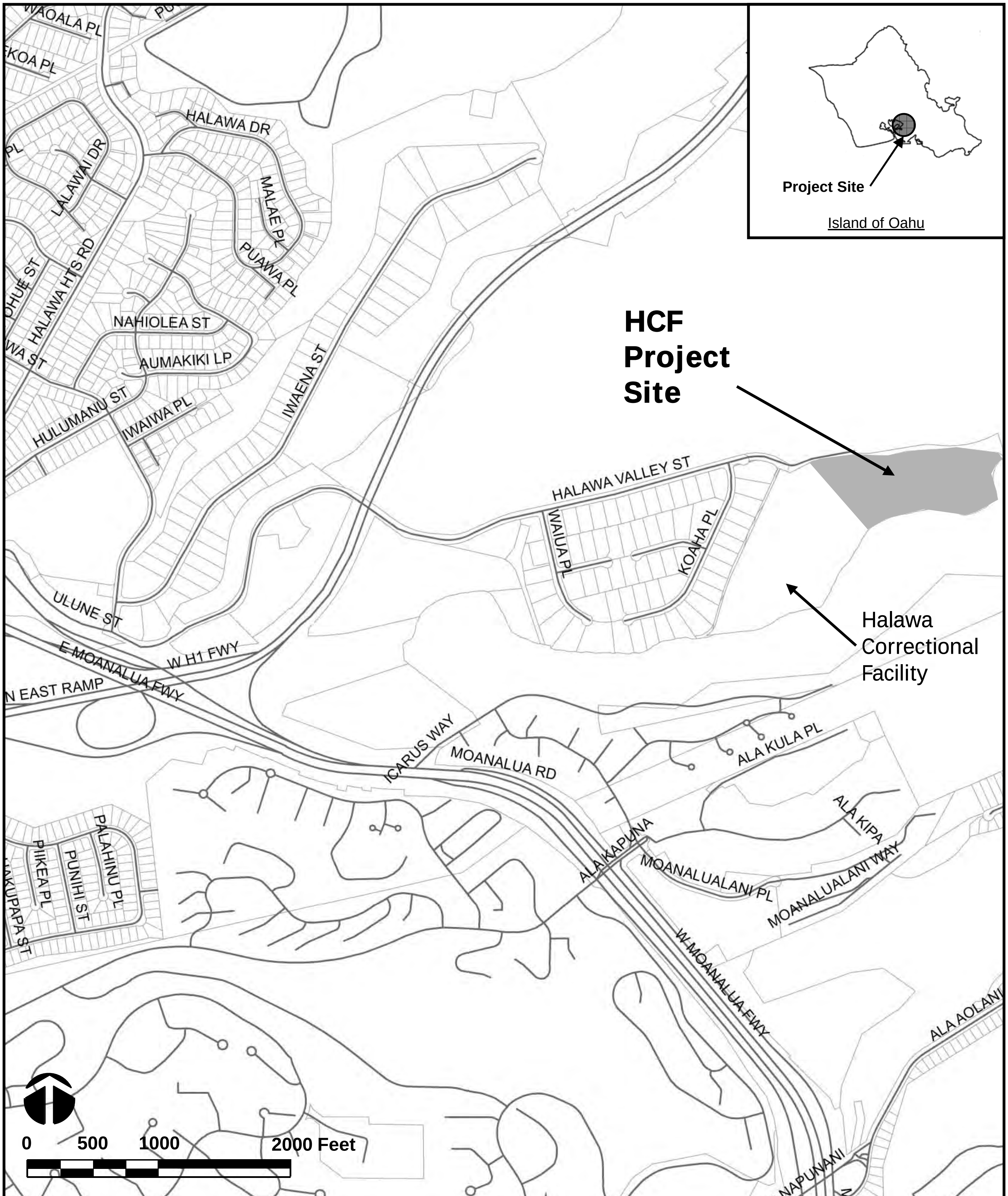
The existing Oahu Community Correctional Center is currently located on a 16-acre site in Kalihi and serves as the largest jail facility for pre-trial detainees in the State of Hawaii with an existing population of approximately 1,137 inmates. However, recent assessments of the facility have indicated that the OCCC facility is significantly overcrowded and functioning beyond its capacity. To adequately serve the facility's high demand and meet projected future needs, the Department of Public Safety (PSD) is currently considering the following alternatives:

- <u>Redevelopment of the existing OCCC facility ("Alternative 1")</u>

  This alternative entails the replacement of the existing OCCC facility and the construction of a new facility. Under Alternative 1, the existing square footage of the facility is expected to double and provide accommodation for approximately 1,480 inmates. Vehicular access to the project site is expected to continue to be provided via an existing driveway off Kamehameha Highway.

- <u>Relocation to MTP site ("Alternative 2")</u>

  Alternative 2 entails the construction of a new facility at the Mililani Tech Park in Mililani, Oahu. The new facility is expected to provide accommodations for approximately 1,380 inmates and would provide similar functions as the existing OCCC. Under this alternative, vehicular access is expected to be provided via new driveways off Kahelu Avenue.



OAHU COMMUNITY CORRECTIONAL CENTER

LOCATION MAP AND VICINITY MAP

FIGURE

3

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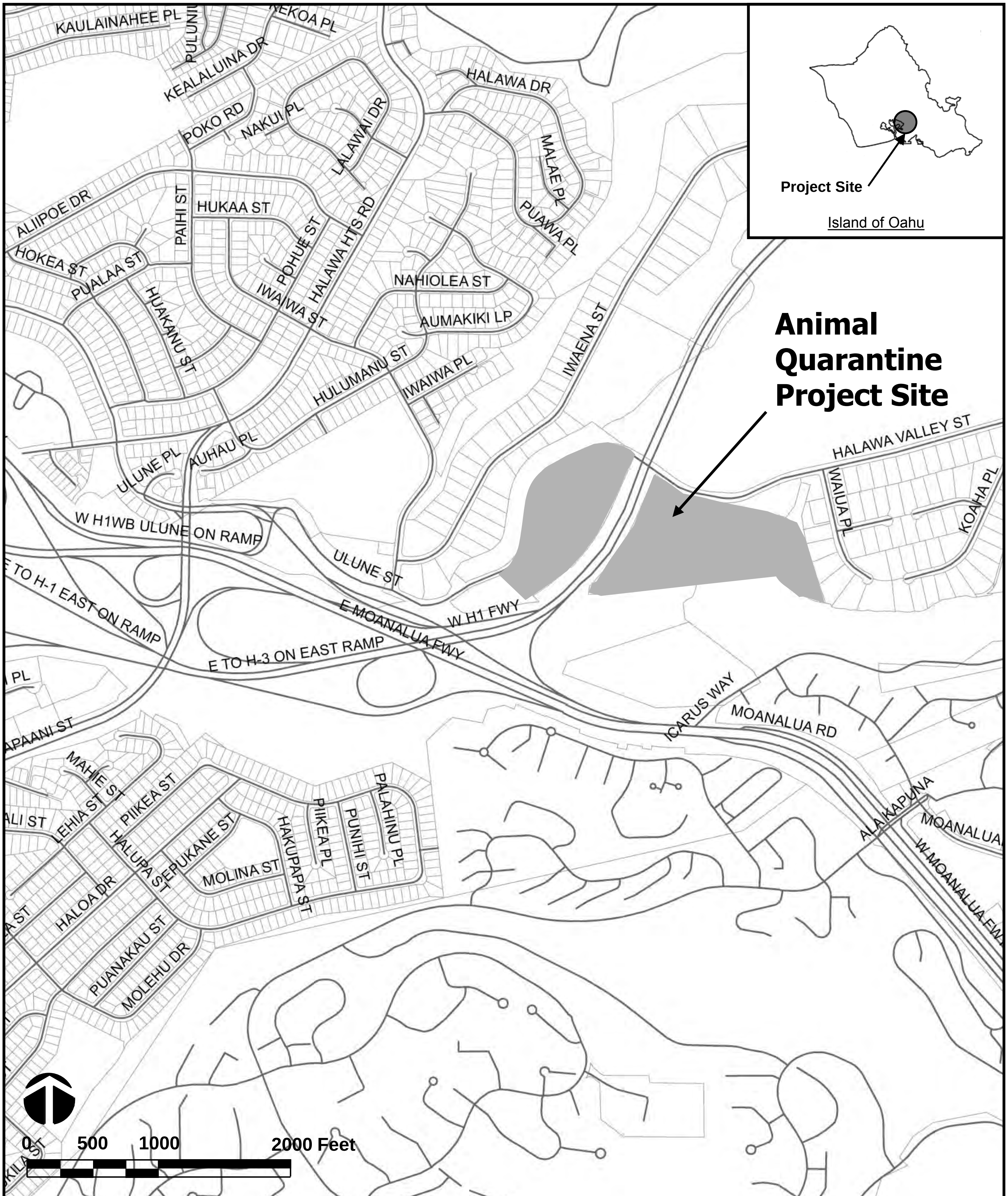
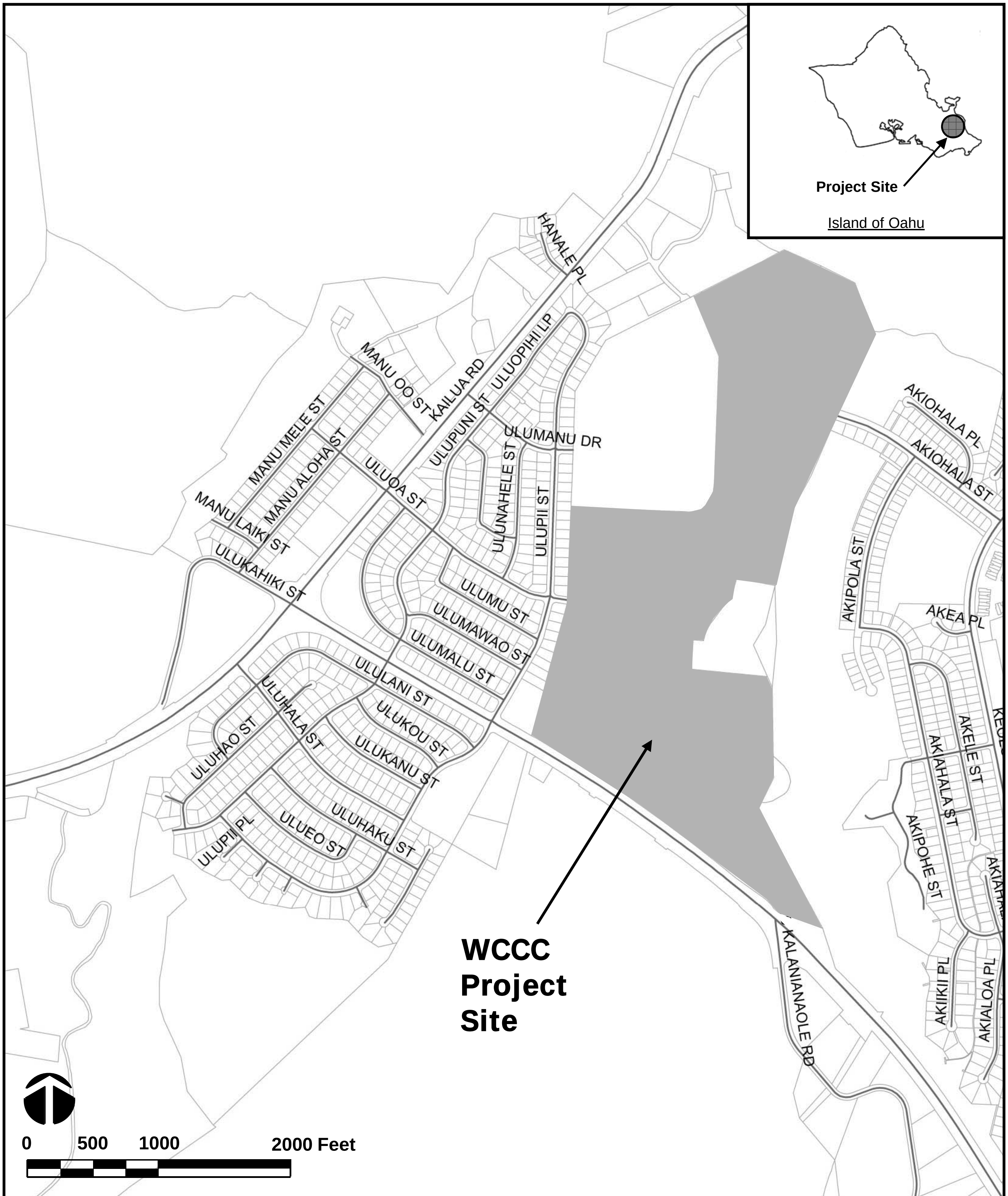


WILSON OKAMOTO CORPORATION	**OAHU COMMUNITY CORRECTIONAL CENTER**	FIGURE
	LOCATION MAP AND VICINITY MAP	4



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OAHU COMMUNITY CORRECTIONAL CENTER

LOCATION MAP AND VICINITY MAP

FIGURE 5

- Relocation to HCF site ("Alternative 3")

  Alternative 3 entails the addition of a new OCCC facility adjacent to the existing Halawa Correctional Facility which already includes a medium security prison. Similar to Alternative 2, the proposed replacement facility at HCF is also expected to provide accommodations for approximately 1,380 inmates and maintain similar functions and services provided at the existing OCCC facility in Kalihi. Vehicular access is expected to be provided via an existing driveway off Halawa Valley Street.

- Relocation to Animal Quarantine Station site ("Alternative 4")

  Alternative 4 entails the removal of the existing Animal Quarantine Station and development of a new OCCC on the portion of the property located east of the Interstate H-3 Freeway and development of a new Animal Quarantine Station west of the freeway. The new OCCC facility is expected to house approximately 1, 380 inmates. Similar to Alternatives 2 and 3, this location is also expected to provide the same services and functions offered at the existing OCCC location in Kalihi. Vehicular access is expected to be provided via new driveways off Halawa Valley Street.

In conjunction with the proposed project, all female inmates currently housed at the existing OCCC are to be relocated to the WCCC facility regardless of which alternative site is selected. WCCC will also be expanded to accommodate the addition of approximately 281 inmates to its existing inmate population. Access to the facility will continue to be provided via existing driveways off Kalanianaole Highway. The new expansion of WCCC and the replacement or reloaction of the existing OCCC facility are expected to be complete and occupied by the Year 2023 under all alternative scenarios. Figures 6 through 10 show the proposed project site plans for each alternative under consideration.

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PROPOSED SITE PLAN (ALTERNATIVE 1)

FIGURE 6

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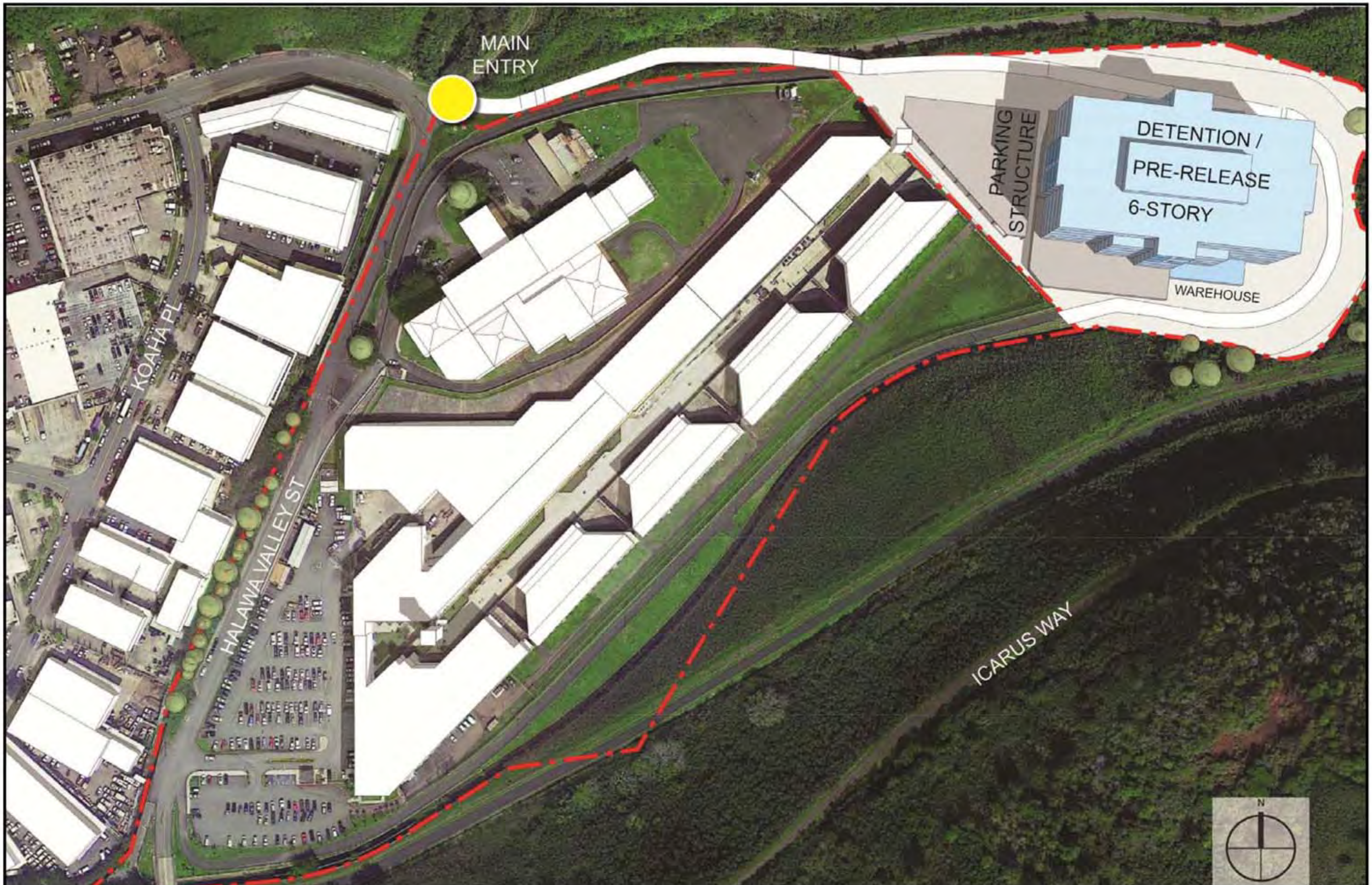
PROPOSED SITE PLAN (ALTERNATIVE 2)

FIGURE 7



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PROPOSED SITE PLAN (ALTERNATIVE 3)

FIGURE 8

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PROPOSED SITE PLAN (ALTERNATIVE 4)

FIGURE 9

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OAHU COMMUNITY CORRECTIONAL CENTER

WCCC PROPOSED SITE PLAN

FIGURE 10

3.0 EXISTING TRAFFIC CONDITIONS

3.1 General

As previously mentioned, there are 4 alternatives under consideration for the replacement or relocation of the existing OCCC facility. Some of the study areas may overlap slightly; as such, the following section includes a description of all the study intersections.

3.1.1 Field Investigation

Field investigations were conducted on April 2017 and consisted of manual turning movement count surveys during the morning commuter peak hours between 6:00 AM and 9:00 AM, and the afternoon commuter peak hours between 3:00 PM and 6:00 PM.

For the Alternative 1, the field investigations were conducted at the following intersections:

- N. Nimitz Highway and Puuhale Road
- Kamehameha Highway, Dillingham Boulevard, and Puuhale Road
- Kamehameha Highway, Laumaka Street, and the OCCC driveway

For Alternative 2, field investigations were conducted at the following intersections:

- Kamehameha Highway and Leilehua Road
- Leilehua Road and the on-ramp to the Interstate H-2 Freeway
- Leilehua Road and the off-ramp from the Interstate H-2 Freeway
- Kahelu Avenue and Akamainui Street

As discussed previously, Alternatives 3 and 4 are both located in the vicinity of Halawa Valley Street. As such, field investigations were conducted at the following:

- Ulune Street and Halawa Valley Street
- Halawa Valley Street and Iwaiwa Street
- Halawa Valley Street and Waiua Place
- Halawa Valley Street and Koaha Place

It should be noted that although both Alternatives 3 and 4 are located along Halawa Valley Street, Alternative 3 is located east of Alternative 4. As such, for the purpose of analysis, the latter two intersections were included in the Alternative 3 scenario to account for the site-generated trips expected to travel to/from that proposed project site, but were not included in the Alternative 4 scenario.

In addition, regardless of which alternative is selected, a portion of the inmates currently residing at the OCCC will be relocated to the WCCC. As such, field investigations were also conducted at the following intersections:

- Kalanianaole Highway and Ulupii Street
- Kalanianaole Highway and the driveways for the WCCC facility and Olomana School

Appendix A includes the existing traffic count data.

3.1.2 Capacity Analysis Methodology

The highway capacity analyses performed in this study is based upon procedures presented in the “Highway Capacity Manual”, Transportation Research Board, 2000, and the “Synchro” software, developed by Trafficware. The analysis is based on the concept of Level of Service (LOS) to identify the traffic impacts associated with traffic demands during the peak periods of traffic.

LOS is a quantitative and qualitative assessment of traffic operations. Levels of Service are defined by LOS “A” through “F”; LOS “A” representing ideal or free-flow traffic operating conditions and LOS “F” unacceptable or potentially congested traffic operating conditions.

“Volume-to-Capacity” (v/c) ratio is another measure indicating the relative traffic demand to the road carrying capacity. A v/c ratio of one (1.00) indicates that the roadway is operating at or near capacity. A v/c ratio of greater than 1.00 indicates that the traffic demand exceeds the road’s carrying capacity. The LOS definitions are included in Appendix A.

3.2 Alternative 1

3.2.1 Area Roadway System

In the vicinity of the proposed Alternative 1 project site, Nimitz Highway is a predominantly six lane, two-way roadway that serves as a major east-west corridor through the downtown Honolulu area. Contraflow operations are implemented along the roadway to provide an additional eastbound lane during the morning peak period. Southeast of the project site, Nimitz Highway intersects Puuhale Road. At this signalized intersection, both approaches of Nimitz Highway have an exclusive left-turn lane, two through lanes, and a shared through and right-turn lane. During the morning contraflow operations, the eastbound approach Nimitz Highway has an exclusive left-turn lane, three through lanes, and a shared through and right-turn lane while the westbound approach has one through lane and a shared through and right-turn lane. Puuhale Road originates at North King Street as a one-lane, one-way (southbound) roadway which transitions to a three-lane, two-way roadway south of the intersection with

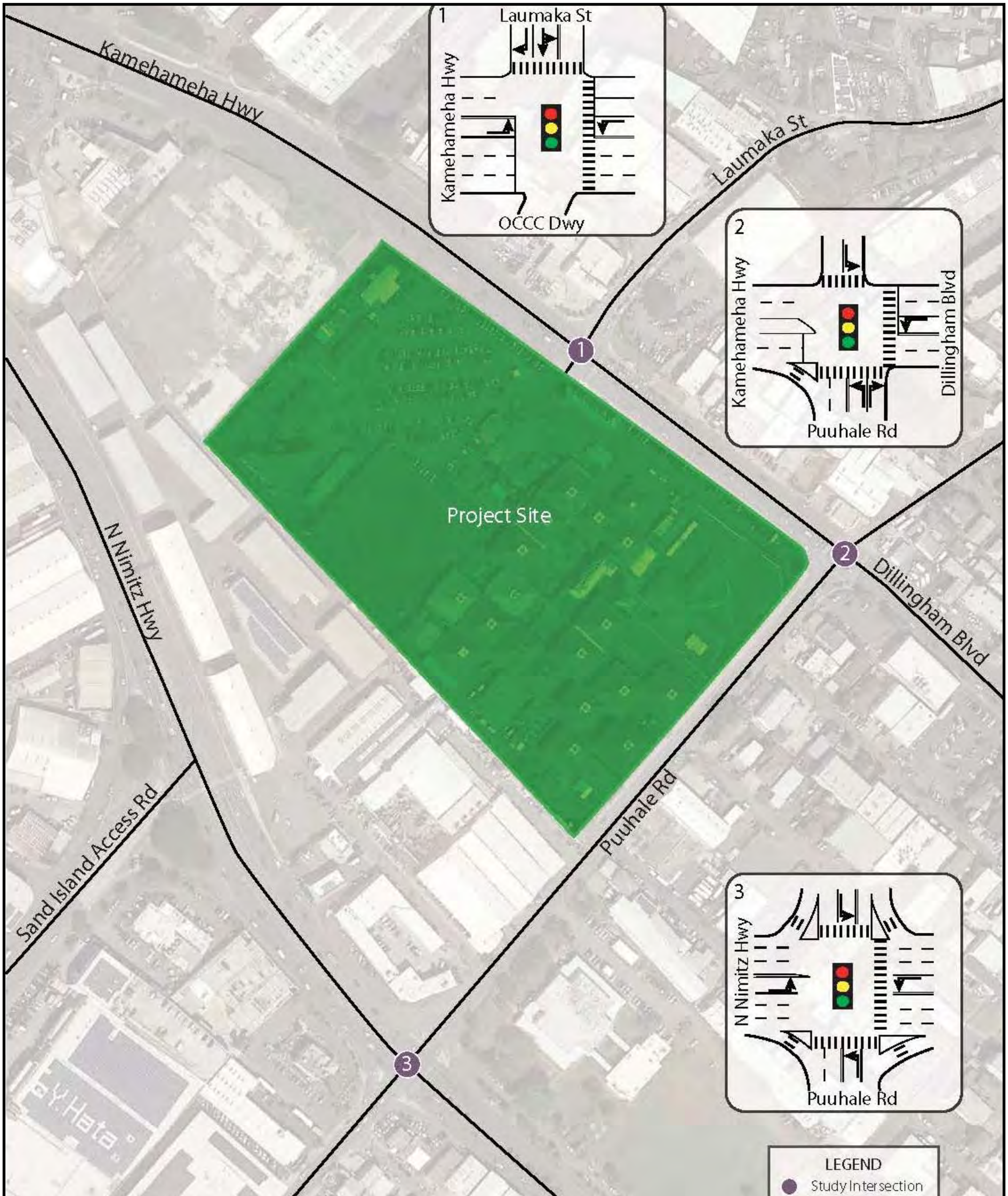
Kamehameha Highway and Dillingham Boulevard. At the intersection with Nimitz Highway, both approaches of Puuhale Road have an exclusive left-turn lane and a shared through and right-turn lane.

North of the intersection with Nimitz Highway, Puuhale Road intersects Kamehameha Highway and Dillingham Boulevard. At this signalized intersection, the northbound approach of Puuhale Road has exclusive lanes for left-turn and right-turn traffic movements while the southbound approach has an exclusive left-turn lane and a shared through and right-turn lane. Kamehameha Highway is a predominantly five-lane, two-way roadway which transitions to a four-lane, two-way roadway referred to as Dillingham Boulevard east of Puuhale Road. At the intersection with Puuhale Road, the eastbound approach of Kamehameha Highway has two through lanes and an exclusive right-turn lane while the westbound approach of Dillingham Boulevard has an exclusive left-turn lane and two through lanes.

West of the intersection with Puuhale Road, Kamehameha Highway intersects Laumaka Street. At this signalized intersection, the eastbound approach of the highway has an exclusive left-turn lane, two through lanes, and a shared through and right-turn lane while the westbound approach has an exclusive left-turn lane, one through lane, and a shared through and right-turn lane. Laumaka Street is a two-lane, two-way roadway generally oriented in the north-south direction between Bannister Street and Kamehameha Highway. At the intersection with Kamehameha Highway the southbound approach has a shared left-turn and through lane with an exclusive right-turn lane. The northbound approach is comprised of a driveway for the existing OCCC facility that has one lane which serves all traffic movements

3.2.2 Existing Peak Hour Traffic

Figures 11 and 12 show the existing lane use and peak hour traffic volumes. The morning peak hour of traffic in the vicinity of Alternative 1 generally occurs between 7:00 AM and 8:00 AM while the afternoon peak hour of traffic generally occurs between the hours of 4:00 PM and 5:00 PM. Although the peak hours of traffic generally occur around the same time periods at each of the study intersections, the absolute commuter peak hour time periods for each intersection may differ slightly. The analysis is based on these absolute commuter peak hour time periods to identify the traffic impacts resulting from the proposed project.



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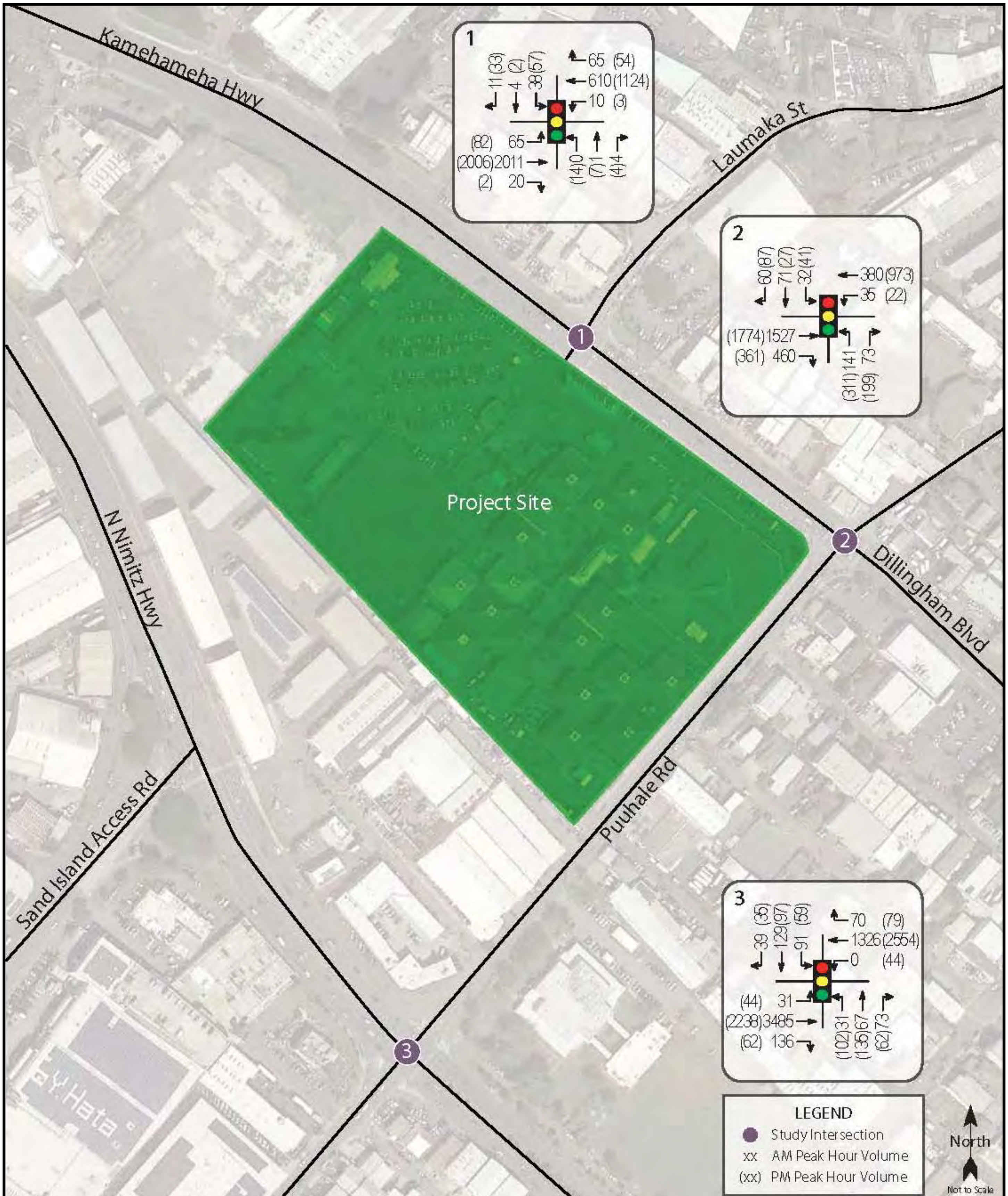
EXISTING LANE CONFIGURATIONS

FIGURE 11



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EXISTING PEAK HOURS OF TRAFFIC

FIGURE 12

3.2.3 Traffic Volumes and Conditions

3.2.3.1 Nimitz Highway and Puuhale Road

At the intersection with Puuhale Road, N. Nimitz Highway carries 3,652 vehicles eastbound and 1,396 vehicles westbound during the AM peak period. During the PM peak period, the overall traffic volume is lower with Nimitz Highway carrying 2,344 vehicles eastbound and 2,677 vehicles westbound. The eastbound approach of Nimitz Highway operates at LOS “B” during both peak periods, while the westbound approach operates at LOS “B” and LOS “C” during the AM and PM peak periods, respectively.

Puuhale Road carries 171 vehicles northbound and 259 vehicles southbound during the AM peak period. During the PM peak period, the overall traffic volume is higher with Puuhale Road carrying 299 vehicles northbound and 191 vehicles southbound. The northbound approach of Puuhale Road operates at LOS “E” and LOS “F” during the AM and PM peak periods, respectively, while the southbound approach operates at LOS “F” during both peak periods. It should be noted that the low levels of service on the Puuhale Road approaches are primarily due to the high traffic demands resulting in long traffic signal cycle lengths at this intersection during the peak periods

3.2.3.2 Kamehameha Highway, Dillingham Boulevard, and Puuhale Road

At the intersection with Puuhale Road, Kamehameha Highway carries 1,987 vehicles eastbound while Dillingham Boulevard carries 415 vehicles westbound during the AM peak period. During the PM peak period, traffic volumes are higher with Kamehameha Highway and Dillingham Boulevard carrying 2,135 vehicles eastbound and 995 vehicles westbound, respectively. The eastbound approach of Kamehameha Highway operates at LOS “A” and LOS “C” during the AM and PM peak periods, respectively, while the westbound approach operates at LOS “A” and LOS “B” during the AM and PM peak periods, respectively.

Puuhale Road carries 214 vehicles northbound and 163 vehicles southbound during the AM peak period. During the PM peak period, the overall traffic volume is higher with Puuhale Road carrying 510 vehicles northbound and 155 vehicles southbound. The northbound approach operates at LOS “D” during both peak periods while the southbound approach operates at LOS “C” during both peak periods.

3.2.3.3 Kamehameha Highway, Laumaka Street, and OCCC Driveway

At the intersection with Laumaka Street, Kamehameha Highway carries 2,096 vehicles eastbound and 685 vehicles westbound during the AM peak period. During the PM peak period, the overall traffic volume is higher with Kamehameha Highway carrying 2,090 vehicles eastbound and 1,181 vehicles westbound. The eastbound approach of Kamehameha Highway operates at LOS “A” and LOS

"C" during the AM and PM peak periods, respectively, while the westbound approaches operates at LOS "A" and LOS "B" during the AM and PM peak periods, respectively.

Laumaka Street carries 53 vehicles southbound during the AM peak period and 92 vehicles during the PM peak period. This approach operates at LOS "D" during both peak periods. The northbound approach of the intersection is comprised of a driveway for the adjacent OCCC facility which carries a minimal volume of traffic during the AM and PM peak periods. 5 vehicles were observed on the approach during the AM peak period and 25 vehicles were observed on the approach during the PM peak period.

3.3 Alternative 2

3.3.1 Area Roadway System

In the vicinity of the proposed Alternative 2 project site, Kamehameha Highway is a predominantly four-lane, two-way roadway generally oriented in the north-south direction. West of the project site, Kamehameha Highway intersects Leilehua Road. At this signalized intersection, the northbound approach of Kamehameha Highway has two through lanes and an exclusive right-turn lane, while the southbound approach has an exclusive left-turn lane and two through lanes. Leilehua Road is a predominantly three-lane, two-way roadway which transitions to a four-lane, two-way roadway referred to as Kahelu Avenue east of the intersection with Wikao Street. At the intersection with Kamehameha Highway, the westbound approach of Leilehua Road has exclusive lanes for left-turn and right-turn traffic movements.

East of the intersection with Kamehameha Highway, Leilehua Road intersects the on-ramp to the Interstate H-2 (southbound) Freeway. At this unsignalized intersection, the eastbound approach of Leilehua Road has a shared through and right-turn lane while the westbound approach has an exclusive left-turn lane and one through lane. The south leg of the intersection is comprised of the on-ramp to the Interstate H-2 Freeway which has one (southbound) departure lane.

East of the intersection with the Interstate H-2 Freeway on-ramp, Leilehua Road intersects the off-ramp from the Interstate H-2 (northbound) Freeway. At this unsignalized intersection, the eastbound approach of Leilehua Road has one through lane while the westbound approach has two through lanes. The northbound approach of that intersection is comprised of the Interstate H-2 Freeway off-ramp which has exclusive lanes for left-turn and right-turn traffic movements.

East of the intersection with the Interstate H-2 Freeway off-ramp, Kahelu Avenue intersects Akamainui Street. At this unsignalized intersection, the eastbound approach of Kahelu Avenue has one through lane and a shared through and right-turn lane while the westbound approach has an exclusive left-turn lane, one through lane, and a shared through and right-turn lane. Akamainui Street is a two-lane, two-way roadway generally oriented in the north-south direction between Kahelu Avenue and Wikao Street. At the intersection with Kahelu Avenue, the northbound approach of Akamainui Street has exclusive lanes for left-turn and right-turn traffic movements. In addition, a refuge lane is provided within the median along Kahelu Avenue to assist vehicles turning left from Akamainui Street. The southbound approach of the intersection is comprised of a driveway for an adjacent commercial property which has one lane that serves primarily right-turn traffic movements.

3.3.2 Existing Peak Hour Traffic

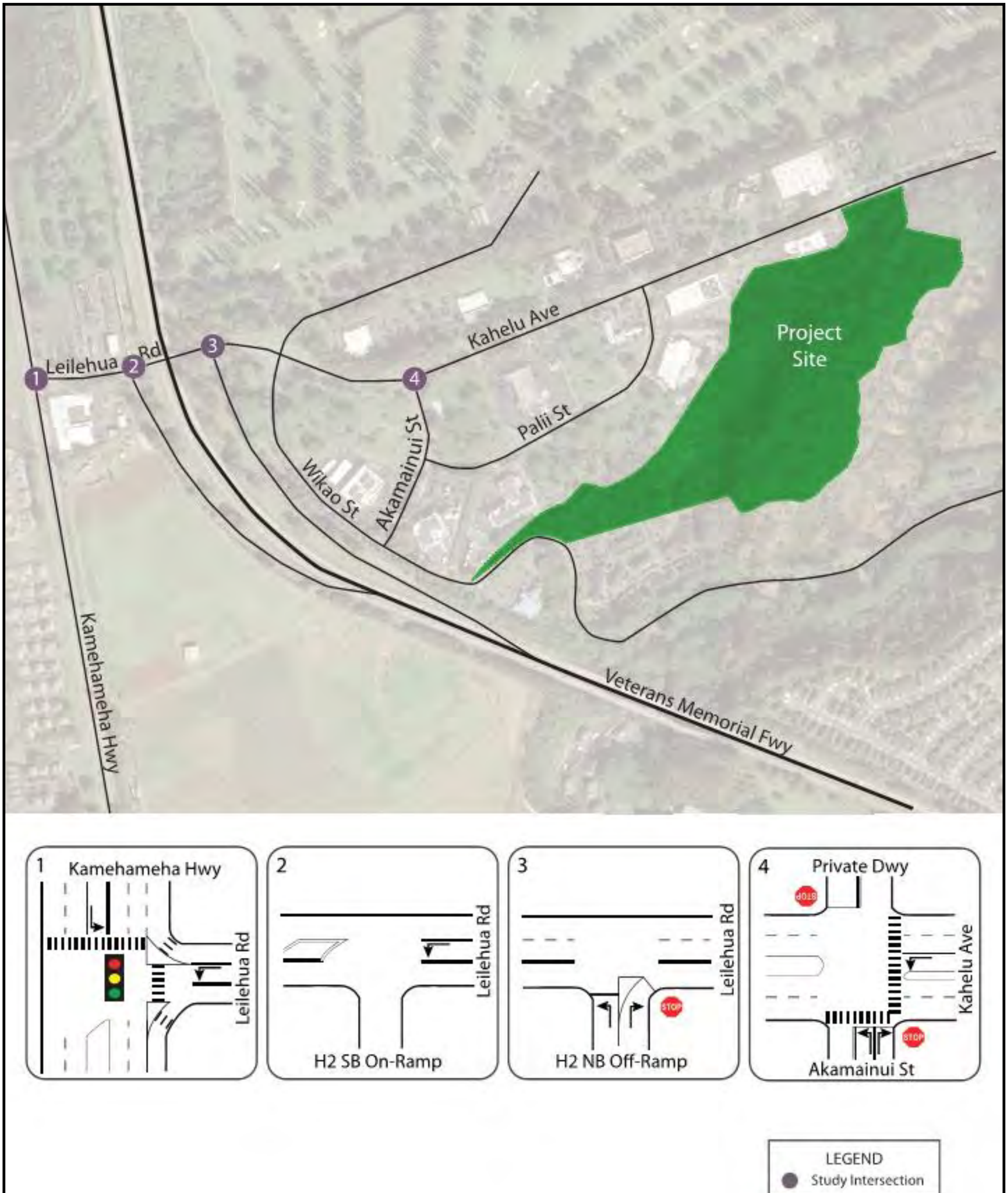
Figures 13 and 14 show the existing lane use and peak hour traffic volumes in the vicinity of the Alternative 2 site. The morning peak hour of traffic generally occurs between 7:15 AM and 8:15 AM while the afternoon peak hour of traffic generally occurs between the hours of 4:15 PM and 5:15 PM. Although the peak hours of traffic generally occur around the same time periods at each of the study intersections, the absolute commuter peak hour time periods for each intersection may differ slightly. The analysis is based on these absolute commuter peak hour time periods to identify the traffic impacts resulting from the proposed project. LOS calculations are included in Appendix B.

3.3.3 Traffic Volumes and Conditions

3.3.3.1 Kamehameha Highway and Leilehua Road

At the intersection with Leilehua Road, Kamehameha Highway carries 787 vehicles northbound and 800 vehicles southbound during the AM peak period. During the PM peak period, the overall traffic volume is higher with Puuhale Road carrying 554 vehicles northbound and 1,086 vehicles southbound. The northbound approach operates at LOS “B” and LOS “C” during the AM and PM peak periods, respectively, while the southbound approach operates at LOS “B” during both peak periods.

The westbound approach of Leilehua Road carries 1,987 vehicles during the AM peak period and 288 vehicles during the PM peak period. The Leilehua Road approach operates at LOS “C” during both the AM and PM peak periods.



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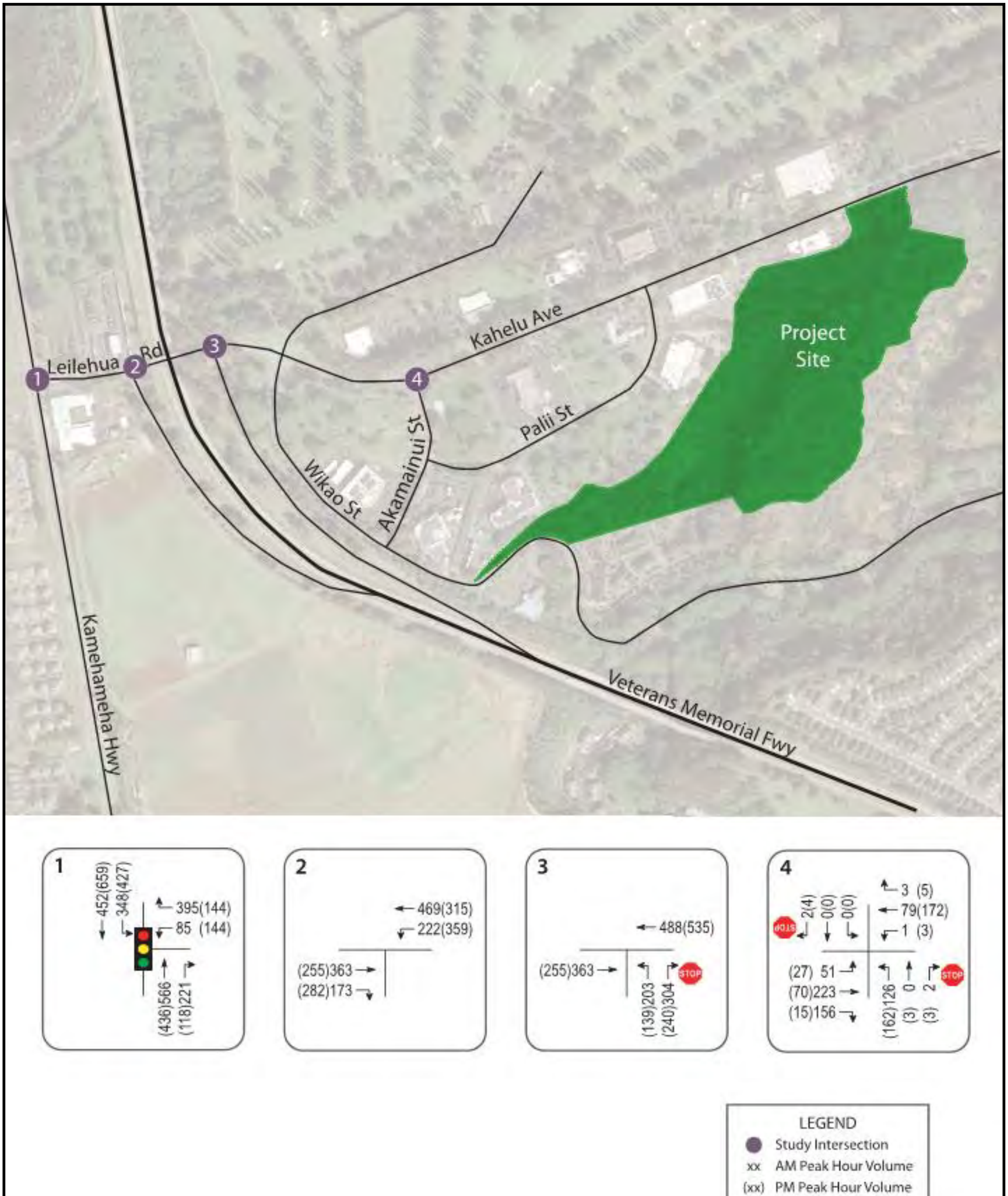
EXISTING LANE CONFIGURATIONS

FIGURE 13



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EXISTING PEAK HOURS OF TRAFFIC

FIGURE 14

3.3.3.2 Leilehua Road and the Interstate H-2 Freeway Ramps

At the intersection with the Interstate H-2 Freeway on-ramp, Leilehua Road carries 536 vehicles eastbound and 691 vehicles westbound during the AM peak period. During the PM peak period, the overall traffic volume is higher with Leilehua Road carrying 537 vehicles eastbound and 674 vehicles westbound. The westbound left-turn traffic movement operates at LOS “A” and LOS “B” during the AM and PM peak periods, respectively.

At the intersection with Leilehua Road, the northbound approach of the Interstate H-2 Freeway off-ramp carries 507 vehicles during the AM peak period and 379 vehicles during the PM peak period. This approach operates at LOS “C” and LOS “B” during both the AM and PM peak periods, respectively.

3.3.3.3 Kahelu Avenue and Akamainui Street

At the intersection with Akamainui Street, Kahelu Avenue carries 430 vehicles eastbound and 83 vehicles westbound during the AM peak period. During the PM peak period, the overall traffic volume is lower with Kahelu Avenue carrying 112 vehicles eastbound and 180 vehicles westbound. Both approaches of Kahelue Avenue operates at LOS “A” during both peak periods.

The northbound approach of Akamainui Street carries 128 vehicles during the AM peak period and 168 vehicles during the PM peak period. This approach operates at LOS “C” and LOS “B” during the AM and PM peak periods, respectively. The southbound approach of the intersection is comprised of a private driveway which carries a minimal volume of traffic during the AM and PM peak periods. 2 vehicles were observed on the approach during the AM peak period and 4 vehicles were observed on the approach during the PM peak period. That approach operates at LOS “A” during both peak periods.

3.4 Alternatives 3 & 4

3.4.1 Area Roadway System

In the vicinity of the proposed project sites for Alternatives 3 and 4, Ulune Street is a three-lane, one-way (westbound) roadway which transitions to a five-lane, two-way roadway west of the intersection with Halawa Valley Street. West of the project sites, Ulune Street intersects Halawa Valley Street. At this signalized intersection, the eastbound approach of Ulune Street has exclusive turning lanes while the westbound approach has two through lanes and a shared through and right-turn lane. Halawa Valley Street is a three-lane, two-way roadway which transitions to a two-lane, two-way roadway east of the intersection with Iwaiwa Street. At the intersection with Ulune Street, the southbound approach of Halawa Valley Street has one through lane and an exclusive right-turn lane.

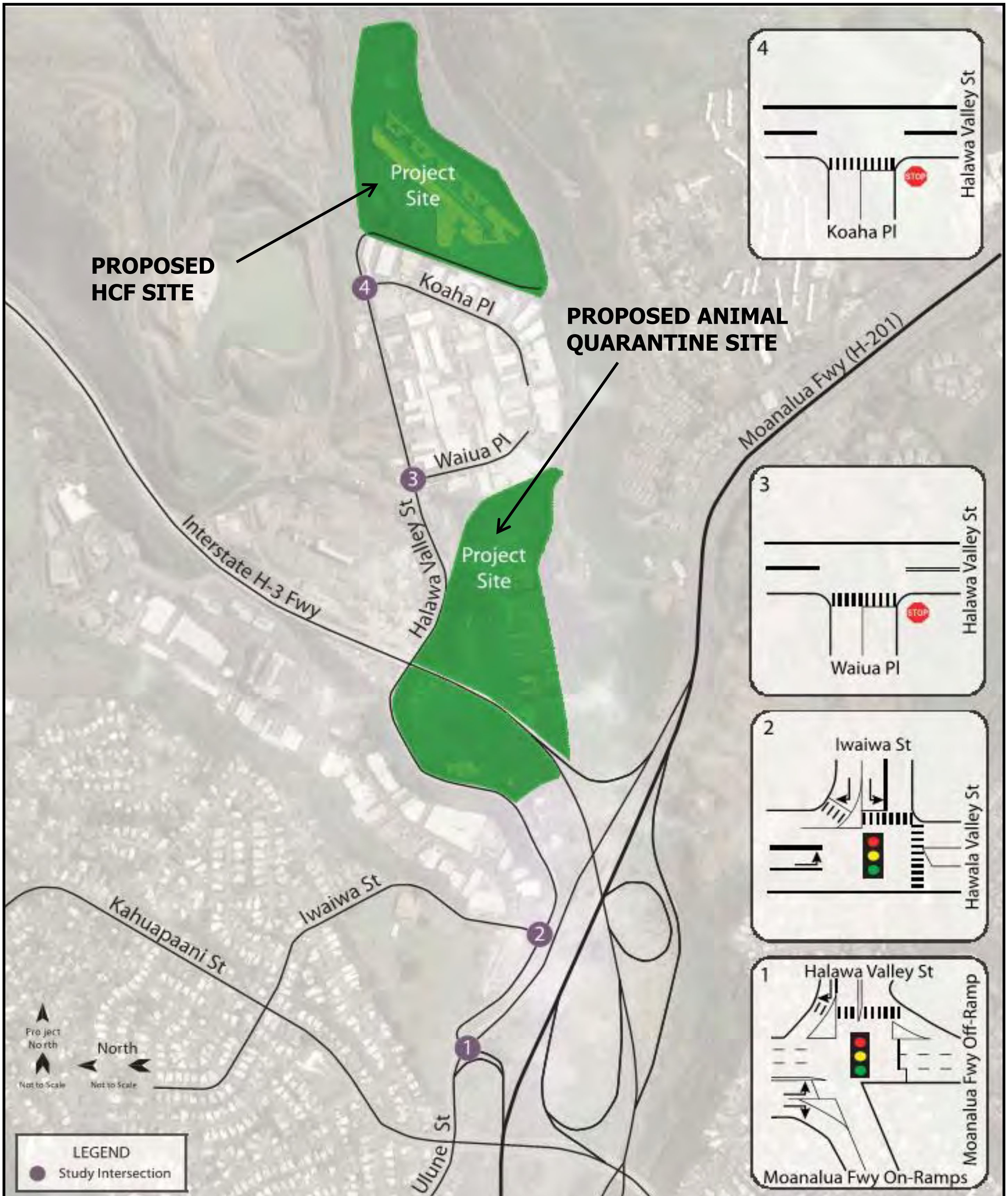
East of the intersection with Ulune Street, Halawa Valley Street intersects Iwaiwa Street. At this signalized T-intersection, the eastbound approach of Halawa Valley Street has an exclusive left-turn lane and one through lane while the westbound approach has a shared through and right-turn lane. Iwaiwa Street is a predominantly two-lane, two-way roadway generally oriented in the north-south direction. At the intersection with Halawa Valley Street, Iwaiwa Street has exclusive lanes for left-turn and right-turn traffic movements.

East of the intersection with Iwaiwa Street, Halawa Valley Street intersects Waiua Place. At this unsignalized T-intersection, the eastbound approach of Halawa Valley Street has a shared through and right-turn lane while the westbound approach has a shared left-turn and through lane. Waiua Place is a predominantly two-lane, two-way roadway which primarily serves the adjacent industrial uses. At the intersection with Halawa Valley Street, Waiua Place has one stop-controlled lane that serves left-turn and right-turn traffic movements. As previously mentioned, although both alternatives are located along Halawa Valley Street, the project site for Alternative 3 is located east of the Alternative 4 project site at the end of the corridor. As such, this intersection was included in the Alternative 3 scenario to account for the site-generated trips expected to travel to/from that proposed project site.

East of the intersection with Waiua Place, Halawa Valley Street intersects Koaha Place. At this unsignalized T-intersection, the eastbound approach of Halawa Valley Street has a shared through and right-turn lane while the westbound approach has a shared left-turn and through lane. Koaha Place is a predominantly two-lane, two-way roadway which also serves the adjacent industrial uses. At the intersection with Halawa Valley Street, Koaha Place has one stop-controlled lane that serves left-turn and right-turn traffic movements. Similar to the intersection of Iwaiwa Street with Halawa Valley Street, this intersection was only included in the Alternative 3 scenario.

3.4.2 Existing Peak Hour Traffic

Figures 15 and 16 show the existing lane use and peak hour traffic volumes. The morning peak hour of traffic generally occurs between 7:15 AM and 8:15 AM while the afternoon peak hour of traffic generally occurs between the hours of 3:15 PM and 4:15 PM. Although the peak hours of traffic generally occur around the same time periods at each of the study intersections, the absolute commuter peak hour time periods for each intersection may differ slightly. The analysis is based on these absolute commuter peak hour time periods to identify the traffic impacts resulting from the proposed project. LOS calculations are included in Appendix C.



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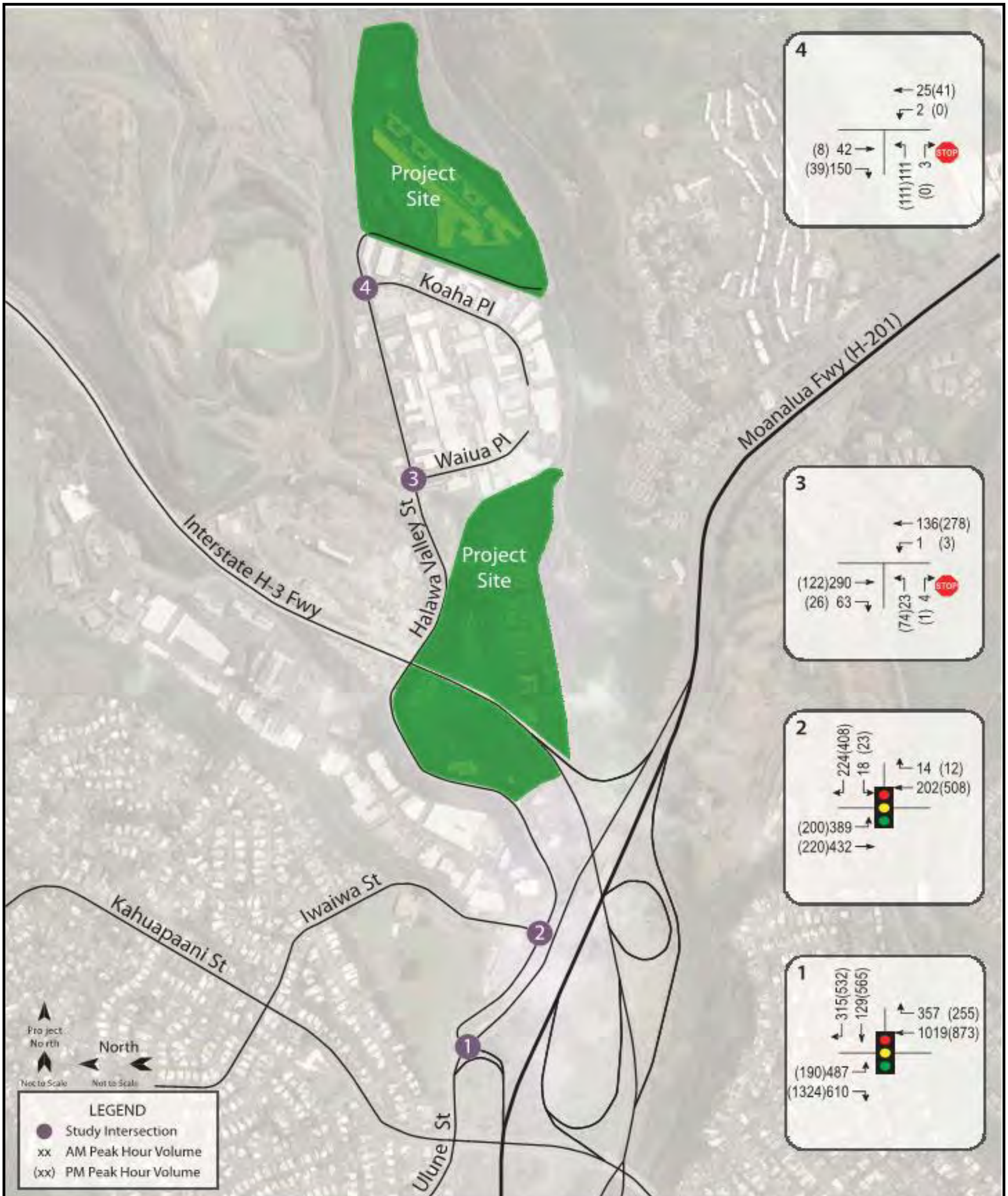
EXISTING LANE CONFIGURATIONS

FIGURE 15



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EXISTING PEAK HOURS OF TRAFFIC

FIGURE 16

3.4.3 Traffic Volumes and Conditions

3.4.3.1 Ulune Street and Halawa Valley Street

At the intersection with Halawa Valley Street, Ulune Street carries 1,097 vehicles eastbound and 1,376 vehicles westbound during the AM peak period. During the PM peak period, the overall traffic volume is higher with Ulune Street carrying 1,514 vehicles eastbound and 1,128 vehicles westbound. The eastbound approach of Ulune Street operates at LOS “C” and LOS “B” during the AM and PM peak periods, respectively, while the westbound approach operates at LOS “D” during both peak periods. The Halawa Valley Street approach carries 444 vehicles southbound during the AM peak period and 1,097 vehicles during the PM peak period. This approach operates at LOS “D” during both the AM and PM peak periods.

3.4.3.2 Halawa Valley Street and Iwaiwa Street

At the intersection with Iwaiwa Street, Halawa Valley Street carries 821 vehicles eastbound and 216 vehicles westbound during the AM peak period. During the PM peak period, the overall traffic volume is lower with Halawa Valley carrying 420 vehicles eastbound and 520 vehicles westbound. The eastbound approach of Halawa Valley Street operates at LOS “B” during both peak periods, while the westbound approach operates at LOS “C” during both peak periods. The Iwaiwa Street approach carries 242 vehicles during the AM peak period and 431 vehicles during the PM peak period. This approach operates at LOS “C” during both the AM and PM peak periods.

3.4.3.3 Halawa Valley Street and Waiua Place

At the intersection with Waiua Place, Halawa Valley Street carries 353 vehicles eastbound and 137 vehicles westbound during the AM peak period. During the PM peak period, the overall traffic volume is lower with Halawa Valley carrying 148 vehicles eastbound and 281 vehicles westbound. The westbound approach of Halawa Valley Street operates at LOS “A” during both peak periods. The Waiua Place approach carries 27 vehicles northbound during the AM peak period and 75 vehicles during the PM peak period. This approach operates at LOS “B” during both the AM and PM peak periods.

3.4.3.4 Halawa Valley Street and Koaha Place

At the intersection with Koaha Place, Halawa Valley Street carries 192 vehicles eastbound and 27 vehicles westbound during the AM peak period. During the PM peak period, the overall traffic volume is lower with Halawa Valley carrying 47 vehicles eastbound and 41 vehicles westbound. The westbound approach of Halawa Valley Street operates at LOS “A” during both peak periods. The Koaha

Place approach carries 114 vehicles northbound during the AM peak period and 111 vehicles during the PM peak period. This approach operates at LOS “B” and LOS “A” during the AM and PM peak periods, respectively.

3.5 WCCC Facility

As previously mentioned, all female inmates currently housed at the existing OCCC are to be relocated to the WCCC facility regardless of which alternative site is selected. As such, traffic impacts in the vicinity of the WCCC facility were assessed in conjunction with Alternatives 1 thru 4.

3.5.1 Area Roadway System

In the vicinity of the proposed project site, Kalanianaole Highway is a predominantly four-lane, two-way roadway generally oriented in the east-west direction. West of the project site, Kalanianaole Highway intersects Ulupii Street. At this unsignalized intersection, both approaches of the highway have an exclusive left-turn lane, one through lane, and a shared through and right-turn lane. Ulupii Street is a predominantly two-lane, two-way roadway generally oriented in the north-south direction and primarily serves the adjacent residential community. At the intersection with Kalanianaole Highway, both approaches of Ulupii Street have one stop-controlled lane that serves all traffic movements. It should be noted that although a refuge lane is not provided, vehicles were observed to utilize the wide median to cross the highway in two-stages.

East of the intersection with Ulupii Street, Kalanianaole Highway intersects the project driveway for the Women’s Community Correctional Center and the Olomana School driveway. At this unsignalized intersection, the eastbound approach of Kalanianaole Highway has an exclusive left-turn lane, two through lanes, and an exclusive right-turn lane while the westbound approach has an exclusive left-turn lane, one through lane, and a shared through and right-turn lane. The southbound approach is comprised of a driveway for the Women’s Community Correctional Center which has one lane that serves all traffic movements. In addition, the northbound approach is comprised of a driveway for Olomana School which also has one lane that serves all traffic movements. It should be noted that although a refuge lane is not provided, vehicles were also observed to utilize the wide median to cross the highway in two-stages.

3.5.2 Existing Peak Hour Traffic

Figures 17 and 18 show the existing lane use and peak hour traffic volumes. The morning peak hour of traffic generally occurs between 7:15 AM and 8:15 AM while the afternoon peak hour of traffic generally occurs between the hours of 4:45 PM and 5:45 PM. Although the peak hours of traffic generally occur around the same time periods at each of the study intersections, the absolute commuter peak hour time periods for each intersection may differ slightly. The analysis is based on these absolute commuter peak hour time periods to identify the traffic impacts resulting from the proposed project. LOS calculations are included in Appendix C.

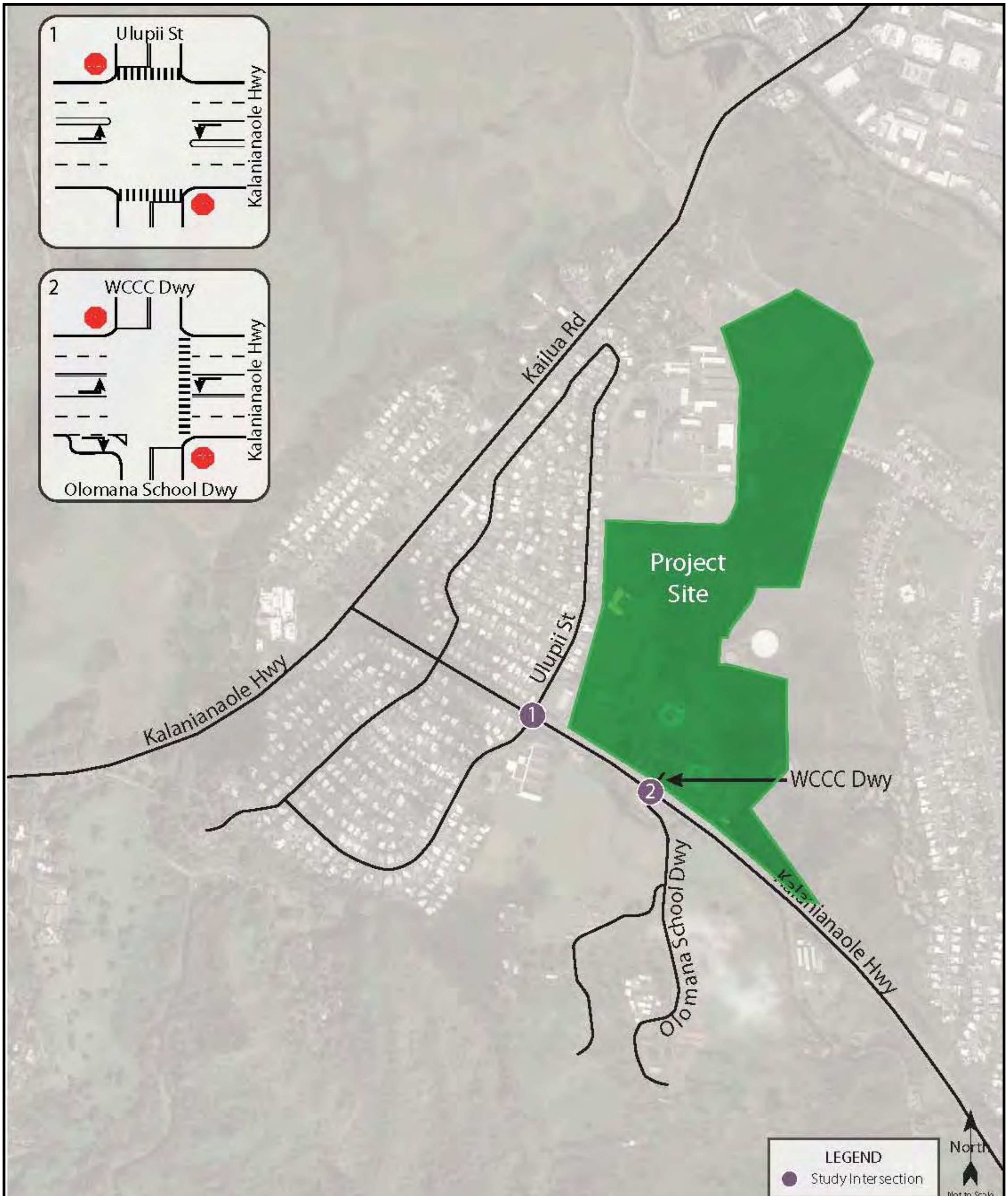
3.5.3 Traffic Volumes and Conditions

3.5.3.1 Kalanianaole Highway and Ulupii Street

At the intersection with Ulupii Street, Kalanianaole Highway carries 770 vehicles eastbound and 1,364 vehicles westbound during the AM peak period. During the PM peak period, the overall traffic volume is higher with Kalanianaole Highway carrying 1,416 vehicles eastbound and 937 vehicles westbound. The eastbound and westbound left-turn traffic movements along Kalanianaole Highway operate at LOS “B” during both peak periods. Ulupii Street carries 94 vehicles northbound and 67 vehicles southbound during the AM peak period. During the PM peak period, the overall traffic volume is lower with Ulupii Street carrying 53 vehicles northbound and 68 vehicles southbound. The northbound approach operates at LOS “C” during both peak periods while the southbound approach operates at LOS “D” and LOS “C” during the AM and PM peak periods, respectively.

3.5.3.2 Kalanianaole Highway and the driveways for WCCC and Olomana School

At the intersection with the driveways for the WCCC facility and Olomana School, Kalanianaole Highway carries 815 vehicles eastbound and 1,284 vehicles westbound during the AM peak period. During the PM peak period, the overall traffic volume is higher with Kalanianaole Highway carrying 1,427 vehicles eastbound and 841 vehicles westbound. The eastbound left-turn traffic movement operates at LOS “B” and LOS “A” during the AM and PM peak periods, respectively, while the westbound left-turn traffic movement operates at LOS “A” during both peak periods.



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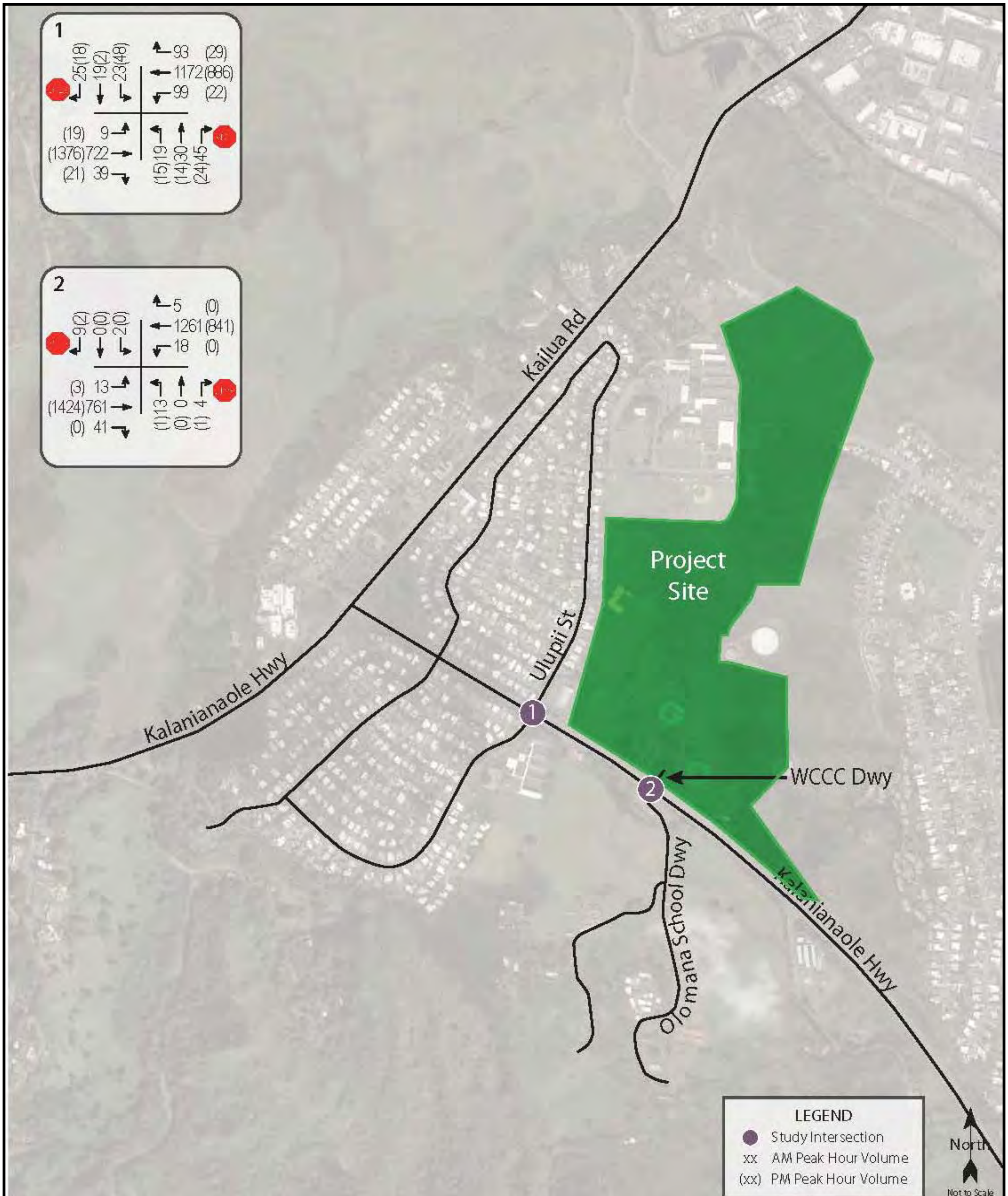
EXISTING LANE CONFIGURATIONS

FIGURE 17



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EXISTING PEAK HOURS OF TRAFFIC

FIGURE 18

The WCCC driveway carries 11 vehicles southbound during the AM peak period and 2 vehicles during the PM peak period. This approach operates at LOS “B” during both peak periods. However, although operating sufficiently based on vehicular traffic demands, turning maneuvers entering and exiting the project site driveway may be a safety hazard as result of the physical layout and configuration of the intersection at the vehicular conflict zones. The northbound approach of the intersection is comprised of a driveway for the adjacent Olomana School which carries a minimal volume of traffic during the AM and PM peak periods. 17 vehicles were observed on the approach during the AM peak period and 2 vehicles were observed on the approach during the PM peak period. This approach operates at LOS “C” during both peak periods.

4.0 PROJECTED TRAFFIC CONDITIONS

4.1 Site-Generated Traffic: Trip Generation Methodology

The trip generation methodology is typically based upon generally accepted techniques developed by the Institute of Transportation Engineers (ITE) and published in “Trip Generation, 9th Edition,” 2012. The ITE trip generation rates are developed empirically by correlating the vehicle trip generation data with various land use characteristics such as the number of vehicle trips generated per inmate. However, trip generation rates for prisons developed empirically are based on a small sample size and may not be an accurate representation of the proposed project conditions. As such, for the purpose of this report, two trip generation characteristics were used to represent a conservative analysis and both methods were applied to the AM and PM peak hours of traffic.

4.1.1 Trip Generation Method 1

The first method (referred to as “Method 1”) uses trip generation rates based on the existing trip generation characteristics at the OCCC facility from the collected field data. Table 1 summarizes the trip generation characteristics related to the proposed project site alternatives, as well as the expansion of the WCCC facility, applied to the AM and PM peak hours of traffic.

Table 1: Peak Hour Trip Generation Method 1

LAND USE: INSTITUTIONAL		Alternative 1	Alternatives 2,3, and 4	WCCC
Independent Variable	# of Additional Inmates	343	1,380	281
AM PEAK	Enter	13	54	11
	Exit	5	18	4
	Total	18	72	15
PM PEAK	Enter	3	12	3
	Exit	9	35	7
	Total	12	47	10

4.1.2 Trip Generation Method 2

Alternatively, the second method (referred to as "Method 2") uses trip generation rates based on characteristics at the OCCC facility from employee data provided by the State of Hawaii Department of Public Safety (PSD). This data included information regarding work shift schedules and corresponding employees for each shift. Based on this data of actual operations at the existing OCCC facility, corresponding trip generation rates were developed for both the morning and afternoon peak traffic periods. These rates are applied to the varying proposed inmate population sizes to reflect the associated trip generating characteristic of each proposed alternative. Table 2 summarizes the trip generation characteristics related to the proposed project alternatives, as well as the expansion of the WCCC facility, applied to the AM and PM peak hours of traffic. Since the resulting traffic volumes based on the trip generation rates derived from Method 2 are generally greater than traffic volumes derived from Method 1, the projected traffic analyses hereinafter are based on projected traffic volume derived from Method 2. As such, the conservative analyses would potentially result in better traffic operations than reported and evaluated herein.

Table 2: Peak Hour Trip Generation Method 2

LAND USE: INSTITUTIONAL		Alternative 1	Alternatives 2,3, and 4	WCCC
Independent Variable	# of Additional Inmates	343	1,380	281
AM PEAK	Enter	41	163	34
	Exit	29	117	24
	Total	70	280	58
PM PEAK	Enter	1	2	1
	Exit	25	98	20
	Total	26	100	21

4.2 Alternative 1

4.2.1 Trip Distribution

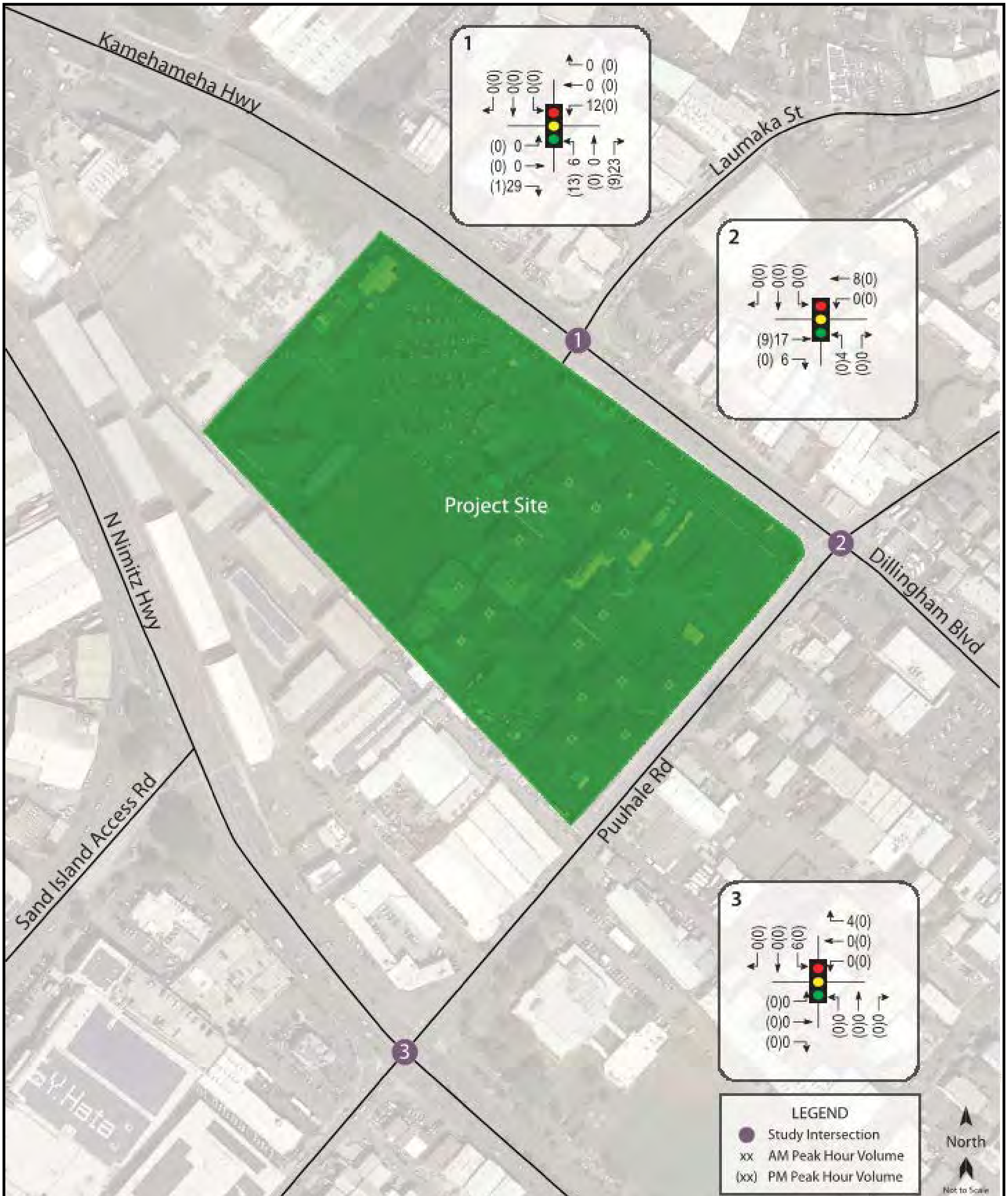
Figure 19 shows the distribution of site-generated traffic during the AM and PM peak periods. Primary access to the proposed site in Kalihi will be provided via the existing driveway off Kamehameha Highway at the intersection with Laumaka Street. The directional distribution at the intersection of Kamehameha Highway and Laumaka Street was assumed to remain similar to existing conditions. As such, 70% of entering trips were assumed to be traveling eastbound while 30% of entering trips were assumed to be traveling westbound during both peak periods. Similarly, 84% of exiting trips were assumed to be traveling eastbound with 16% assumed to be traveling westbound during the AM peak period. During the PM peak period, 24% of exiting trips were assumed to be traveling eastbound with 76% of exiting trips assumed to be traveling westbound.

4.2.2 Through Traffic Forecasting Methodology

The travel forecast is based upon historical traffic count data obtained from the State DOT, Highways Division at survey stations located along Nimitz Highway and Kamehameha Highway (Kalihi) in the vicinity of the proposed project site. The historical data indicates relatively stable traffic volumes along the study corridors and, as such, an annual traffic growth rate of approximately 0.5 % was conservatively assumed in the project vicinity. Using 2017 as the Base Year, a growth rate factor of 1.03 was applied to the existing traffic demands in the project vicinity to achieve the projected Year 2023 traffic demands.

4.2.3 Year 2023 Total Traffic Volumes Without Project

The projected Year 2023 AM and PM peak period traffic volumes and operating conditions without the implementation of Alternative 1 is shown in Figure 20 and summarized in Table 3. The existing levels of service are provided for comparison purposes. LOS calculations are included in Appendix D.



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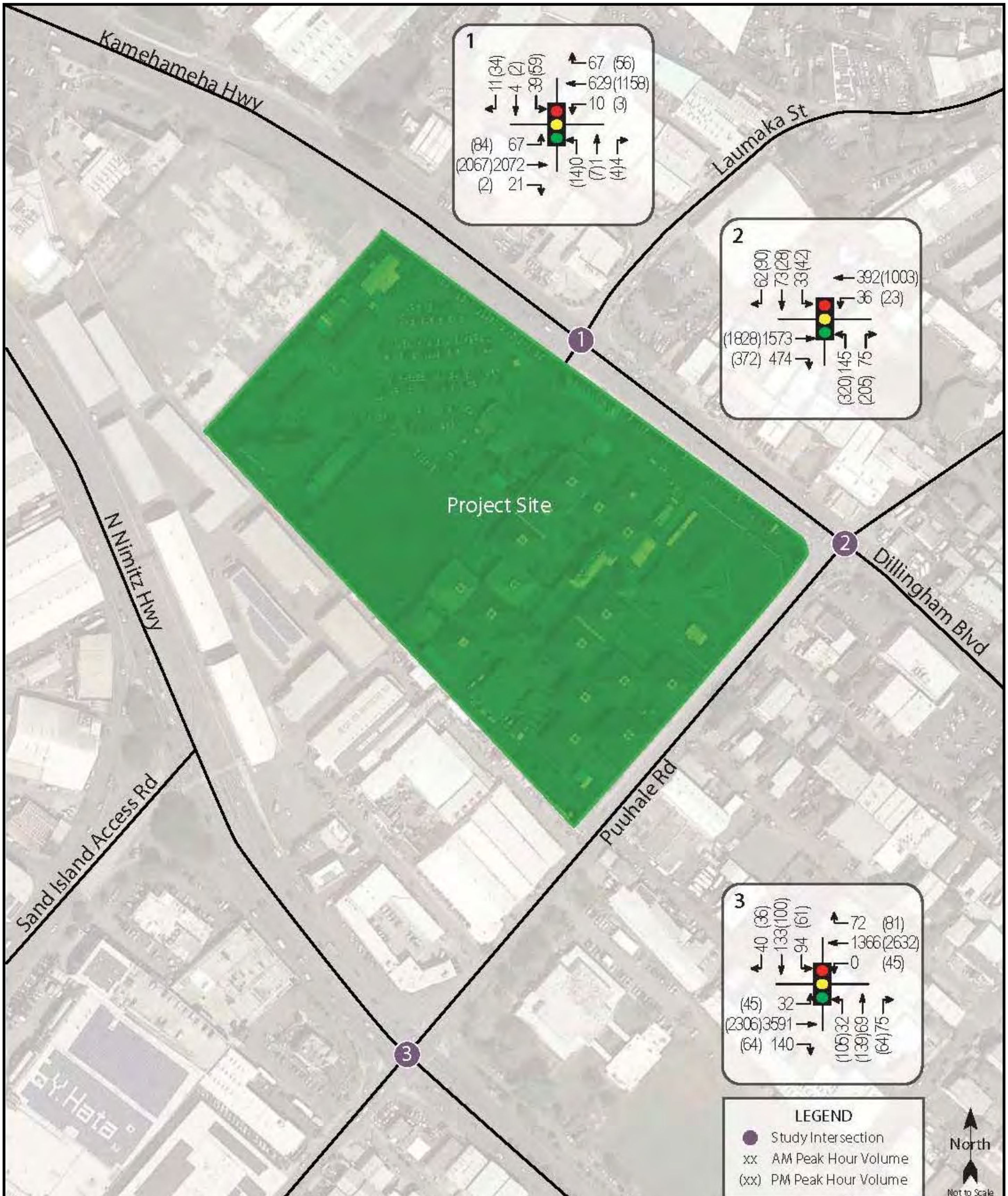
DISTRIBUTION OF SITE-GENERATED VEHICLES WITH ALTERNATIVE 1

FIGURE 19



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YEAR 2023 PEAK HOURS OF TRAFFIC WITHOUT ALTERNATIVE 1

FIGURE 20

Table 3: Existing and Projected Year 2023 (Without Project) LOS Traffic Operating Conditions

Intersection	Approach	AM		PM	
		Exist	Year 2023 w/o Proj	Exist	Year 2023 w/o Proj
N. Nimitz Hwy/ Puuhale Rd.	Eastbound	B	B	B	B
	Westbound	B	B	C	C
	Northbound	E	E	F	F
	Southbound	F	F	F	F
Kamehameha Hwy/ Dillingham Blvd/ Puuhale Rd	Eastbound	A	A	C	C
	Westbound	A	A	B	B
	Northbound	D	D	D	D
	Southbound	C	C	C	C
Kamehameha Hwy/ Laumaka St/ OCCC Dwy	Eastbound	A	A	A	A
	Westbound	A	A	A	A
	Northbound	C	D	C	C
	Southbound	D	D	D	D

Under Year 2023 without project conditions, traffic operations are expected to remain similar to existing conditions. Near the existing OCCC facility, traffic operations at the intersection of N. Nimitz Highway and Puuhale Road are expected to continue operating at LOS “C” or better during both peak periods with the exception of the side street approaches which are expected to continue operating at LOS “F” during both peak periods. As previously discussed, the low levels of service along the side streets are primarily due to the long traffic signal cycle lengths along the highway. Along Kamehameha Highway and Dillingham Boulevard, traffic operations at the other study intersections are expected to operate at LOS “D” or better during both peak periods.

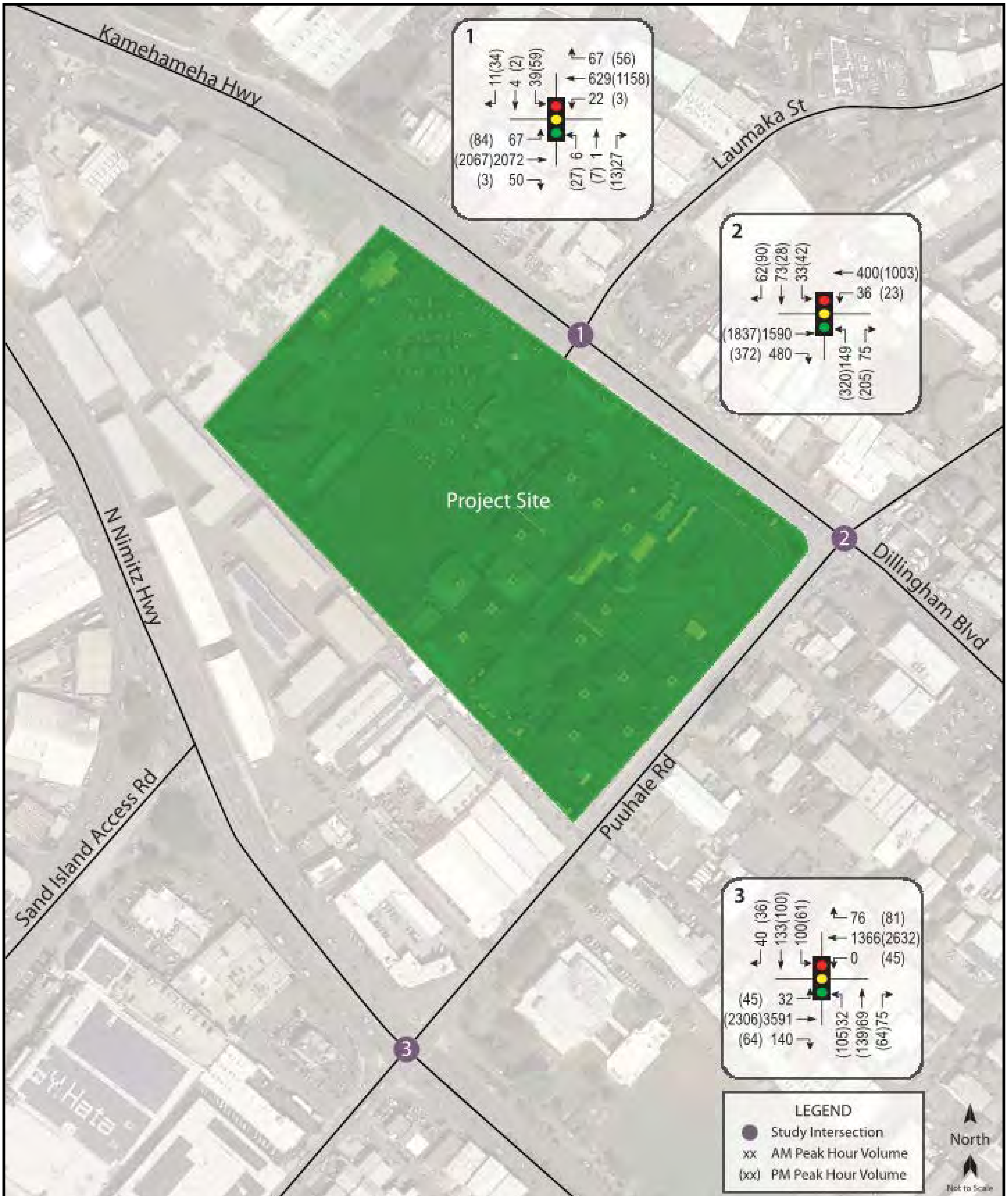
4.2.4 Year 2023 Total Traffic Volumes With Project

The Year 2023 cumulative AM and PM peak hour traffic conditions with the implementation of Alternative 1 are shown in Figures 21 and summarized in Table 4. The cumulative volumes consist of site-generated traffic superimposed over the Year 2023 projected traffic demands. The existing and projected Year 2023 (Without Project) operating conditions are provided for comparison purposes. LOS calculations are included in Appendix E.

Table 4: Existing and Projected Year 2023 (Without and With Alternative 1) LOS Traffic Operating Conditions

Intersection	Approach	AM			PM		
		Exist	Year 2023 w/out Proj	Year 2023 w/ Project	Exist	Year 2023 w/out Proj	Year 2023 w/ Project
N. Nimitz Hwy/ Puuhale Rd.	Eastbound	B	B	A	B	B	B
	Westbound	B	B	A	C	C	B
	Northbound	E	E	E	F	F	F
	Southbound	F	F	E	F	F	F
Kamehameha Hwy/ Dillingham Blvd/ Puuhale Rd	Eastbound	A	A	A	C	C	C
	Westbound	A	A	A	B	B	B
	Northbound	D	D	D	D	D	D
	Southbound	C	C	C	C	C	C
Kamehameha Hwy/ Laumaka St/ OCCC Dwy	Eastbound	A	A	A	A	A	A
	Westbound	A	A	A	A	A	A
	Northbound	C	D	D	C	C	D
	Southbound	D	D	D	D	D	D

Traffic operations with the implementation of Alternative 1 are generally expected to remain similar to without project conditions despite the addition of site-generated trips to the surrounding roadway network. Along Kamehameha Highway and Dillingham Boulevard, traffic operations at the intersection with Puuhale Road and at Laumaka Street and the OCCC driveway are expected to continue operating at LOS “D” or better during both the AM and PM peak periods. Near the existing OCCC facility, traffic operations along the N. Nimitz Highway approaches at the intersection with Puuhale Road are expected to improve to LOS “A” during the AM peak period and LOS “B” during the PM peak period. However, the northbound and southbound approaches along Puuhale Road are anticipated to continue operating at low levels of service. As previously discussed, the low levels of service along Puuhale Road are primarily due to the long traffic signal cycle lengths along the highway.



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YEAR 2023 PEAK HOURS OF TRAFFIC WITH ALTERNATIVE 1

FIGURE 21

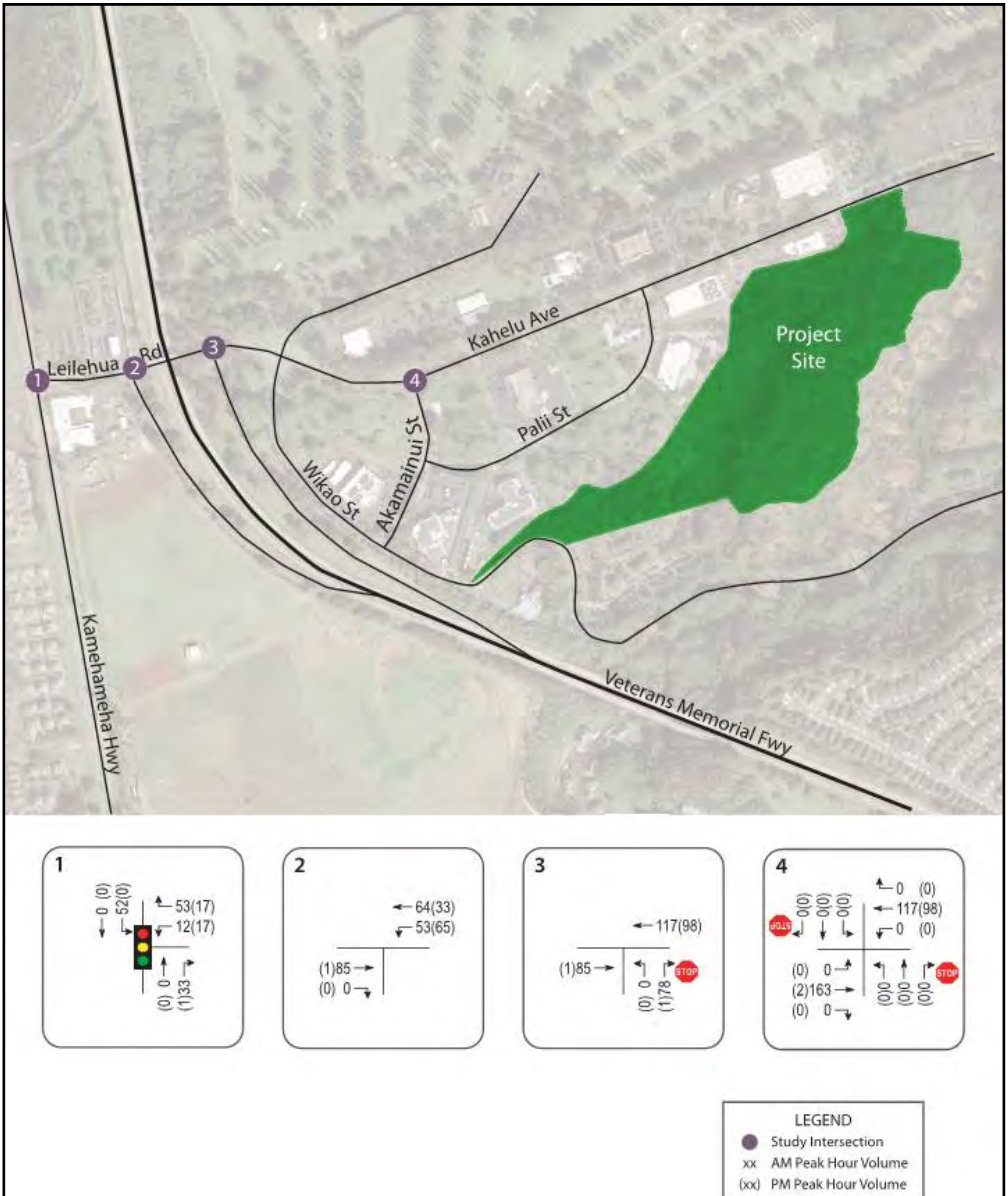
4.3 Alternative 2

4.3.1 Trip Distribution

Figure 22 shows the distribution of site-generated traffic during the AM and PM peak periods under Alternative 2. Primary access to the proposed site in Mililani will be provided via a new driveway off Kahelu Avenue. The directional distribution at the intersections of Leilehua Road and the ramps to/from the Interstate H-2 Freeway were assumed to remain similar to existing conditions. As such, 48% of entering vehicles were assumed to utilize the Interstate H-2 (northbound) off-ramp with 45% of exiting trips assumed to use the Interstate H-2 southbound on-ramp during the AM peak period. Similarly, during the PM peak period, 49% of entering vehicles were assumed to utilize the Interstate H-2 northbound off-ramp with 67% of exiting trips assumed to use the Interstate H-2 southbound on-ramp.

4.3.2 Through Traffic Forecasting Methodology

The travel forecast is based upon historical traffic count data obtained from the State DOT, Highways Division at survey stations located along Kamehameha Highway (Mililani) in the vicinity of the proposed project sites. The historical data indicates relatively stable traffic volumes along the study corridors and, as such, an annual traffic growth rate of approximately 0.5 % was conservatively assumed in the project vicinity. Using 2017 as the Base Year, a growth rate factor of 1.03 was applied to the existing traffic demands in the project vicinity to achieve the projected Year 2023 traffic demands.



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DISTRIBUTION OF SITE-GENERATED VEHICLES WITH ALTERNATIVE 2

FIGURE 22

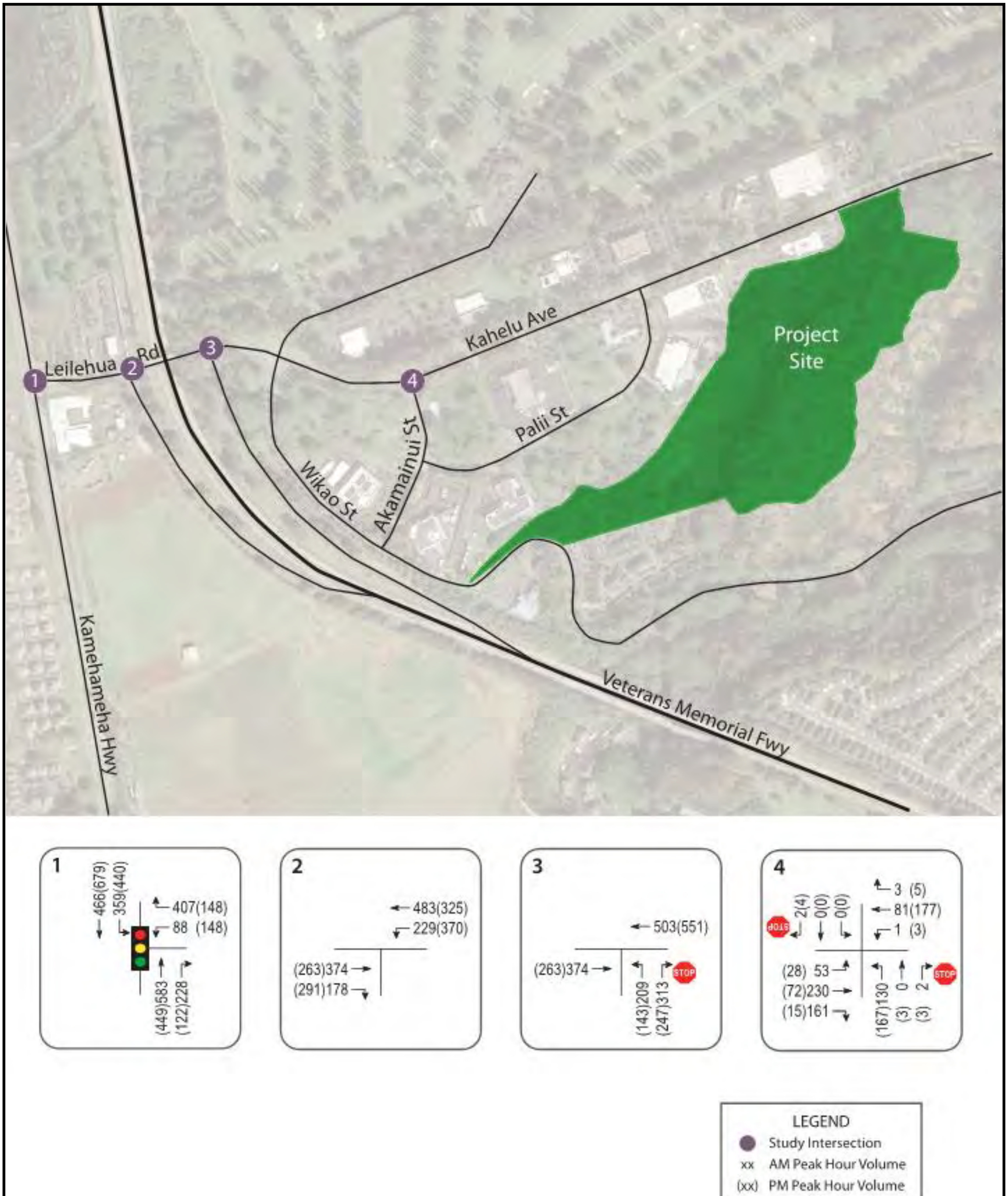
4.3.3 Year 2023 Total Traffic Volumes Without Project

The projected Year 2023 AM and PM peak period traffic volumes and operating conditions without the implementation of Alternative 2 is shown in Figure 23 and summarized in Table 5. The existing levels of service are provided for comparison purposes. LOS calculations are included in Appendix F.

Table 5: Existing and Projected Year 2023 (Without Project) LOS Traffic Operating Conditions

Intersection	Approach	AM		PM	
		Exist	Year 2023 w/o Proj	Exist	Year 2023 w/o Proj
Kamehameha Hwy/ Leilehua Rd.	Westbound	C	C	C	C
	Northbound	B	B	C	C
	Southbound	B	B	B	B
Leilehua Rd./ H-2 SB On-Ramp	Westbound	A	A	B	B
Leilehua Rd/ H-2 NB Off-Ramp	Northbound	C	C	B	B
Kahelu Ave/ Akamainui St	Eastbound	A	A	A	A
	Westbound	A	A	A	A
	Northbound	C	C	B	B
	Southbound	A	A	A	A

Under Year 2023 without project conditions, traffic operations are expected to remain similar to existing conditions. At the intersection of Kamehameha Highway and Leilehua Road near the proposed MTP site, traffic operations are expected to continue operating at LOS “C” or better during both peak periods, while those at the intersection of Kahelu Avenue and Akamainui Street are expected to continue operating at LOS “C” or better during the AM peak period and LOS “B” or better during the PM peak period. At the intersections of Leilehua Road and the ramps to/from the Interstate H-2 Freeway, traffic operations are expected to continue operating at LOS “C” or better during the AM peak period and LOS “B” or better during the PM peak period.



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YEAR 2023 PEAK HOURS OF TRAFFIC WITHOUT ALTERNATIVE 2

FIGURE 23

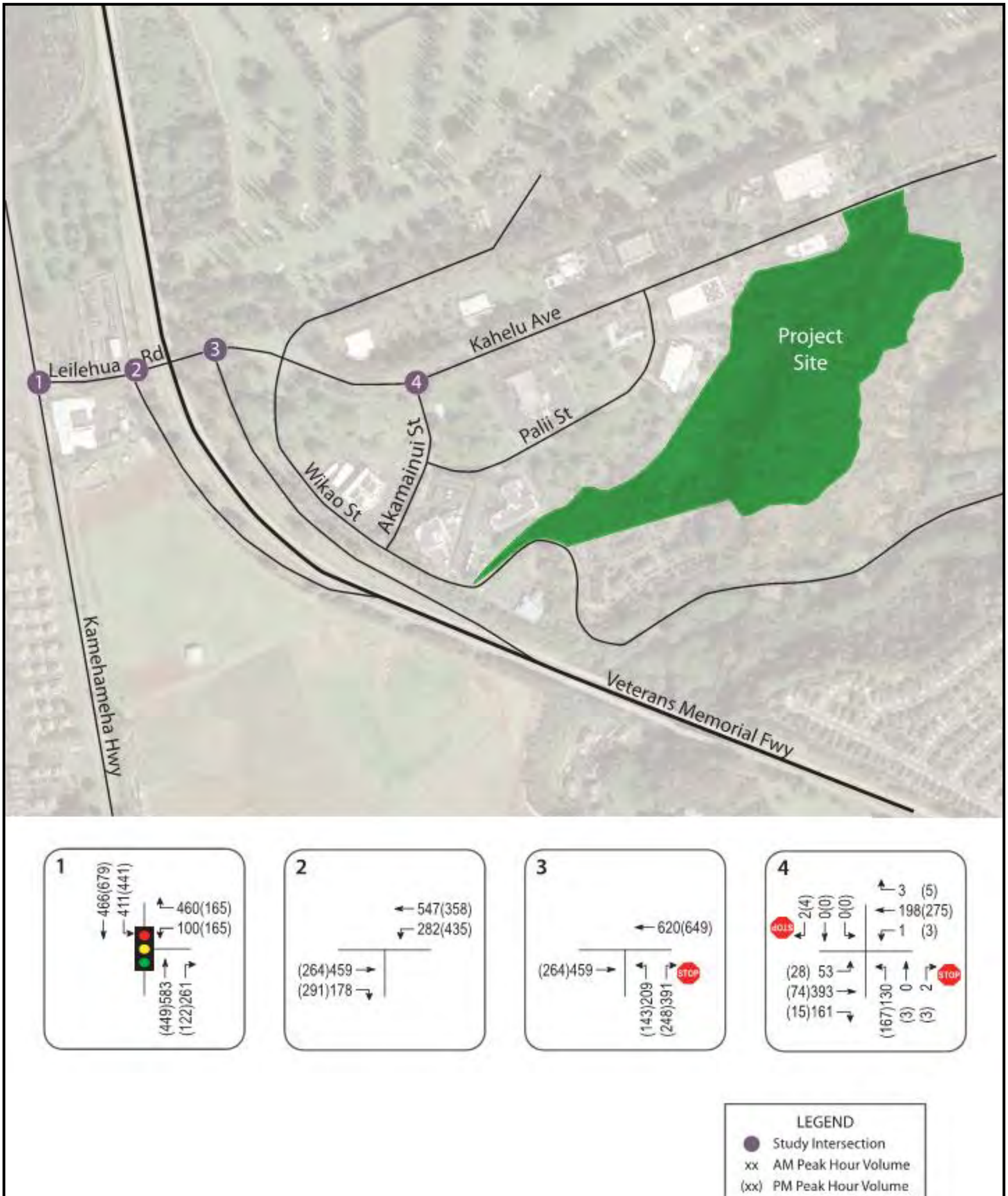
4.3.4 Year 2023 Total Traffic Volumes With Project

The Year 2023 cumulative AM and PM peak hour traffic conditions with the implementation of Alternative 2 is shown on Figure 24 and summarized in Table 6. The cumulative volumes consist of site-generated traffic superimposed over the Year 2023 projected traffic demands. The existing and projected Year 2023 (Without Project) operating conditions are provided for comparison purposes. LOS calculations are included in Appendix G.

Table 6: Existing and Projected Year 2023 (Without and With Alternative 2) LOS Traffic Operating Conditions

Intersection	Approach	AM			PM		
		Exist	Year 2023 w/out Proj	Year 2023 w/ Project	Exist	Year 2023 w/out Proj	Year 2023 w/ Project
Kamehameha Hwy/ Leilehua Rd.	Westbound	C	C	C	C	C	C
	Northbound	B	B	C	C	C	C
	Southbound	B	B	B	B	B	B
Leilehua Rd./ H-2 SB On-Ramp	Westbound	A	A	B	B	B	B
Leilehua Rd/ H-2 NB Off-Ramp	Northbound	C	C	D	B	B	B
Kahelu Ave/ Akamainui St	Eastbound	A	A	A	A	A	A
	Westbound	A	A	A	A	A	A
	Northbound	C	C	D	B	B	B
	Southbound	A	A	A	A	A	A

Traffic operations with the implementation of Alternative 2 are generally expected to remain similar to the without project conditions despite the addition of site-generated trips to the surrounding roadway network. Traffic operations along Leilehua Road at the intersection with Kamehameha Highway near the proposed MTP site are expected to continue operating at LOS "C" or better during both AM and PM peak periods. Along the H-2 On and Off-Ramps, traffic operations are expected to continue operating similar to without project conditions with the exception of the H-2 Northbound Off-Ramp where the northbound approach is expected to change from an LOS "C" to an LOS "D" during the AM peak period. During the PM peak period, all study intersections are anticipated to remain similar to existing and without project conditions.



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YEAR 2023 PEAK HOURS OF TRAFFIC WITH ALTERNATIVE 2

FIGURE 24

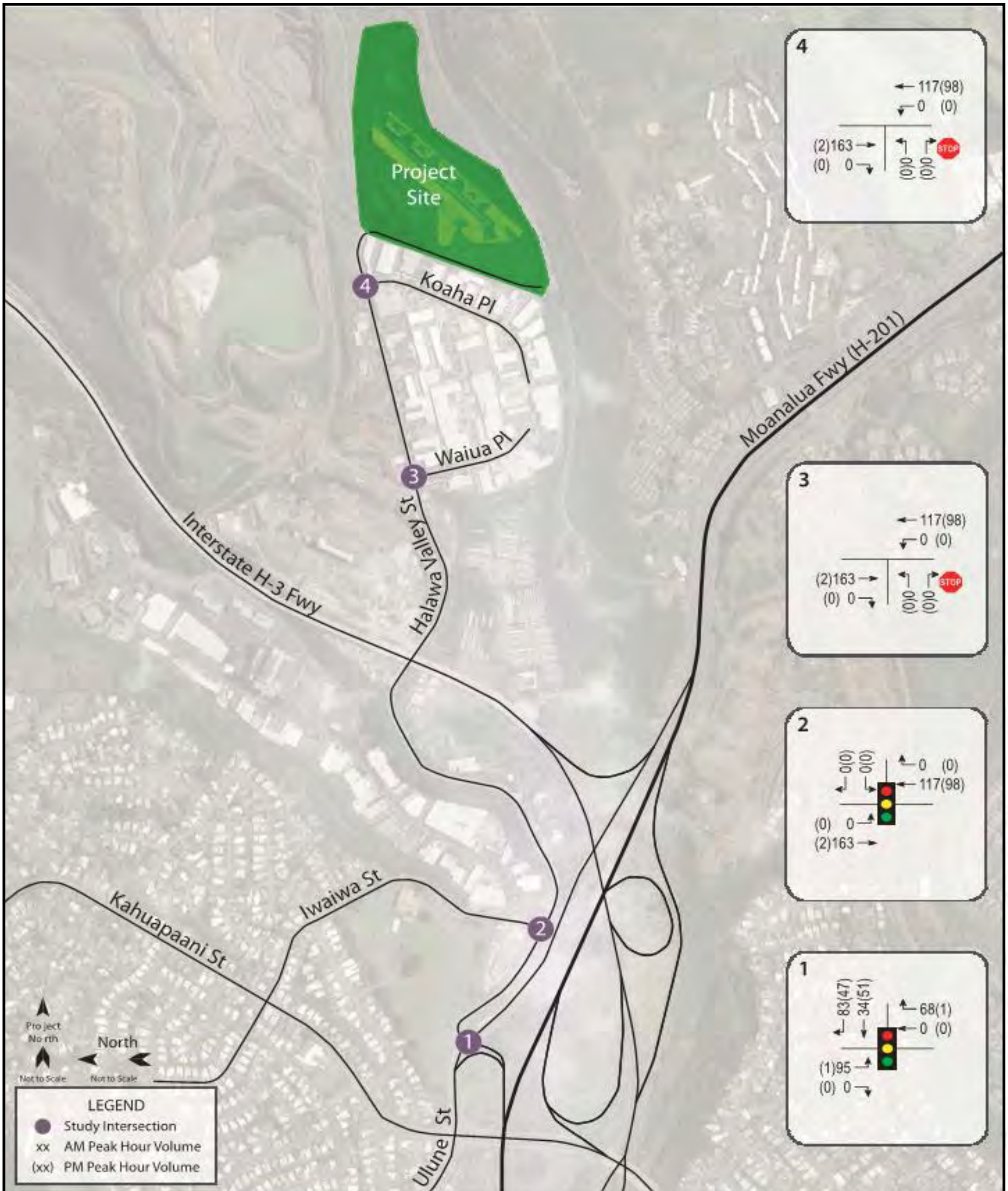
4.4 Alternative 3

4.4.1 Trip Distribution

Figure 25 shows the distribution of site-generated traffic during the AM and PM peak periods under Alternative 3. Primary access to the proposed HCF site will be provided via a new driveway off Halawa Valley Street. The directional distribution at the intersection of Ulune Street and Halawa Valley Street was assumed to remain similar to existing conditions. As such, 58% of entering trips were assumed to be traveling eastbound while 42% of entering trips were assumed to be traveling westbound during the AM peak period. Similarly, during the PM peak period, 43% of entering trips were assumed to be traveling eastbound while 57% were assumed to be traveling westbound. Exiting trips were also based on the existing directional distribution at the intersection of Ulune Street and Halawa Valley Street. As such, 71% of exiting trips were assumed to be traveling westbound at that intersection while 29% of exiting trips were assumed to be traveling southbound during the AM peak period. Similarly, during the PM peak period, 47% of exiting trips were assumed to be traveling westbound that intersection while 53% of exiting trips were assumed to be traveling southbound.

4.4.2 Through Traffic Forecasting Methodology

The travel forecast is based upon historical traffic count data obtained from the State DOT, Highways Division at survey stations located along Halawa Valley Street in the vicinity of the proposed project sites. The historical data indicates relatively stable traffic volumes along the study corridors and, as such, an annual traffic growth rate of approximately 0.5 % was conservatively assumed in the project vicinity. Using 2017 as the Base Year, a growth rate factor of 1.03 was applied to the existing traffic demands in the project vicinity to achieve the projected Year 2023 traffic demands.



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DISTRIBUTION OF SITE-GENERATED VEHICLES WITH ALTERNATIVE 3

FIGURE 25

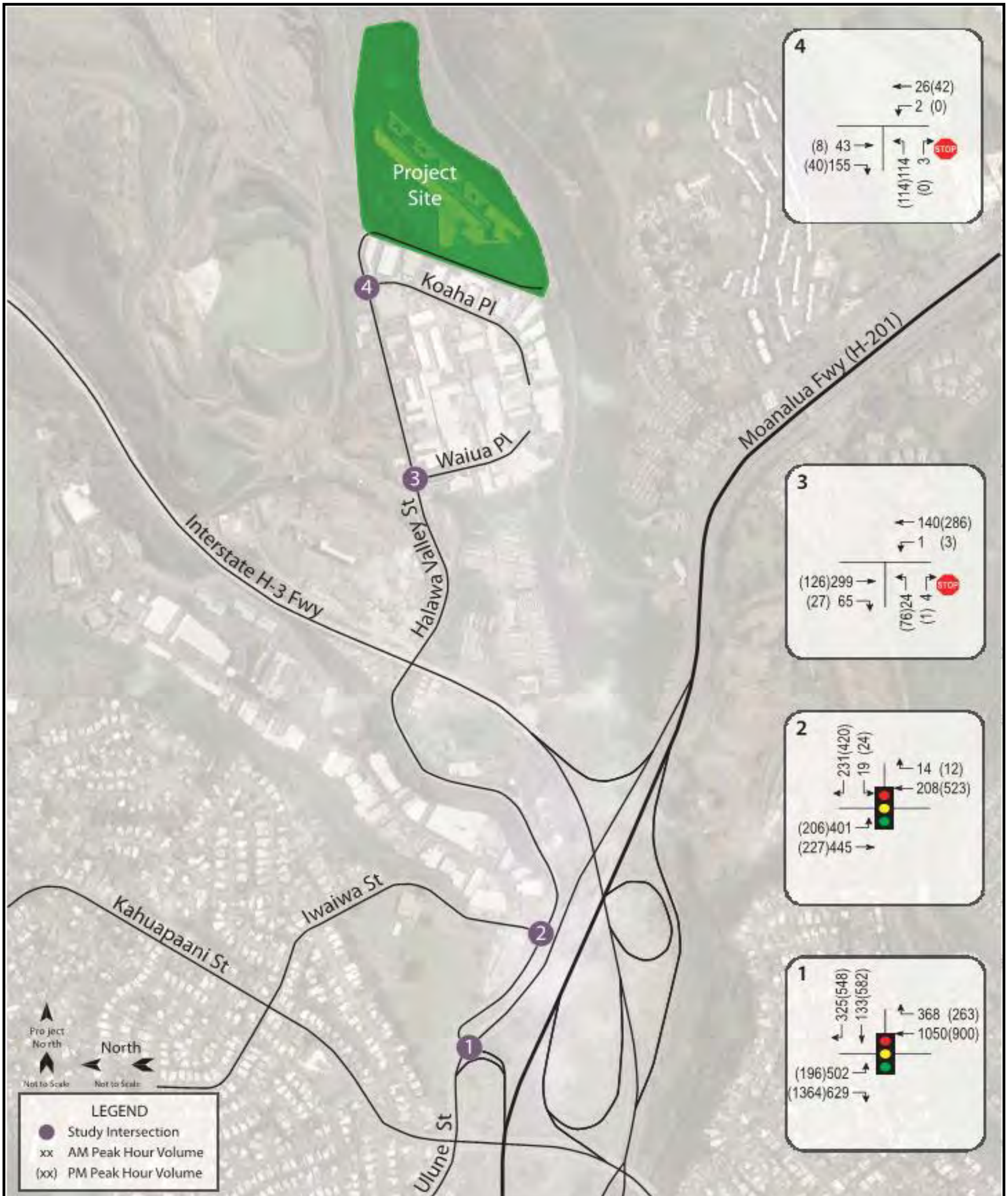
4.4.3 Year 2023 Total Traffic Volumes Without Project

The projected Year 2023 AM and PM peak period traffic volumes and operating conditions without the implementation of Alternative 3 is shown in Figure 26, and summarized in Table 7. The cumulative volumes consist of site-generated traffic previously shown in Tables 1 and 2 superimposed over the Year 2023 projected traffic demands. The existing levels of service are provided for comparison purposes. LOS calculations are included in Appendix H.

Table 7: Existing and Projected Year 2023 (Without Project) LOS Traffic Operating Conditions

Intersection	Approach	AM		PM	
		Exist	Year 2023 w/o Proj	Exist	Year 2023 w/o Proj
Ulune St/ Halawa Valley St	Eastbound	C	C	B	C
	Westbound	D	D	D	D
	Southbound	D	D	D	D
Halawa Valley St/ Iwaiwa St	Eastbound	B	B	B	B
	Westbound	C	C	C	C
	Southbound	C	C	C	C
Halawa Valley St/ Waiua Pl	Westbound	A	A	A	A
	Northbound	B	B	B	B
Halawa Valley St/ Koaha Pl	Westbound	A	A	-	-
	Northbound	B	B	A	A

Under Year 2023 without project conditions, traffic operations are expected to remain generally similar to existing conditions. At the intersection of Ulune Street and Halawa Valley Street near the proposed HCF site, traffic operations are expected to continue operating at LOS “D” or better during both peak periods with the exception of the eastbound approach which is expected to deteriorate from LOS “B” to LOS “C” during the PM peak period. Along Halawa Valley Street, traffic operations at the intersection with Iwaiwa Street are expected to operate at LOS “C” or better during both peak periods, while those at the intersections with Waiua Place and Koaha Place are expected to operate at LOS “B” or better during both peak periods. It should be noted that a level of service was not included in the westbound approach of the intersection of Halawa Valley Street and Koaha Place as no vehicles were counted executing a left-turn movement at this approach



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YEAR 2023 PEAK HOURS OF TRAFFIC WITHOUT ALTERNATIVE 3

FIGURE 26

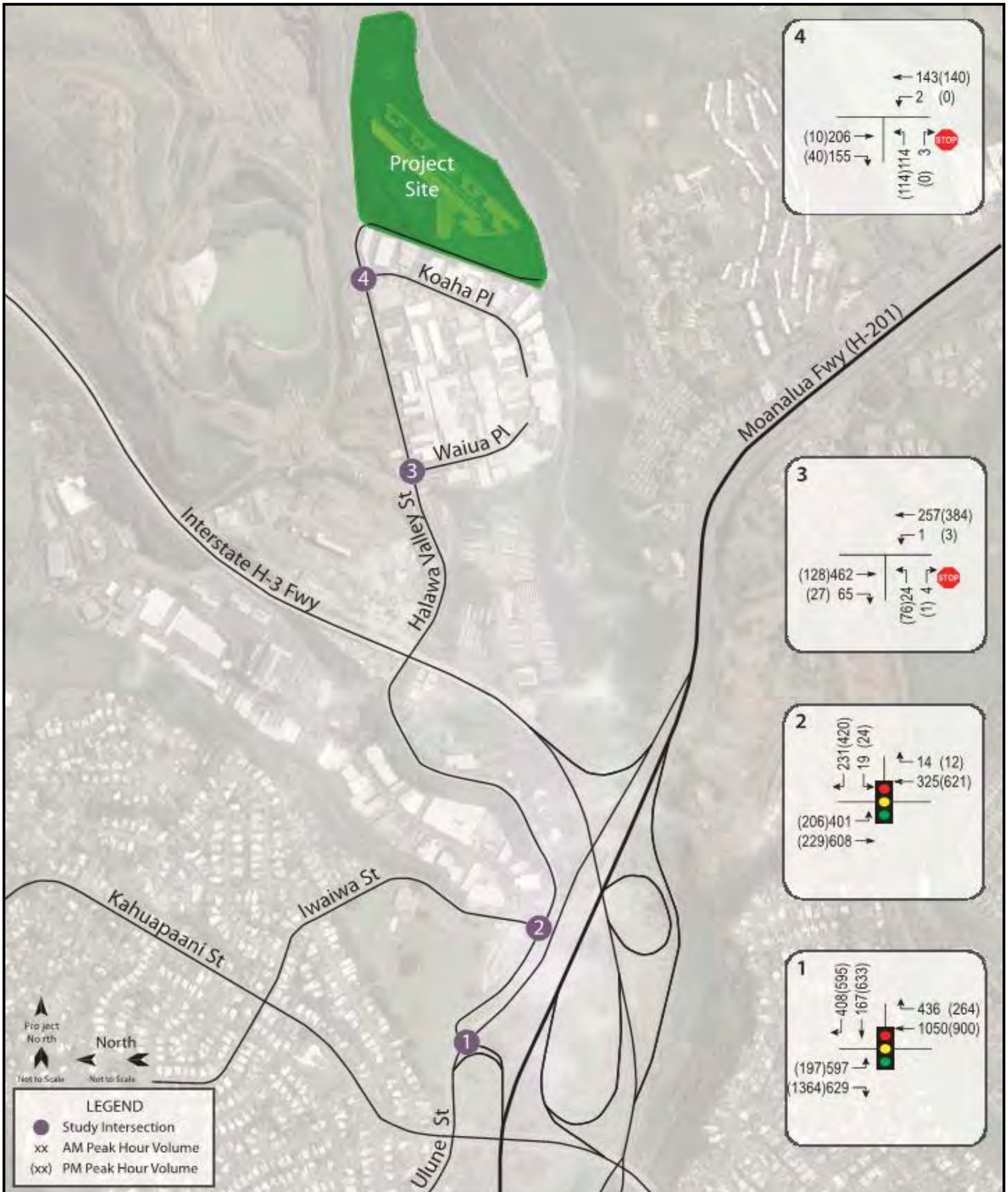
4.4.4 Year 2023 Total Traffic Volumes With Project

The Year 2023 cumulative AM and PM peak hour traffic conditions with the implementation of Alternative 3 are shown on Figure 27 and summarized in Table 8. The existing and projected Year 2023 (Without Project) operating conditions are provided for comparison purposes. LOS calculations are included in Appendix I.

Table 8: Existing and Projected Year 2023 (Without and With Alternative 3) LOS Traffic Operating Conditions

Intersection	Approach	AM			PM		
		Exist	Year 2023		Exist	Year 2023	
			w/out Proj	w/ Project		w/out Proj	w/ Project
Ulune St/ Halawa Valley St	Eastbound	C	C	C	B	C	B
	Westbound	D	D	D	D	D	D
	Southbound	D	D	D	D	D	D
Halawa Valley St/ Iwaiwa St	Eastbound	B	B	B	B	B	B
	Westbound	C	C	C	C	C	C
	Southbound	C	C	C	C	C	C
Halawa Valley St/ Waiua Pl	Westbound	A	A	A	A	A	A
	Northbound	B	B	C	B	B	B
Halawa Valley St/ Koaha Pl	Westbound	A	A	A	-	-	-
	Northbound	B	B	B	A	A	B

Traffic operations with the implementation of Alternative 3 are generally expected to remain similar to without project conditions despite the addition of site-generated trips. At the intersection of Ulune Street and Halawa Valley Street near the proposed HCF site, traffic operations are expected to continue operating at LOS “D” or better during both peak periods, while those at the intersection of Halawa Valley Street and Iwaiwa Street are expected to continue operating at LOS “C” or better during both peak periods. The other study intersections along Halawa Valley are expected to continue operating similar to without project conditions during both peak periods with the exception of Waiua Place where the northbound approach is expected to change from an LOS “B” to a slightly lower, but still acceptable LOS “C” during the AM peak period. It should be noted that a level of service was not included in the westbound approach of the intersection of Halawa Valley Street and Koaha Place as no vehicles were counted executing a left-turn movement at this approach



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YEAR 2023 PEAK HOURS OF TRAFFIC WITH ALTERNATIVE 3

FIGURE 27

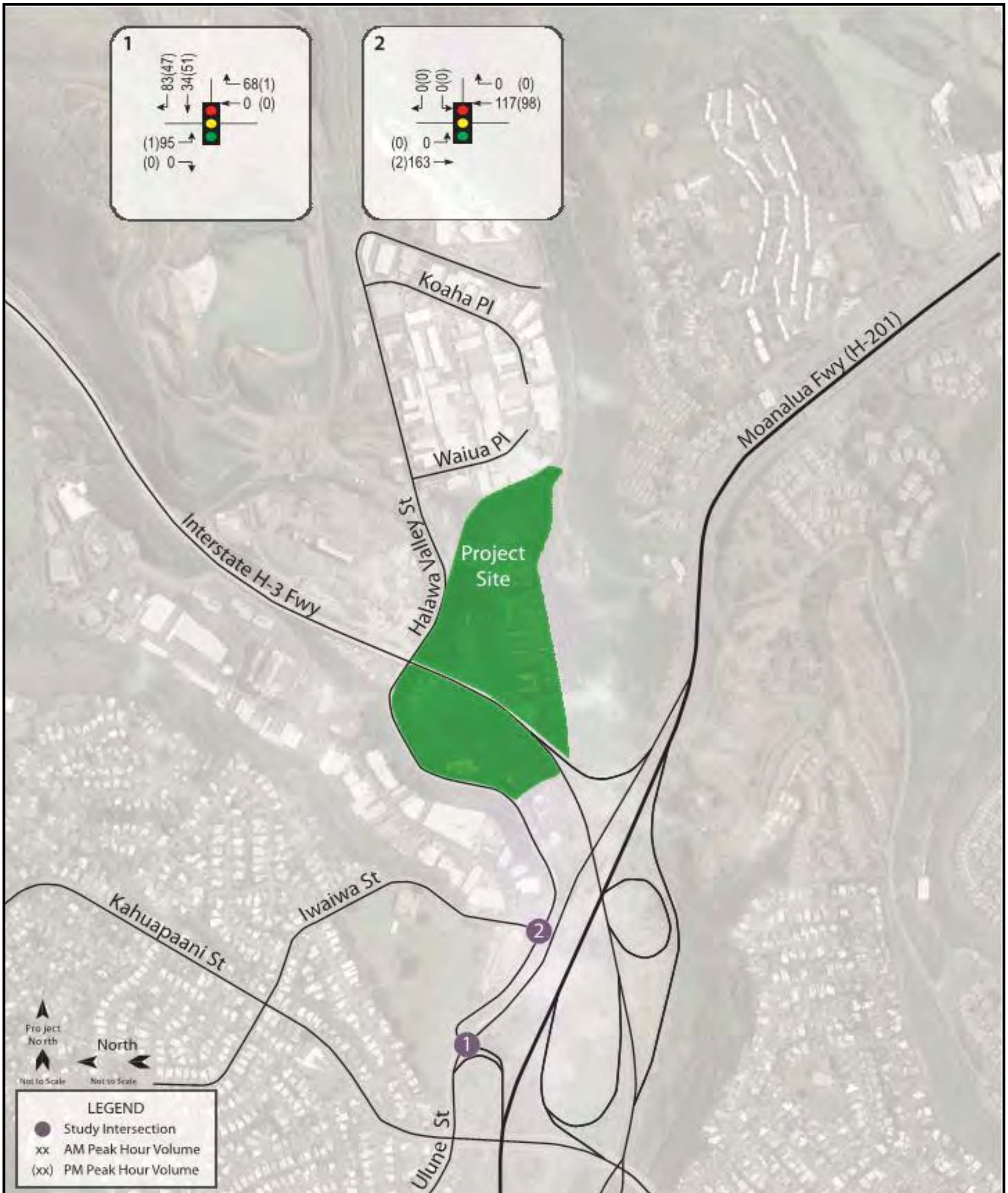
4.5 Alternative 4

4.5.1 Trip Distribution

Figure 28 shows the distribution of site-generated traffic during the AM and PM peak periods under Alternative 4. Primary access to the proposed Animal Quarantine Station site will be provided via a new driveway off Halawa Valley Street. It should be noted that the distribution of site-generated vehicles for Alternative 3 and Alternative 4 are expected to be similar due to the close proximity of the two sites, as well as the limited access points and available routes along Halawa Valley Street. The directional distribution at the intersection of Ulune Street and Halawa Valley Street was assumed to remain similar to existing conditions. As such, 58% of entering trips were assumed to be traveling eastbound while 42% of entering trips were assumed to be traveling westbound during the AM peak period. Similarly, during the PM peak period, 43% of entering trips were assumed to be traveling eastbound while 57% were assumed to be traveling westbound. Exiting trips were also based on the existing directional distribution at the intersection of Ulune Street and Halawa Valley Street. As such, 71% of exiting trips were assumed to be traveling westbound at that intersection while 29% of exiting trips were assumed to be traveling southbound during the AM peak period. Similarly, during the PM peak period, 47% of exiting trips were assumed to be traveling westbound that intersection while 53% of exiting trips were assumed to be traveling southbound

4.5.2 Through Traffic Forecasting Methodology

The travel forecast is based upon historical traffic count data obtained from the State DOT, Highways Division at survey stations located along Halawa Valley Street in the vicinity of the proposed project sites. The historical data indicates relatively stable traffic volumes along the study corridors and, as such, an annual traffic growth rate of approximately 0.5 % was conservatively assumed in the project vicinity. Using 2017 as the Base Year, a growth rate factor of 1.03 was applied to the existing traffic demands in the project vicinity to achieve the projected Year 2023 traffic demands.



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DISTRIBUTION OF SITE-GENERATED VEHICLES WITH ALTERNATIVE 4

FIGURE 28

4.5.3 Year 2023 Total Traffic Volumes Without Project

The projected Year 2023 AM and PM peak period traffic volumes and operating conditions without the implementation of Alternative 4 is shown in Figure 29, and summarized in Table 9. The existing levels of service are provided for comparison purposes. LOS calculations are included in Appendix J.

Table 9: Existing and Projected Year 2023 (Without Project) LOS Traffic Operating Conditions

Intersection	Approach	AM		PM	
		Exist	Year 2023 w/o Proj	Exist	Year 2023 w/o Proj
Ulune St/ Halawa Valley St	Eastbound	C	C	C	B
	Westbound	D	D	D	D
	Southbound	D	D	D	D
Halawa Valley St/ Iwaiwa St	Eastbound	B	B	B	B
	Westbound	C	C	C	C
	Southbound	C	C	C	C

Under Year 2023 without project conditions, traffic operations are expected to remain generally similar to existing conditions. At the intersection of Ulune Street and Halawa Valley Street near the proposed Animal Quarantine Station site, traffic operations are expected to continue operating at LOS “D” or better during both peak periods with the exception of the eastbound approach which is expected to change from LOS “B” to LOS “C” during the PM peak period. Along Halawa Valley Street, traffic operations at the intersection with Iwaiwa Street are expected to continue operating at LOS “C” or better during both peak periods.

4.5.4 Year 2023 Total Traffic Volumes With Project

The Year 2023 cumulative AM and PM peak hour traffic conditions with the implementation of Alternative 4 are shown in Figure 30 and summarized in Table 10. The cumulative volumes consist of site-generated traffic superimposed over the Year 2023 projected traffic demands. The existing and projected Year 2023 (Without Project) operating conditions are provided for comparison purposes. LOS calculations are included in Appendix K.

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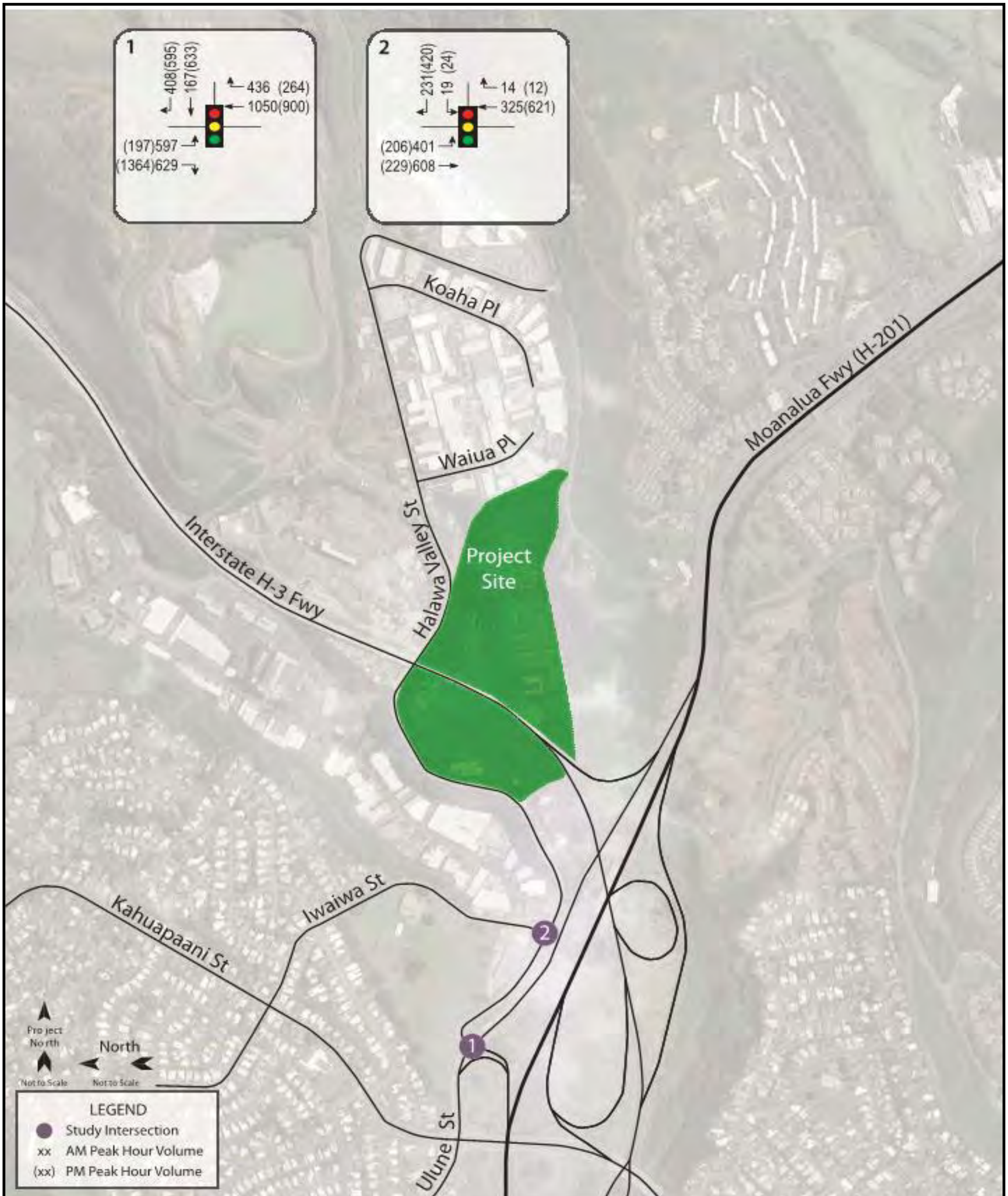
YEAR 2023 PEAK HOURS OF TRAFFIC WITHOUT ALTERNATIVE 4

FIGURE 29



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YEAR 2023 PEAK HOURS OF TRAFFIC WITH ALTERNATIVE 4

FIGURE 30

Table 10: Existing and Projected Year 2023 (Without and With Alternative 4) LOS Traffic Operating Conditions

Intersection	Approach	AM			PM		
		Exist	Year 2023		Exist	Year 2023	
			w/out Proj	w/ Project		w/out Proj	w/ Project
Ulune St/ Halawa Valley St	Eastbound	C	C	C	B	C	B
	Westbound	D	D	D	D	D	D
	Southbound	D	D	D	D	D	D
Halawa Valley St/ Iwaiwa St	Eastbound	B	B	B	B	B	B
	Westbound	C	C	C	C	C	C
	Southbound	C	C	C	C	C	C

Traffic operations with the implementation of Alternative 4 are generally expected to remain similar to without project conditions despite the addition of site-generated trips determined from Methods 1 and 2. At the intersection of Ulune Street and Halawa Valley Street near the proposed Animal Quarantine Station site, traffic operations are expected to continue operating at LOS "D" or better during both peak periods, while those at the intersection of Halawa Valley Street and Iwaiwa Street are expected to continue operating at LOS "C" during both peak periods.

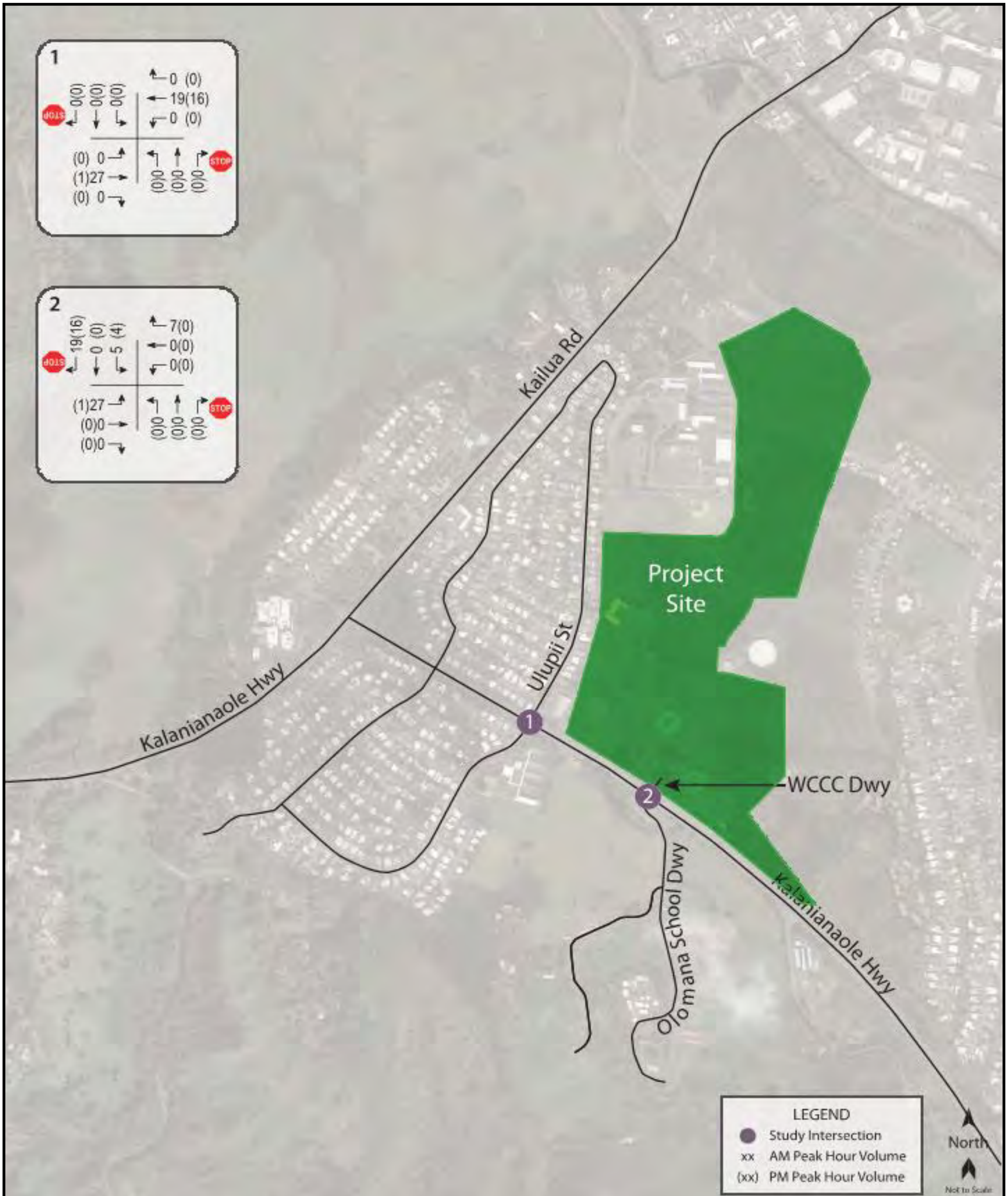
4.6 WCCC Facility

4.6.1 Trip Distribution

Figure 31 shows the distribution of site-generated traffic during the AM and PM peak periods with the proposed expansion of the WCCC facility. Primary access to the WCCC facility in Kailua will continue to be provided via the existing driveway off Kalanianaole Highway. The directional distribution at the intersection of Kalanianaole Highway and the WCCC driveway was assumed to remain similar to existing conditions. As such, 80% were assumed to be traveling to/from the west via Kalanianaole Highway while 20% were assumed to be traveling to/from the east during the AM peak period. Similarly, during the PM peak period, 86% were assumed to be traveling to/from the west via Kalanianaole Highway while 14% were assumed to be traveling to/from the east.

4.6.2 Through Traffic Forecasting Methodology

The travel forecast is based upon historical traffic count data obtained from the State DOT, Highways Division at survey stations located along Kalanianaole Highway (Kailua) in the vicinity of the proposed project site. The historical data indicates relatively stable traffic volumes along the study



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DISTRIBUTION OF SITE-GENERATED VEHICLES WITH PROJECT

FIGURE 31

corridors and, as such, an annual traffic growth rate of approximately 0.5 % was conservatively assumed in the project vicinity. Using 2017 as the Base Year, a growth rate factor of 1.03 was applied to the existing traffic demands in the project vicinity to achieve the projected Year 2023 traffic demands.

4.6.3 Year 2023 Total Traffic Volumes Without Project

The projected Year 2023 AM and PM peak period traffic volumes and operating conditions without the expansion of WCCC is shown in Figure 32, and summarized in Table 11. The existing levels of service are provided for comparison purposes. LOS calculations are included in Appendix L.

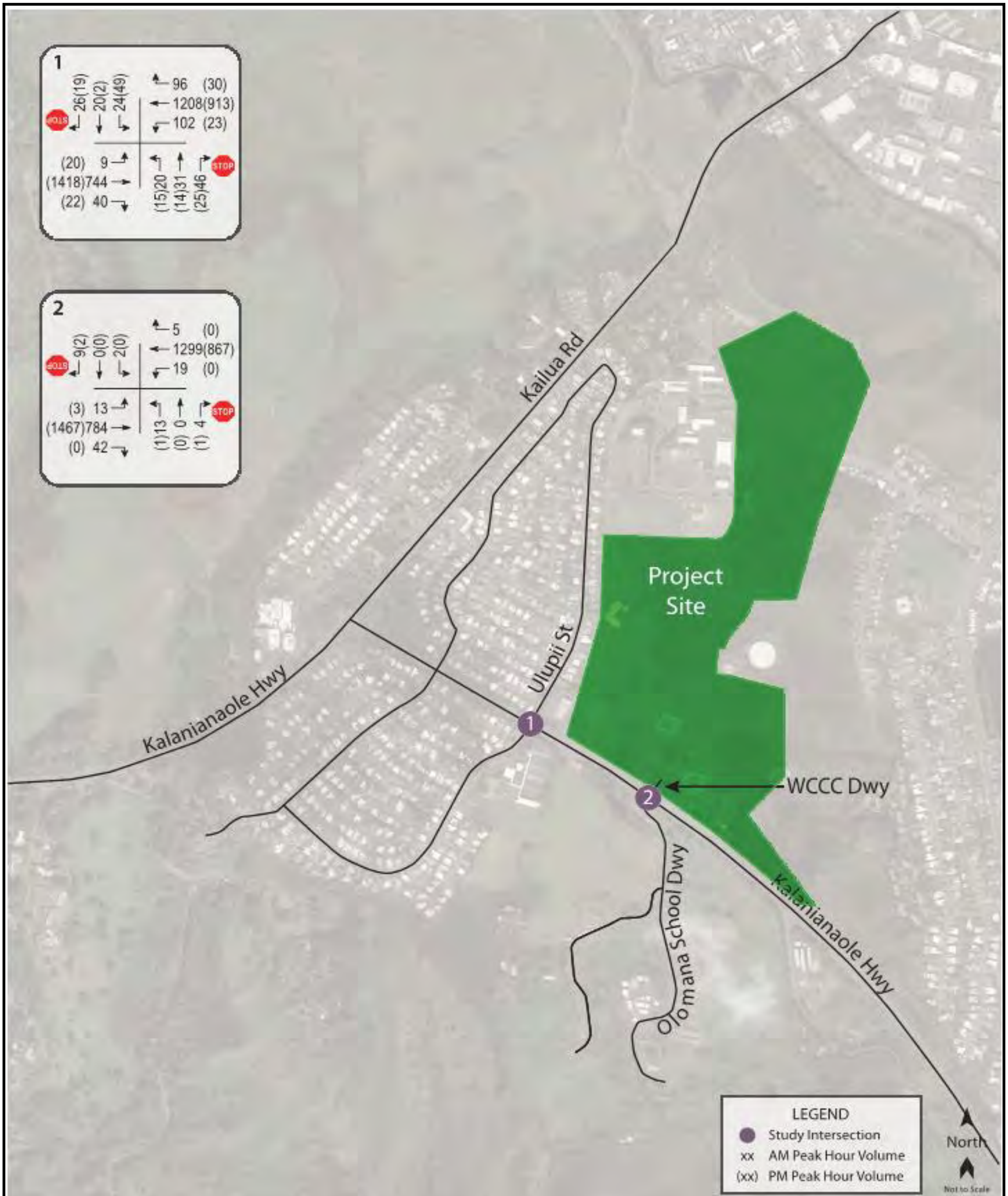
Table 11: Existing and Projected Year 2023 (Without Project) LOS Traffic Operating Conditions

Intersection	Approach	AM		PM	
		Exist	Year 2023 w/o Proj	Exist	Year 2023 w/o Proj
	Southbound	D	D	D	D
Kalanianaole Hwy/ Ulupii St	Eastbound	B	B	B	B
	Westbound	B	B	B	B
	Northbound	C	C	C	C
	Southbound	D	D	C	C
Kalanianaole Hwy/WCCC Dwy	Eastbound	B	B	A	A
	Westbound	A	A	-	-
	Northbound	C	C	C	C
	Southbound	B	B	B	B

In the vicinity of the existing WCCC facility, traffic operations at the intersections along Kalanianaole Highway are expected to continue operating at LOS “D” or better during the AM peak period and LOS “C” or better during the PM peak period. It should be noted that a level of service has not been included for the westbound approach of the intersection of Kalanianaole Highway and the WCCC Driveway during the PM peak period because no vehicles were observed executing a left-turn maneuver from this approach during the PM peak period.

4.6.4 Year 2023 Total Traffic Volumes With Project

The Year 2023 cumulative AM and PM peak hour traffic conditions with the expansion of the WCCC facility is shown in Figure 33 and summarized in Table 12. The cumulative volumes consist of site-generated traffic superimposed over the Year 2023 projected traffic demands. The existing and projected Year 2023 (Without Project) operating conditions are provided for comparison purposes. LOS calculations are included in Appendix M.



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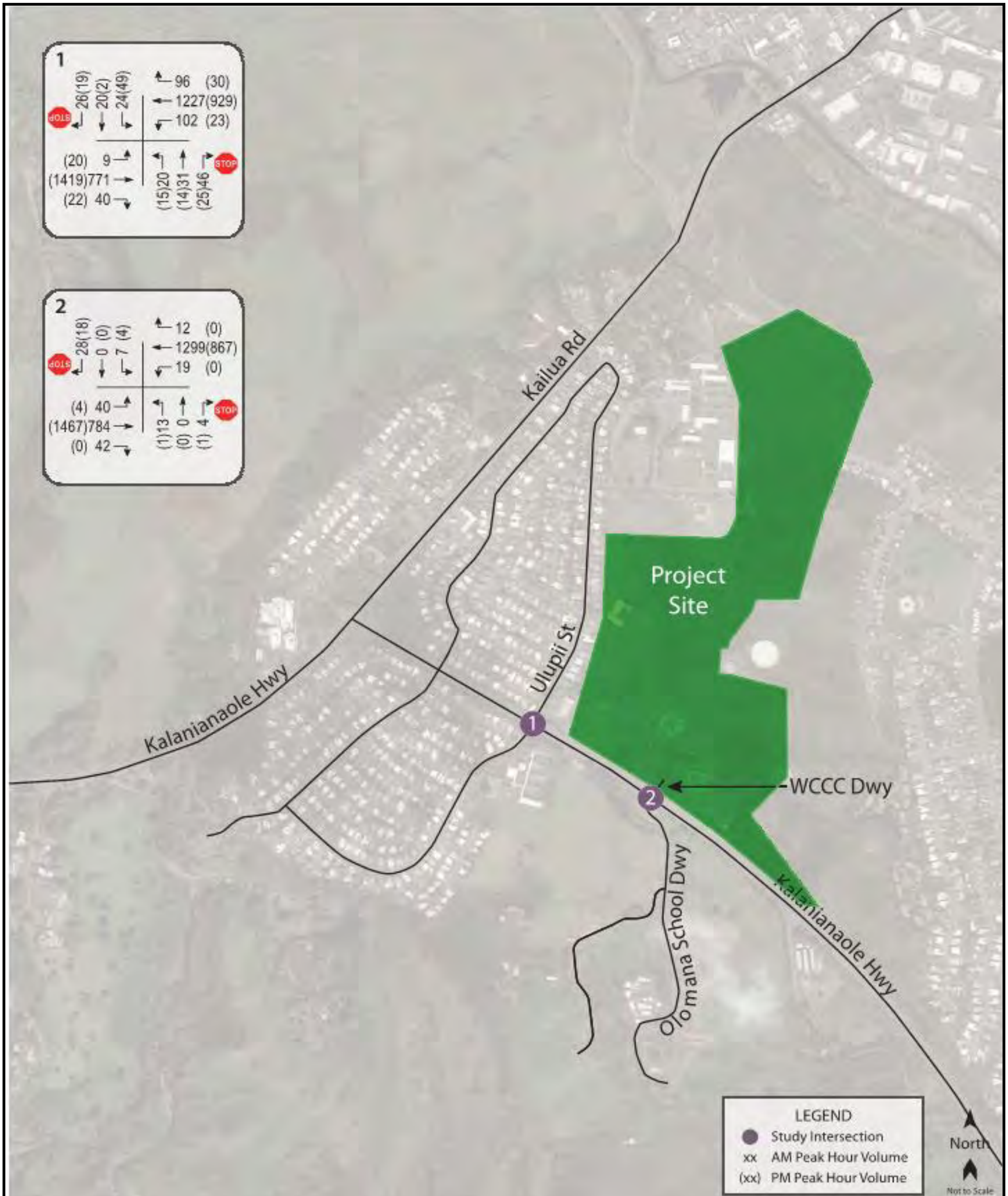
YEAR 2023 PEAK HOURS OF TRAFFIC WITHOUT PROJECT

FIGURE 32



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YEAR 2023 PEAK HOURS OF TRAFFIC WITH PROJECT

FIGURE 33

Table 12: Existing and Projected Year 2023 (Without and With Alternative 4) LOS Traffic Operating Conditions

Intersection	Approach	AM			PM		
		Exist	Year 2023		Exist	Year 2023	
			w/out Proj	w/ Project		w/out Proj	w/ Project
Kalanianaole Hwy/ Ulupii St	Eastbound	B	B	B	B	B	B
	Westbound	B	B	B	B	B	B
	Northbound	C	C	C	C	C	C
	Southbound	D	D	D	C	C	C
Kalanianaole Hwy/ WCCC Dwy	Eastbound	B	B	B	A	A	B
	Westbound	A	A	B	-	-	-
	Northbound	C	C	C	C	C	C
	Southbound	B	B	C	B	B	C

With the implementation of the proposed project at the WCCC facility traffic operations are generally expected to remain similar to without project conditions despite the addition of site-generated trips. In the vicinity of the existing WCCC facility, traffic operations at the intersections along Kalanianaole Highway are expected to continue operating at LOS "D" or better during the AM peak period and LOS "C" or better during the PM peak period. It should be noted that a level of service has not been included for the westbound approach of the intersection of Kalanianaole Highway and the WCCC Driveway during the PM peak period because no vehicles were observed executing a left-turn maneuver from this approach during the PM peak period.

5.0 RECOMMENDATIONS

Based on the analysis of the traffic data, the following are the recommendations of this study to be incorporated in the project design under each alternative.

1. Maintain sufficient sight distance for motorists to safely enter and exit all project driveways.

2. Provide adequate on-site loading and off-loading service areas and prohibit off-site loading operations.

3. Provide adequate turn-around area for service, delivery, and refuse collection vehicles to maneuver on the project site to avoid vehicle-reversing maneuvers onto public roadways.

4. Provide sufficient turning radii at all project driveways to avoid vehicle encroachments to oncoming traffic lanes.

5. Provide adequate on-site parking with clear way-finding instructions to properly direct employees, visitors, delivery trucks, etc.

6. If access at the entrance to the selected site is controlled, provide sufficient storage for entering vehicles at the parking area access controls (i.e., automatic gate, etc.) to ensure that queues do not extend onto the adjacent public roadways.

7. Update the Traffic Impact Report for the Oahu Community Correctional Center 6-9 months after the project is completed and occupied to verify trip generation, trip distribution, and projected operating conditions.

Based on the analysis of the traffic data and field operations, the following recommendation should be considered during the design phase for the expansion of the WCCC facility.

1. Consider providing acceleration and deceleration lanes on Kalanianole Highway at the project access driveway to maintain through traffic movements on the highway as well as to facilitate turning maneuvers entering and exiting the project site. The specific dimensions and configuration of such shall be coordinated with the State Department of Transportation during the design phase of the project.

6.0 CONCLUSION

The Department of Public Safety is currently considering several alternatives for the Oahu Community Correctional Center to alleviate the facility's overcapacity and anticipate future needs. The alternatives under consideration include either replacing the existing OCCC facility in Kalihi, or constructing a new facility either in the Mililani Technology Park, next to the existing Halawa Correctional Facility, or at the existing Animal Quarantine Station. In addition, each alternative is also expected to transfer a portion of inmates to the existing Women's Community Correctional Center in Kailua. With the implementation of the aforementioned recommendations, each of the four alternatives for the proposed Oahu Community Correctional Center are not expected to have a significant impact on traffic operations in the project vicinity. However, although traffic operations are expected to be similar to without project conditions, an update to the traffic study is recommended to be prepared 6-9 months after the completion of the proposed project to verify projected conditions.

APPENDIX A

EXISTING TRAFFIC COUNT DATA

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: AH, YS
Counter: TU-1958, TU-0652
Weather: Clear

File Name : DillPuu AM
Site Code : 00000000
Start Date : 4/11/2017
Page No : 1

Groups Printed- Unshifted

	Puuhale Road Southbound					Dillingham Boulevard Westbound					Puuhale Road Northbound					Kamehameha Highway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	5	14	10	0	29	12	72	0	2	86	14	0	13	17	44	0	214	58	0	272	431
06:15 AM	2	17	20	0	39	5	79	0	2	86	17	0	9	13	39	0	219	68	0	287	451
06:30 AM	7	8	12	0	27	7	113	0	2	122	30	0	13	6	49	0	269	76	0	345	543
06:45 AM	4	15	12	0	31	7	95	0	1	103	29	0	14	14	57	0	340	71	0	411	602
Total	18	54	54	0	126	31	359	0	7	397	90	0	49	50	189	0	1042	273	0	1315	2027
07:00 AM	3	14	10	0	27	6	85	0	3	94	24	0	15	4	43	0	374	99	0	473	637
07:15 AM	6	24	16	0	46	7	92	0	6	105	45	0	19	13	77	0	362	84	0	446	674
07:30 AM	10	19	20	0	49	12	87	0	5	104	31	0	18	20	69	0	382	160	0	542	764
07:45 AM	13	17	14	0	44	10	107	0	2	119	27	0	17	11	55	0	387	112	0	499	717
Total	32	74	60	0	166	35	371	0	16	422	127	0	69	48	244	0	1505	455	0	1960	2792
08:00 AM	3	11	10	0	24	6	94	0	2	102	38	0	19	6	63	0	396	104	0	500	689
08:15 AM	9	13	10	0	32	12	102	0	2	116	52	0	21	5	78	0	289	72	0	361	587
08:30 AM	2	8	11	0	21	12	122	0	2	136	32	0	18	14	64	0	255	49	0	304	525
08:45 AM	3	8	11	0	22	7	120	0	0	127	29	0	21	5	55	0	240	74	0	314	518
Total	17	40	42	0	99	37	438	0	6	481	151	0	79	30	260	0	1180	299	0	1479	2319
Grand Total	67	168	156	0	391	103	1168	0	29	1300	368	0	197	128	693	0	3727	1027	0	4754	7138
Apprch %	17.1	43	39.9	0		7.9	89.8	0	2.2		53.1	0	28.4	18.5		0	78.4	21.6	0		
Total %	0.9	2.4	2.2	0	5.5	1.4	16.4	0	0.4	18.2	5.2	0	2.8	1.8	9.7	0	52.2	14.4	0	66.6	

	Puuhale Road Southbound				Dillingham Boulevard Westbound				Puuhale Road Northbound				Kamehameha Highway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	6	**24**	16	46	7	92	0	99	**45**	0	**19**	**64**	0	362	84	446	655
07:30 AM	10	19	**20**	**49**	**12**	87	0	99	31	0	18	49	0	382	**160**	**542**	**739**
07:45 AM	**13**	17	14	44	10	**107**	0	**117**	27	0	17	44	0	387	112	499	704
08:00 AM	3	11	10	24	6	94	0	100	38	0	19	57	0	**396**	104	500	681
Total Volume	32	71	60	163	35	380	0	415	141	0	73	214	0	1527	460	1987	2779
% App. Total	19.6	43.6	36.8		8.4	91.6	0		65.9	0	34.1		0	76.8	23.2		
PHF	.615	.740	.750	.832	.729	.888	.000	.887	.783	.000	.961	.836	.000	.964	.719	.917	.940

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: AH, YS
Counter: TU-1958, TU-0652
Weather: Clear

File Name : DillPuu PM
Site Code : 00000000
Start Date : 4/11/2017
Page No : 1

Groups Printed- Unshifted

	Puuhale Road Southbound					Dillingham Boulevard Westbound					Puuhale Road Northbound					Kamehameha Highway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	6	5	20	0	31	4	218	0	1	223	45	0	30	7	82	0	249	34	0	283	619
03:15 PM	4	4	10	0	18	5	181	0	10	196	31	0	21	9	61	0	277	57	0	334	609
03:30 PM	9	5	28	0	42	11	207	0	1	219	53	0	37	18	108	0	395	99	0	494	863
03:45 PM	5	6	23	0	34	9	233	0	2	244	58	0	37	10	105	0	479	87	0	566	949
Total	24	20	81	0	125	29	839	0	14	882	187	0	125	44	356	0	1400	277	0	1677	3040
04:00 PM	7	6	19	0	32	2	192	0	2	196	51	0	42	15	108	0	405	110	0	515	851
04:15 PM	10	2	22	0	34	7	238	0	4	249	75	0	41	7	123	0	480	118	0	598	1004
04:30 PM	16	13	22	0	51	7	240	0	5	252	70	0	79	14	163	0	459	105	0	564	1030
04:45 PM	8	6	24	0	38	6	303	0	2	311	115	0	37	4	156	0	430	28	0	458	963
Total	41	27	87	0	155	22	973	0	13	1008	311	0	199	40	550	0	1774	361	0	2135	3848
05:00 PM	11	11	28	0	50	0	201	30	3	234	64	0	34	11	109	0	394	45	0	439	832
05:15 PM	4	6	13	0	23	3	262	0	0	265	49	0	16	8	73	0	321	42	0	363	724
05:30 PM	8	6	12	0	26	3	208	0	3	214	46	0	20	7	73	0	203	18	0	221	534
Grand Total	88	70	221	0	379	57	2483	30	33	2603	657	0	394	110	1161	0	4092	743	0	4835	8978
Apprch %	23.2	18.5	58.3	0		2.2	95.4	1.2	1.3		56.6	0	33.9	9.5		0	84.6	15.4	0		
Total %	1	0.8	2.5	0	4.2	0.6	27.7	0.3	0.4	29	7.3	0	4.4	1.2	12.9	0	45.6	8.3	0	53.9	

	Puuhale Road Southbound				Dillingham Boulevard Westbound				Puuhale Road Northbound				Kamehameha Highway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:30 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	7	6	19	32	2	192	0	194	51	0	42	93	0	405	110	515	834
04:15 PM	10	2	22	34	**7**	238	0	245	75	0	41	116	0	**480**	**118**	**598**	993
04:30 PM	**16**	**13**	22	**51**	7	240	0	247	70	0	**79**	149	0	459	105	564	**1011**
04:45 PM	8	6	**24**	38	6	**303**	0	**309**	**115**	0	37	**152**	0	430	28	458	957
Total Volume	41	27	87	155	22	973	0	995	311	0	199	510	0	1774	361	2135	3795
% App. Total	26.5	17.4	56.1		2.2	97.8	0		61	0	39		0	83.1	16.9		
PHF	.641	.519	.906	.760	.786	.803	.000	.805	.676	.000	.630	.839	.000	.924	.765	.893	.938

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: DY, EV
Counter: TU-0654, D4-3888
Weather: Clear

File Name : KamLau AM
Site Code : 00000001
Start Date : 4/11/2017
Page No : 1

Groups Printed- Unshifted

	Laumaka Street Southbound					Kamehameha Highway Westbound					OCCC Driveway Northbound					Kamehameha Highway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	1	0	1	0	2	5	94	6	1	106	13	1	10	0	24	12	254	3	1	270	402
06:15 AM	9	2	1	6	18	3	97	17	5	122	7	1	7	0	15	16	283	8	0	307	462
06:30 AM	4	1	1	0	6	0	141	13	2	156	2	2	4	1	9	14	337	7	0	358	529
06:45 AM	8	2	2	1	13	1	124	19	1	145	6	0	0	1	7	26	394	5	0	425	590
Total	22	5	5	7	39	9	456	55	9	529	28	4	21	2	55	68	1268	23	1	1360	1983
07:00 AM	8	0	2	4	14	3	110	13	9	135	1	0	2	0	3	19	476	3	0	498	650
07:15 AM	9	1	3	6	19	3	162	12	5	182	0	0	2	0	2	13	517	4	0	534	737
07:30 AM	15	1	3	5	24	2	150	16	3	171	0	0	0	0	0	16	511	6	0	533	728
07:45 AM	9	1	2	0	12	2	160	21	7	190	0	0	1	0	1	18	494	6	0	518	721
Total	41	3	10	15	69	10	582	62	24	678	1	0	5	0	6	66	1998	19	0	2083	2836
08:00 AM	5	1	3	2	11	3	138	16	10	167	0	1	1	0	2	18	489	4	0	511	691
08:15 AM	14	0	3	3	20	4	147	15	5	171	1	1	1	0	3	12	359	4	0	375	569
08:30 AM	12	1	4	7	24	4	146	16	8	174	1	1	3	0	5	10	318	2	0	330	533
08:45 AM	10	0	4	1	15	6	127	20	3	156	1	0	3	0	4	15	296	2	0	313	488
Total	41	2	14	13	70	17	558	67	26	668	3	3	8	0	14	55	1462	12	0	1529	2281
Grand Total	104	10	29	35	178	36	1596	184	59	1875	32	7	34	2	75	189	4728	54	1	4972	7100
Apprch %	58.4	5.6	16.3	19.7		1.9	85.1	9.8	3.1		42.7	9.3	45.3	2.7		3.8	95.1	1.1	0		
Total %	1.5	0.1	0.4	0.5	2.5	0.5	22.5	2.6	0.8	26.4	0.5	0.1	0.5	0	1.1	2.7	66.6	0.8	0	70	

	Laumaka Street Southbound				Kamehameha Highway Westbound				OCCC Driveway Northbound				Kamehameha Highway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	9	**1**	**3**	13	**3**	**162**	12	177	0	0	**2**	**2**	13	**517**	4	**534**	**726**
07:30 AM	**15**	1	3	**19**	2	150	16	168	0	0	0	0	16	511	**6**	533	720
07:45 AM	9	1	2	12	2	160	**21**	**183**	0	0	1	1	**18**	494	6	518	714
08:00 AM	5	1	3	9	3	138	16	157	0	**1**	1	2	18	489	4	511	679
Total Volume	38	4	11	53	10	610	65	685	0	1	4	5	65	2011	20	2096	2839
% App. Total	71.7	7.5	20.8		1.5	89.1	9.5		0	20	80		3.1	95.9	1		
PHF	.633	1.00	.917	.697	.833	.941	.774	.936	.000	.250	.500	.625	.903	.972	.833	.981	.978

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: DY, FS
Counter: TU-0654, D4-3888
Weather: Clear

File Name : KamLau PM
Site Code : 00000002
Start Date : 4/11/2017
Page No : 1

Groups Printed- Unshifted

	Laumaka Street Southbound					Kamehameha Highway Westbound					OCCC Driveway Northbound					Kamehameha Highway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	10	0	8	4	22	3	249	22	5	279	6	0	3	0	9	11	277	0	0	288	598
03:15 PM	13	0	12	2	27	1	215	16	1	233	3	2	2	0	7	13	385	0	0	398	665
03:30 PM	9	0	5	8	22	1	272	28	1	302	1	2	0	0	3	22	487	1	0	510	837
03:45 PM	15	1	8	0	24	0	255	12	4	271	6	2	2	1	11	20	496	0	0	516	822
Total	47	1	33	14	95	5	991	78	11	1085	16	6	7	1	30	66	1645	1	0	1712	2922
04:00 PM	14	1	11	4	30	0	274	11	3	288	1	1	0	0	2	23	514	0	0	537	857
04:15 PM	15	0	6	2	23	3	281	19	2	305	2	4	2	0	8	16	504	1	0	521	857
04:30 PM	13	0	8	3	24	0	314	12	5	331	5	0	0	0	5	23	492	1	0	516	876
04:45 PM	16	0	9	4	29	3	268	14	1	286	6	0	1	0	7	15	351	2	0	368	690
Total	58	1	34	13	106	6	1137	56	11	1210	14	5	3	0	22	77	1861	4	0	1942	3280
05:00 PM	13	1	9	1	24	1	321	15	2	339	5	0	1	0	6	14	365	1	0	380	749
05:15 PM	15	0	7	2	24	1	263	13	3	280	2	0	3	2	7	13	276	1	0	290	601
05:30 PM	14	1	5	0	20	5	284	12	1	302	3	0	4	0	7	15	225	1	0	241	570
05:45 PM	11	0	4	0	15	1	234	12	14	261	2	0	1	0	3	16	176	1	0	193	472
Total	53	2	25	3	83	8	1102	52	20	1182	12	0	9	2	23	58	1042	4	0	1104	2392
Grand Total	158	4	92	30	284	19	3230	186	42	3477	42	11	19	3	75	201	4548	9	0	4758	8594
Apprch %	55.6	1.4	32.4	10.6		0.5	92.9	5.3	1.2		56	14.7	25.3	4		4.2	95.6	0.2	0		
Total %	1.8	0	1.1	0.3	3.3	0.2	37.6	2.2	0.5	40.5	0.5	0.1	0.2	0	0.9	2.3	52.9	0.1	0	55.4	

	Laumaka Street Southbound				Kamehameha Highway Westbound				OCCC Driveway Northbound				Kamehameha Highway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 03:45 PM																	
03:45 PM	**15**	**1**	8	24	0	255	12	267	**6**	2	**2**	**10**	20	496	0	516	817
04:00 PM	14	1	**11**	**26**	0	274	11	285	1	1	0	2	**23**	**514**	0	**537**	850
04:15 PM	15	0	6	21	**3**	281	**19**	303	2	**4**	2	8	16	504	**1**	521	853
04:30 PM	13	0	8	21	0	**314**	12	**326**	5	0	0	5	23	492	1	516	**868**
Total Volume	57	2	33	92	3	1124	54	1181	14	7	4	25	82	2006	2	2090	3388
% App. Total	62	2.2	35.9		0.3	95.2	4.6		56	28	16		3.9	96	0.1		
PHF	.950	.500	.750	.885	.250	.895	.711	.906	.583	.438	.500	.625	.891	.976	.500	.973	.976

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: PA
Counter: D4-5677
Weather: Clear

File Name : KamOCCC AM
Site Code : 00000005
Start Date : 4/11/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Kamehameha Highway Westbound					OCCC Visitor Parking Driveway Northbound					Kamehameha Highway Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	2
06:15 AM	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	2
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	2	0	2	0	4	0	0	1	0	1	5
07:00 AM	0	1	0	0	0	1	1	0	0	0	1	0	0	4	0	4	6
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	3
07:45 AM	0	1	0	0	0	1	0	0	0	0	0	0	0	3	0	3	4
Total	0	2	0	0	0	2	1	0	0	0	1	0	0	11	0	11	14
08:00 AM	0	0	0	0	0	0	1	0	3	0	4	0	0	2	0	2	6
08:15 AM	0	1	0	0	0	1	0	0	1	0	1	0	0	1	0	1	3
08:30 AM	0	1	0	0	0	1	0	0	3	0	3	0	0	1	0	1	5
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
Total	0	2	0	0	0	2	1	0	7	0	8	0	0	5	0	5	15
Grand Total	0	4	0	0	0	4	4	0	9	0	13	0	0	17	0	17	34
Apprch %		100	0	0	0		30.8	0	69.2	0		0	0	100	0		
Total %	0	11.8	0	0	0	11.8	11.8	0	26.5	0	38.2	0	0	50	0	50	

	Southbound	Kamehameha Highway Westbound				OCCC Visitor Parking Driveway Northbound				Kamehameha Highway Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 07:45 AM														
07:45 AM	0	**1**	0	0	**1**	0	0	0	0	0	0	**3**	**3**	4
08:00 AM	0	0	0	0	0	**1**	0	**3**	**4**	0	0	2	2	**6**
08:15 AM	0	1	0	0	1	0	0	1	1	0	0	1	1	3
08:30 AM	0	1	0	0	1	0	0	3	3	0	0	1	1	5
Total Volume	0	3	0	0	3	1	0	7	8	0	0	7	7	18
% App. Total		100	0	0		12.5	0	87.5		0	0	100		
PHF	.000	.750	.000	.000	.750	.250	.000	.583	.500	.000	.000	.583	.583	.750

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: PA
Counter: D4-5677
Weather: Clear

File Name : KamOCCC PM
Site Code : 00000005
Start Date : 4/11/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Kamehameha Highway Westbound					OCCC Visitor Parking Driveway Northbound					Kamehameha Highway Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
03:30 PM	0	0	0	0	0	0	1	0	3	0	4	0	0	2	0	2	6
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	1	0	3	0	4	0	0	3	0	3	7
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	2
Total	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	2
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Grand Total	0	0	0	0	0	0	1	0	4	0	5	0	0	4	1	5	10
Apprch %		0	0	0	0		20	0	80	0		0	0	80	20		
Total %	0	0	0	0	0	0	10	0	40	0	50	0	0	40	10	50	

	Southbound	Kamehameha Highway Westbound				OCCC Visitor Parking Driveway Northbound				Kamehameha Highway Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 03:00 PM														
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	1	1	1
03:30 PM	0	0	0	0	0	**1**	0	**3**	**4**	0	0	**2**	**2**	**6**
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	1	0	3	4	0	0	3	3	7
% App. Total		0	0	0		25	0	75		0	0	100		
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.250	.000	.000	.375	.375	.292

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: CK, HM
Counter: TU-2049, TU-1957
Weather: Clear

File Name : NimPuu AM
Site Code : 00000003
Start Date : 4/11/2017
Page No : 1

Groups Printed- Unshifted

	Puuhale Road Southbound					Nimitz Highway Westbound					Puuhale Road Northbound					Nimitz Highway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	9	28	16	0	53	0	234	11	15	260	9	11	10	13	43	6	520	48	0	574	930
06:15 AM	4	21	19	1	45	0	247	8	18	273	11	11	31	13	66	3	634	71	0	708	1092
06:30 AM	15	34	12	1	62	0	249	19	12	280	10	19	21	3	53	5	727	45	0	777	1172
06:45 AM	16	30	7	1	54	0	344	19	11	374	8	16	18	2	44	9	804	46	0	859	1331
Total	44	113	54	3	214	0	1074	57	56	1187	38	57	80	31	206	23	2685	210	0	2918	4525
07:00 AM	20	35	10	0	65	0	320	14	1	335	5	11	24	0	40	9	936	45	0	990	1430
07:15 AM	22	28	14	0	64	0	321	20	6	347	8	22	18	1	49	7	943	19	0	969	1429
07:30 AM	33	36	8	0	77	0	341	17	15	373	10	18	13	4	45	6	802	26	0	834	1329
07:45 AM	15	55	10	0	80	0	321	22	5	348	12	24	14	3	53	7	676	19	0	702	1183
Total	90	154	42	0	286	0	1303	73	27	1403	35	75	69	8	187	29	3357	109	0	3495	5371
08:00 AM	21	37	12	0	70	0	355	22	7	384	8	7	18	1	34	8	613	18	0	639	1127
08:15 AM	17	23	8	1	49	0	301	24	4	329	13	18	15	0	46	11	778	34	0	823	1247
08:30 AM	20	41	14	0	75	0	329	16	8	353	8	11	20	1	40	13	677	40	0	730	1198
08:45 AM	16	32	17	0	65	0	250	16	2	268	9	11	9	1	30	8	499	30	0	537	900
Total	74	133	51	1	259	0	1235	78	21	1334	38	47	62	3	150	40	2567	122	0	2729	4472
Grand Total	208	400	147	4	759	0	3612	208	104	3924	111	179	211	42	543	92	8609	441	0	9142	14368
Apprch %	27.4	52.7	19.4	0.5		0	92	5.3	2.7		20.4	33	38.9	7.7		1	94.2	4.8	0		
Total %	1.4	2.8	1	0	5.3	0	25.1	1.4	0.7	27.3	0.8	1.2	1.5	0.3	3.8	0.6	59.9	3.1	0	63.6	

	Puuhale Road Southbound				Nimitz Highway Westbound				Puuhale Road Northbound				Nimitz Highway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 06:45 AM																	
06:45 AM	16	30	7	53	0	**344**	19	**363**	8	16	18	42	**9**	804	**46**	859	1317
07:00 AM	20	35	10	65	0	320	14	334	5	11	**24**	40	9	936	45	**990**	**1429**
07:15 AM	22	28	**14**	64	0	321	**20**	341	8	**22**	18	**48**	7	**943**	19	969	1422
07:30 AM	**33**	**36**	8	**77**	0	341	17	358	**10**	18	13	41	6	802	26	834	1310
Total Volume	91	129	39	259	0	1326	70	1396	31	67	73	171	31	3485	136	3652	5478
% App. Total	35.1	49.8	15.1		0	95	5		18.1	39.2	42.7		0.8	95.4	3.7		
PHF	.689	.896	.696	.841	.000	.964	.875	.961	.775	.761	.760	.891	.861	.924	.739	.922	.958

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: CK, JT
Counter: TU-2049, TU-1957
Weather: Clear

File Name : NimPuu PM
Site Code : 00000003
Start Date : 4/11/2017
Page No : 1

Groups Printed- Unshifted

	Puuhale Road Southbound					Nimitz Highway Westbound					Puuhale Road Northbound					Nimitz Highway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	13	21	0	0	34	18	488	17	2	525	24	34	11	4	73	12	489	19	0	520	1152
03:15 PM	22	21	1	0	44	29	510	7	11	557	24	29	21	0	74	10	502	20	0	532	1207
03:30 PM	18	29	20	0	67	23	627	16	10	676	18	41	21	2	82	3	460	12	0	475	1300
03:45 PM	5	37	10	0	52	8	647	17	9	681	16	31	21	0	68	8	501	22	0	531	1332
Total	58	108	31	0	197	78	2272	57	32	2439	82	135	74	6	297	33	1952	73	0	2058	4991
04:00 PM	17	20	15	0	52	19	665	15	7	706	31	38	20	2	91	2	475	13	0	490	1339
04:15 PM	15	30	9	0	54	7	638	18	0	663	29	41	19	0	89	13	505	22	0	540	1346
04:30 PM	11	29	8	0	48	12	628	13	6	659	31	44	15	0	90	11	571	4	0	586	1383
04:45 PM	18	29	9	0	56	10	618	30	16	674	25	32	12	0	69	14	563	18	0	595	1394
Total	61	108	41	0	210	48	2549	76	29	2702	116	155	66	2	339	40	2114	57	0	2211	5462
05:00 PM	17	16	9	0	42	10	682	15	5	712	21	37	23	6	87	7	542	25	0	574	1415
05:15 PM	13	23	9	0	45	12	626	21	8	667	25	22	12	3	62	12	562	15	0	589	1363
05:30 PM	10	9	6	0	25	10	686	18	5	719	15	17	9	0	41	4	507	17	0	528	1313
05:45 PM	16	9	7	0	32	10	616	12	2	640	21	17	4	0	42	9	410	17	0	436	1150
Total	56	57	31	0	144	42	2610	66	20	2738	82	93	48	9	232	32	2021	74	0	2127	5241
Grand Total	175	273	103	0	551	168	7431	199	81	7879	280	383	188	17	868	105	6087	204	0	6396	15694
Apprch %	31.8	49.5	18.7	0		2.1	94.3	2.5	1		32.3	44.1	21.7	2		1.6	95.2	3.2	0		
Total %	1.1	1.7	0.7	0	3.5	1.1	47.3	1.3	0.5	50.2	1.8	2.4	1.2	0.1	5.5	0.7	38.8	1.3	0	40.8	

	Puuhale Road Southbound				Nimitz Highway Westbound				Puuhale Road Northbound				Nimitz Highway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:30 PM																	
04:30 PM	11	**29**	8	48	**12**	628	13	653	**31**	**44**	15	**90**	11	**571**	4	586	1377
04:45 PM	**18**	29	**9**	**56**	10	618	**30**	658	25	32	12	69	**14**	563	18	**595**	1378
05:00 PM	17	16	9	42	10	**682**	15	**707**	21	37	**23**	81	7	542	**25**	574	**1404**
05:15 PM	13	23	9	45	12	626	21	659	25	22	12	59	12	562	15	589	1352
Total Volume	59	97	35	191	44	2554	79	2677	102	135	62	299	44	2238	62	2344	5511
% App. Total	30.9	50.8	18.3		1.6	95.4	3		34.1	45.2	20.7		1.9	95.5	2.6		
PHF	.819	.836	.972	.853	.917	.936	.658	.947	.823	.767	.674	.831	.786	.980	.620	.985	.981

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: BE, GH
Counter: TU-0649, TU-2050
Weather: Clear

File Name : NimSand AM
Site Code : 00000004
Start Date : 4/11/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Nimitz Highway Westbound					Sand Island Access Road Northbound					Nimitz Highway Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	73	167	0	6	246	67	0	27	6	100	0	615	369	0	984	1330
06:15 AM	0	65	220	0	3	288	92	0	37	3	132	0	766	332	0	1098	1518
06:30 AM	0	86	226	0	5	317	95	0	28	9	132	0	828	302	0	1130	1579
06:45 AM	0	89	268	0	7	364	124	0	38	6	168	0	880	264	0	1144	1676
Total	0	313	881	0	21	1215	378	0	130	24	532	0	3089	1267	0	4356	6103
07:00 AM	0	72	267	0	1	340	120	0	41	2	163	0	1057	270	0	1327	1830
07:15 AM	0	64	278	0	4	346	131	0	37	8	176	0	992	182	0	1174	1696
07:30 AM	0	93	290	0	7	390	95	0	38	12	145	0	797	201	0	998	1533
07:45 AM	0	87	294	0	4	385	115	0	36	1	152	0	776	202	0	978	1515
Total	0	316	1129	0	16	1461	461	0	152	23	636	0	3622	855	0	4477	6574
08:00 AM	0	88	255	0	2	345	83	0	44	2	129	0	788	200	0	988	1462
08:15 AM	0	62	278	0	4	344	93	0	40	5	138	0	812	246	0	1058	1540
08:30 AM	0	88	309	0	3	400	98	0	36	3	137	0	690	213	0	903	1440
08:45 AM	0	63	225	0	0	288	118	0	42	1	161	0	554	181	0	735	1184
Total	0	301	1067	0	9	1377	392	0	162	11	565	0	2844	840	0	3684	5626
Grand Total	0	930	3077	0	46	4053	1231	0	444	58	1733	0	9555	2962	0	12517	18303
Apprch %		22.9	75.9	0	1.1		71	0	25.6	3.3		0	76.3	23.7	0		
Total %	0	5.1	16.8	0	0.3	22.1	6.7	0	2.4	0.3	9.5	0	52.2	16.2	0	68.4	

	Southbound	Nimitz Highway Westbound				Sand Island Access Road Northbound				Nimitz Highway Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 06:30 AM														
06:30 AM	0	86	226	0	312	95	0	28	123	0	828	**302**	1130	1565
06:45 AM	0	**89**	268	0	**357**	124	0	38	162	0	880	264	1144	1663
07:00 AM	0	72	267	0	339	120	0	**41**	161	0	**1057**	270	**1327**	**1827**
07:15 AM	0	64	**278**	0	342	**131**	0	37	**168**	0	992	182	1174	1684
Total Volume	0	311	1039	0	1350	470	0	144	614	0	3757	1018	4775	6739
% App. Total		23	77	0		76.5	0	23.5		0	78.7	21.3		
PHF	.000	.874	.934	.000	.945	.897	.000	.878	.914	.000	.889	.843	.900	.922

Wilson Okamoto Corporation
1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: BE, GH
Counter: TU-0649, TU-2050
Weather: Clear

File Name : NimSand PM
Site Code : 00000004
Start Date : 4/11/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Nimtiz Highway Westbound					Sand Island Access Road Northbound					Nimtiz Highway Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	0	43	519	0	10	572	219	0	50	16	285	0	481	138	0	619	1476
03:15 PM	0	39	561	0	5	605	191	0	56	3	250	0	548	170	0	718	1573
03:30 PM	0	70	586	0	5	661	185	0	58	4	247	0	518	139	0	657	1565
03:45 PM	0	45	648	0	8	701	185	0	52	8	245	0	553	135	0	688	1634
Total	0	197	2314	0	28	2539	780	0	216	31	1027	0	2100	582	0	2682	6248
04:00 PM	0	39	689	0	5	733	178	0	49	5	232	0	534	135	0	669	1634
04:15 PM	0	34	651	0	5	690	151	2	71	8	232	0	507	131	0	638	1560
04:30 PM	0	36	616	0	12	664	163	0	62	16	241	0	552	118	0	670	1575
04:45 PM	0	31	645	0	4	680	127	0	59	2	188	0	555	143	0	698	1566
Total	0	140	2601	0	26	2767	619	2	241	31	893	0	2148	527	0	2675	6335
05:00 PM	0	45	667	0	2	714	141	0	55	3	199	0	524	80	0	604	1517
05:15 PM	0	28	636	0	0	664	132	0	56	0	188	0	562	77	0	639	1491
05:30 PM	0	43	626	0	6	675	89	0	45	6	140	0	489	78	0	567	1382
05:45 PM	0	38	605	0	4	647	85	0	32	6	123	0	441	61	0	502	1272
Total	0	154	2534	0	12	2700	447	0	188	15	650	0	2016	296	0	2312	5662
Grand Total	0	491	7449	0	66	8006	1846	2	645	77	2570	0	6264	1405	0	7669	18245
Apprch %		6.1	93	0	0.8		71.8	0.1	25.1	3		0	81.7	18.3	0		
Total %	0	2.7	40.8	0	0.4	43.9	10.1	0	3.5	0.4	14.1	0	34.3	7.7	0	42	

	Southbound	Nimtiz Highway Westbound				Sand Island Access Road Northbound				Nimtiz Highway Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 03:15 PM														
03:15 PM	0	39	561	0	600	**191**	0	56	**247**	0	548	**170**	**718**	1565
03:30 PM	0	**70**	586	0	656	185	0	**58**	243	0	518	139	657	1556
03:45 PM	0	45	648	0	693	185	0	52	237	0	**553**	135	688	1618
04:00 PM	0	39	**689**	0	**728**	178	0	49	227	0	534	135	669	**1624**
Total Volume	0	193	2484	0	2677	739	0	215	954	0	2153	579	2732	6363
% App. Total		7.2	92.8	0		77.5	0	22.5		0	78.8	21.2		
PHF	.000	.689	.901	.000	.919	.967	.000	.927	.966	.000	.973	.851	.951	.980

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: AH, GH
Counter: D4-3888, TU-0652
Weather: Clear

File Name : KamLei AM
Site Code : 00000001
Start Date : 4/27/2017
Page No : 1

Groups Printed- Unshifted

	Kamehameha Highway Southbound					Leilehua Road Westbound					Kamehameha Highway Northbound					Eastbound	
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Int. Total
06:00 AM	59	54	0	0	113	4	0	105	0	109	0	127	48	0	175	0	397
06:15 AM	39	59	0	0	98	9	0	77	0	86	0	105	26	0	131	0	315
06:30 AM	48	69	0	1	118	10	0	84	2	96	0	130	43	0	173	0	387
06:45 AM	79	86	0	2	167	8	0	110	1	119	0	136	35	0	171	0	457
Total	225	268	0	3	496	31	0	376	3	410	0	498	152	0	650	0	1556
07:00 AM	44	88	0	0	132	12	0	105	0	117	0	164	38	0	202	0	451
07:15 AM	81	111	0	0	192	18	0	114	0	132	0	133	47	0	180	0	504
07:30 AM	79	127	0	1	207	27	0	114	1	142	0	154	54	0	208	0	557
07:45 AM	120	118	0	0	238	17	0	81	0	98	0	153	66	0	219	0	555
Total	324	444	0	1	769	74	0	414	1	489	0	604	205	0	809	0	2067
08:00 AM	68	96	0	0	164	23	0	86	0	109	0	126	54	0	180	0	453
08:15 AM	69	107	0	0	176	22	0	74	0	96	0	112	26	0	138	0	410
08:30 AM	61	73	0	0	134	14	0	95	0	109	0	118	29	0	147	0	390
08:45 AM	73	85	0	0	158	15	0	74	0	89	0	102	24	0	126	0	373
Total	271	361	0	0	632	74	0	329	0	403	0	458	133	0	591	0	1626
Grand Total	820	1073	0	4	1897	179	0	1119	4	1302	0	1560	490	0	2050	0	5249
Apprch %	43.2	56.6	0	0.2		13.7	0	85.9	0.3		0	76.1	23.9	0			
Total %	15.6	20.4	0	0.1	36.1	3.4	0	21.3	0.1	24.8	0	29.7	9.3	0	39.1	0	

	Kamehameha Highway Southbound				Leilehua Road Westbound				Kamehameha Highway Northbound				Eastbound	
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 07:15 AM														
07:15 AM	81	111	0	192	18	0	**114**	132	0	133	47	180	0	504
07:30 AM	79	**127**	0	206	**27**	0	114	**141**	0	**154**	54	208	0	**555**
07:45 AM	**120**	118	0	**238**	17	0	81	98	0	153	**66**	**219**	0	555
08:00 AM	68	96	0	164	23	0	86	109	0	126	54	180	0	453
Total Volume	348	452	0	800	85	0	395	480	0	566	221	787	0	2067
% App. Total	43.5	56.5	0		17.7	0	82.3		0	71.9	28.1			
PHF	.725	.890	.000	.840	.787	.000	.866	.851	.000	.919	.837	.898	.000	.931

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: FS, GH
Counter: D4-3888, TU-0652
Weather: Clear

File Name : KamLei PM
Site Code : 00000001
Start Date : 4/27/2017
Page No : 1

Groups Printed- Unshifted

	Kamehameha Highway Southbound					Leilehua Road Westbound					Kamehameha Highway Northbound					Eastbound	
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Int. Total
03:00 PM	114	115	0	0	229	22	0	20	0	42	0	121	33	0	154	0	425
03:15 PM	85	156	0	0	241	32	0	21	1	54	0	129	37	0	166	0	461
03:30 PM	136	157	0	0	293	25	0	32	0	57	0	81	29	0	110	0	460
03:45 PM	93	156	0	0	249	29	0	30	0	59	0	129	36	0	165	0	473
Total	428	584	0	0	1012	108	0	103	1	212	0	460	135	0	595	0	1819
04:00 PM	135	162	0	0	297	36	0	26	0	62	0	104	19	0	123	0	482
04:15 PM	86	171	0	0	257	32	0	38	1	71	0	122	40	0	162	0	490
04:30 PM	108	156	0	0	264	35	0	41	0	76	0	110	28	0	138	0	478
04:45 PM	98	170	0	0	268	41	0	39	0	80	0	100	31	0	131	0	479
Total	427	659	0	0	1086	144	0	144	1	289	0	436	118	0	554	0	1929
05:00 PM	111	144	0	0	255	31	0	53	0	84	0	91	25	0	116	0	455
05:15 PM	104	161	0	0	265	22	0	41	0	63	0	96	29	0	125	0	453
05:30 PM	89	163	0	0	252	27	0	30	0	57	0	125	28	0	153	0	462
05:45 PM	62	126	0	0	188	23	0	40	0	63	0	104	30	0	134	0	385
Total	366	594	0	0	960	103	0	164	0	267	0	416	112	0	528	0	1755
Grand Total	1221	1837	0	0	3058	355	0	411	2	768	0	1312	365	0	1677	0	5503
Apprch %	39.9	60.1	0	0		46.2	0	53.5	0.3		0	78.2	21.8	0			
Total %	22.2	33.4	0	0	55.6	6.5	0	7.5	0	14	0	23.8	6.6	0	30.5	0	

	Kamehameha Highway Southbound				Leilehua Road Westbound				Kamehameha Highway Northbound				Eastbound	
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 04:00 PM														
04:00 PM	**135**	162	0	**297**	36	0	26	62	0	104	19	123	0	482
04:15 PM	86	**171**	0	257	32	0	38	70	0	**122**	**40**	**162**	0	**489**
04:30 PM	108	156	0	264	35	0	**41**	76	0	110	28	138	0	478
04:45 PM	98	170	0	268	**41**	0	39	**80**	0	100	31	131	0	479
Total Volume	427	659	0	1086	144	0	144	288	0	436	118	554	0	1928
% App. Total	39.3	60.7	0		50	0	50		0	78.7	21.3			
PHF	.791	.963	.000	.914	.878	.000	.878	.900	.000	.893	.738	.855	.000	.986

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: BE
Counter: D4-5676
Weather: Clear

File Name : H-2 On-Ramp AM
Site Code : 00000002
Start Date : 4/27/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Leilehua Road Westbound					Northbound	Leilehua Road Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	55	99	0	0	154	0	0	28	69	0	97	251
06:15 AM	0	47	83	0	0	130	0	0	35	32	0	67	197
06:30 AM	0	48	95	0	0	143	0	0	34	57	0	91	234
06:45 AM	0	50	106	0	0	156	0	0	47	44	0	91	247
Total	0	200	383	0	0	583	0	0	144	202	0	346	929
07:00 AM	0	70	107	0	0	177	0	0	31	45	0	76	253
07:15 AM	0	54	129	0	0	183	0	0	76	53	0	129	312
07:30 AM	0	50	130	0	0	180	0	0	92	38	0	130	310
07:45 AM	0	52	106	0	0	158	0	0	124	44	0	168	326
Total	0	226	472	0	0	698	0	0	323	180	0	503	1201
08:00 AM	0	66	104	0	0	170	0	0	71	38	0	109	279
08:15 AM	0	48	91	0	0	139	0	0	42	52	0	94	233
08:30 AM	0	48	114	0	0	162	0	0	48	40	0	88	250
08:45 AM	0	43	89	0	0	132	0	0	48	39	0	87	219
Total	0	205	398	0	0	603	0	0	209	169	0	378	981
Grand Total	0	631	1253	0	0	1884	0	0	676	551	0	1227	3111
Apprch %		33.5	66.5	0	0			0	55.1	44.9	0		
Total %	0	20.3	40.3	0	0	60.6	0	0	21.7	17.7	0	39.4	

	Southbound	Leilehua Road Westbound				Northbound	Leilehua Road Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1											
Peak Hour for Entire Intersection Begins at 07:15 AM											
07:15 AM	0	54	129	0	**183**	0	0	76	**53**	129	312
07:30 AM	0	50	**130**	0	180	0	0	92	38	130	310
07:45 AM	0	52	106	0	158	0	0	**124**	44	**168**	**326**
08:00 AM	0	**66**	104	0	170	0	0	71	38	109	279
Total Volume	0	222	469	0	691	0	0	363	173	536	1227
% App. Total		32.1	67.9	0			0	67.7	32.3		
PHF	.000	.841	.902	.000	.944	.000	.000	.732	.816	.798	.941

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: BE
Counter: D4-5676
Weather: Clear

File Name : H-2 On-Ramp PM
Site Code : 00000002
Start Date : 4/27/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Leilehua Road Westbound					Northbound	Leilehua Road Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	0	66	79	0	0	145	0	0	59	69	0	128	273
03:15 PM	0	65	66	0	0	131	0	0	49	81	0	130	261
03:30 PM	0	76	78	0	0	154	0	0	45	117	0	162	316
03:45 PM	0	67	74	0	0	141	0	0	63	89	0	152	293
Total	0	274	297	0	0	571	0	0	216	356	0	572	1143
04:00 PM	0	90	85	0	0	175	0	0	53	89	0	142	317
04:15 PM	0	53	72	0	0	125	0	0	59	63	0	122	247
04:30 PM	0	92	83	0	0	175	0	0	58	75	0	133	308
04:45 PM	0	88	81	0	0	169	0	0	78	55	0	133	302
Total	0	323	321	0	0	644	0	0	248	282	0	530	1174
05:00 PM	0	113	89	0	0	202	0	0	59	79	0	138	340
05:15 PM	0	66	62	0	0	128	0	0	60	73	0	133	261
05:30 PM	0	87	63	0	0	150	0	0	56	63	0	119	269
05:45 PM	0	58	57	0	0	115	0	0	61	40	0	101	216
Total	0	324	271	0	0	595	0	0	236	255	0	491	1086
Grand Total	0	921	889	0	0	1810	0	0	700	893	0	1593	3403
Apprch %		50.9	49.1	0	0			0	43.9	56.1	0		
Total %	0	27.1	26.1	0	0	53.2	0	0	20.6	26.2	0	46.8	

	Southbound	Leilehua Road Westbound				Northbound	Leilehua Road Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1											
Peak Hour for Entire Intersection Begins at 04:30 PM											
04:30 PM	0	92	83	0	175	0	0	58	75	133	308
04:45 PM	0	88	81	0	169	0	0	**78**	55	133	302
05:00 PM	0	**113**	**89**	0	**202**	0	0	59	**79**	**138**	**340**
05:15 PM	0	66	62	0	128	0	0	60	73	133	261
Total Volume	0	359	315	0	674	0	0	255	282	537	1211
% App. Total		53.3	46.7	0			0	47.5	52.5		
PHF	.000	.794	.885	.000	.834	.000	.000	.817	.892	.973	.890

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: BE
Counter: D4-5676
Weather: Clear

File Name : H-2 Off-Ramp AM
Site Code : 00000002
Start Date : 4/27/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Westbound	H-2 Off-Ramp Northbound					Eastbound	
Start Time	App. Total	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Int. Total
06:00 AM	0	0	48	0	14	0	62	0	62
06:15 AM	0	0	38	0	34	0	72	0	72
06:30 AM	0	0	52	0	37	0	89	0	89
06:45 AM	0	0	45	0	31	0	76	0	76
Total	0	0	183	0	116	0	299	0	299
07:00 AM	0	0	49	0	63	0	112	0	112
07:15 AM	0	0	55	0	65	0	120	0	120
07:30 AM	0	0	56	0	82	0	138	0	138
07:45 AM	0	0	43	0	94	0	137	0	137
Total	0	0	203	0	304	0	507	0	507
08:00 AM	0	0	42	0	47	0	89	0	89
08:15 AM	0	0	39	0	72	0	111	0	111
08:30 AM	0	0	46	0	53	0	99	0	99
08:45 AM	0	0	27	0	54	0	81	0	81
Total	0	0	154	0	226	0	380	0	380
Grand Total	0	0	540	0	646	0	1186	0	1186
Apprch %			45.5	0	54.5	0			
Total %	0	0	45.5	0	54.5	0	100	0	

	Southbound	Westbound	H-2 Off-Ramp Northbound				Eastbound	
Start Time	App. Total	App. Total	Left	Thru	Right	App. Total	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1								
Peak Hour for Entire Intersection Begins at 07:00 AM								
07:00 AM	0	0	49	0	63	112	0	112
07:15 AM	0	0	55	0	65	120	0	120
07:30 AM	0	0	**56**	0	82	**138**	0	**138**
07:45 AM	0	0	43	0	**94**	137	0	137
Total Volume	0	0	203	0	304	507	0	507
% App. Total			40	0	60			
PHF	.000	.000	.906	.000	.809	.918	.000	.918

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: AH
Counter: TU-0654
Weather: Clear

File Name : H-2 Off-Ramp PM
Site Code : 00000002
Start Date : 4/27/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Westbound	H-2 Off-Ramp Northbound					Eastbound	
Start Time	App. Total	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Int. Total
03:00 PM	0	0	30	0	60	0	90	0	90
03:15 PM	0	0	36	0	63	0	99	0	99
03:30 PM	0	0	41	0	42	0	83	0	83
03:45 PM	0	0	35	0	62	0	97	0	97
Total	0	0	142	0	227	0	369	0	369
04:00 PM	0	0	39	0	52	0	91	0	91
04:15 PM	0	0	30	0	59	1	90	0	90
04:30 PM	0	0	33	0	65	0	98	0	98
04:45 PM	0	0	37	0	64	0	101	0	101
Total	0	0	139	0	240	1	380	0	380
05:00 PM	0	0	40	0	50	0	90	0	90
05:15 PM	0	0	29	0	57	0	86	0	86
05:30 PM	0	0	24	0	51	0	75	0	75
05:45 PM	0	0	28	0	54	0	82	0	82
Total	0	0	121	0	212	0	333	0	333
Grand Total	0	0	402	0	679	1	1082	0	1082
Apprch %			37.2	0	62.8	0.1			
Total %	0	0	37.2	0	62.8	0.1	100	0	

	Southbound	Westbound	H-2 Off-Ramp Northbound				Eastbound	
Start Time	App. Total	App. Total	Left	Thru	Right	App. Total	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1								
Peak Hour for Entire Intersection Begins at 04:00 PM								
04:00 PM	0	0	**39**	0	52	91	0	91
04:15 PM	0	0	30	0	59	89	0	89
04:30 PM	0	0	33	0	**65**	98	0	98
04:45 PM	0	0	37	0	64	**101**	0	**101**
Total Volume	0	0	139	0	240	379	0	379
% App. Total			36.7	0	63.3			
PHF	.000	.000	.891	.000	.923	.938	.000	.938

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: YS
Counter: TU-1958
Weather: Clear

File Name : KahAka AM
Site Code : 00000004
Start Date : 4/27/2017
Page No : 1

Groups Printed- Unshifted

	Castle&Cooke Driveway Southbound					Kahelu Avenue Westbound					Akamaunui Street Northbound					Kahelu Avenue Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	0	0	0	0	1	10	0	1	12	5	0	4	0	9	1	22	4	2	29	50
06:15 AM	0	0	0	0	0	0	8	1	2	11	6	0	0	0	6	0	30	8	2	40	57
06:30 AM	0	0	0	0	0	0	7	0	3	10	16	0	0	0	16	6	36	21	3	66	92
06:45 AM	0	0	0	0	0	0	7	0	0	7	19	0	0	0	19	6	48	30	1	85	111
Total	0	0	0	0	0	1	32	1	6	40	46	0	4	0	50	13	136	63	8	220	310
07:00 AM	0	0	0	1	1	0	21	0	0	21	23	1	0	0	24	3	40	31	0	74	120
07:15 AM	0	0	1	0	1	1	15	1	1	18	40	0	0	0	40	2	59	34	2	97	156
07:30 AM	0	0	1	0	1	0	22	0	0	22	40	0	1	0	41	15	49	39	1	104	168
07:45 AM	0	0	0	0	0	0	20	2	0	22	26	0	0	0	26	21	66	57	0	144	192
Total	0	0	2	1	3	1	78	3	1	83	129	1	1	0	131	41	214	161	3	419	636
08:00 AM	0	0	0	0	0	0	22	0	2	24	20	0	1	1	22	13	49	26	0	88	134
08:15 AM	0	0	0	0	0	0	20	1	0	21	14	0	1	0	15	8	27	37	0	72	108
08:30 AM	0	0	1	0	1	2	16	0	0	18	8	0	0	0	8	11	33	23	0	67	94
08:45 AM	0	0	2	0	2	0	11	2	0	13	5	0	2	1	8	7	34	19	1	61	84
Total	0	0	3	0	3	2	69	3	2	76	47	0	4	2	53	39	143	105	1	288	420
Grand Total	0	0	5	1	6	4	179	7	9	199	222	1	9	2	234	93	493	329	12	927	1366
Apprch %	0	0	83.3	16.7		2	89.9	3.5	4.5		94.9	0.4	3.8	0.9		10	53.2	35.5	1.3		
Total %	0	0	0.4	0.1	0.4	0.3	13.1	0.5	0.7	14.6	16.3	0.1	0.7	0.1	17.1	6.8	36.1	24.1	0.9	67.9	

	Castle&Cooke Driveway Southbound				Kahelu Avenue Westbound				Akamaunui Street Northbound				Kahelu Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	0	0	**1**	**1**	**1**	15	1	17	**40**	0	0	40	2	59	34	95	153
07:30 AM	0	0	1	1	0	**22**	0	**22**	40	0	**1**	**41**	15	49	39	103	167
07:45 AM	0	0	0	0	0	20	**2**	22	26	0	0	26	**21**	**66**	**57**	**144**	**192**
08:00 AM	0	0	0	0	0	22	0	22	20	0	1	21	13	49	26	88	131
Total Volume	0	0	2	2	1	79	3	83	126	0	2	128	51	223	156	430	643
% App. Total	0	0	100		1.2	95.2	3.6		98.4	0	1.6		11.9	51.9	36.3		
PHF	.000	.000	.500	.500	.250	.898	.375	.943	.788	.000	.500	.780	.607	.845	.684	.747	.837

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: YS
Counter: TU-1958
Weather: Clear

File Name : KahAka PM
Site Code : 00000004
Start Date : 4/27/2017
Page No : 1

Groups Printed- Unshifted

	Castle&Cooke Driveway Southbound					Kahelu Avenue Westbound					Akamainui Street Northbound					Kahelu Avenue Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	1	0	1	0	2	1	25	4	0	30	12	0	0	0	12	6	5	6	0	17	61
03:15 PM	0	0	1	0	1	0	15	1	0	16	15	0	0	0	15	4	9	5	0	18	50
03:30 PM	0	0	0	0	0	0	26	0	0	26	12	0	2	0	14	7	5	5	0	17	57
03:45 PM	0	0	2	0	2	0	19	0	0	19	6	0	0	0	6	5	9	2	0	16	43
Total	1	0	4	0	5	1	85	5	0	91	45	0	2	0	47	22	28	18	0	68	211
04:00 PM	0	0	0	0	0	0	37	0	0	37	38	0	2	0	40	1	17	5	0	23	100
04:15 PM	0	0	0	0	0	0	20	1	1	22	22	1	2	2	27	6	12	5	5	28	77
04:30 PM	0	0	0	0	0	0	46	0	0	46	39	0	3	0	42	4	19	6	2	31	119
04:45 PM	0	0	0	0	0	2	47	0	0	49	31	2	0	0	33	19	17	5	2	43	125
Total	0	0	0	0	0	2	150	1	1	154	130	3	7	2	142	30	65	21	9	125	421
05:00 PM	0	0	1	0	1	0	40	3	1	44	64	1	0	0	65	3	17	4	0	24	134
05:15 PM	0	0	3	0	3	1	39	2	0	42	28	0	0	0	28	1	17	0	5	23	96
05:30 PM	0	0	1	0	1	1	37	0	0	38	44	0	2	0	46	3	12	2	2	19	104
05:45 PM	0	0	2	0	2	1	24	0	0	25	20	0	2	0	22	4	25	3	0	32	81
Total	0	0	7	0	7	3	140	5	1	149	156	1	4	0	161	11	71	9	7	98	415
Grand Total	1	0	11	0	12	6	375	11	2	394	331	4	13	2	350	63	164	48	16	291	1047
Apprch %	8.3	0	91.7	0		1.5	95.2	2.8	0.5		94.6	1.1	3.7	0.6		21.6	56.4	16.5	5.5		
Total %	0.1	0	1.1	0	1.1	0.6	35.8	1.1	0.2	37.6	31.6	0.4	1.2	0.2	33.4	6	15.7	4.6	1.5	27.8	

	Castle&Cooke Driveway Southbound				Kahelu Avenue Westbound				Akamainui Street Northbound				Kahelu Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:30 PM																	
04:30 PM	0	0	0	0	0	46	0	46	39	0	**3**	42	4	**19**	**6**	29	117
04:45 PM	0	0	0	0	**2**	**47**	0	**49**	31	**2**	0	33	**19**	17	5	**41**	123
05:00 PM	0	0	1	1	0	40	**3**	43	**64**	1	0	**65**	3	17	4	24	**133**
05:15 PM	0	0	**3**	**3**	1	39	2	42	28	0	0	28	1	17	0	18	91
Total Volume	0	0	4	4	3	172	5	180	162	3	3	168	27	70	15	112	464
% App. Total	0	0	100		1.7	95.6	2.8		96.4	1.8	1.8		24.1	62.5	13.4		
PHF	.000	.000	.333	.333	.375	.915	.417	.918	.633	.375	.250	.646	.355	.921	.625	.683	.872

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: AH
Counter: D4-5673
Weather: Clear

File Name : HalWai AM
Site Code : 00000003
Start Date : 4/12/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Halawa Valley Street Westbound					Waiua Place Northbound					Halawa Valley Street Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	0	42	0	0	42	6	0	0	0	6	0	73	12	0	85	133
06:15 AM	0	2	33	0	0	35	9	0	0	0	9	0	58	16	1	75	119
06:30 AM	0	0	47	0	0	47	6	0	0	0	6	0	74	13	1	88	141
06:45 AM	0	0	32	0	0	32	9	0	0	0	9	0	66	13	0	79	120
Total	0	2	154	0	0	156	30	0	0	0	30	0	271	54	2	327	513
07:00 AM	0	0	30	0	0	30	3	0	1	0	4	0	66	13	1	80	114
07:15 AM	0	0	31	0	0	31	6	0	2	0	8	0	61	17	0	78	117
07:30 AM	0	1	36	0	0	37	8	0	0	0	8	0	67	18	0	85	130
07:45 AM	0	0	39	0	0	39	6	0	1	0	7	0	96	15	0	111	157
Total	0	1	136	0	0	137	23	0	4	0	27	0	290	63	1	354	518
08:00 AM	0	0	21	0	0	21	6	0	0	0	6	0	61	17	1	79	106
08:15 AM	0	0	37	0	0	37	4	0	1	0	5	0	57	23	1	81	123
08:30 AM	0	1	15	0	0	16	6	0	1	0	7	0	18	9	1	28	51
Grand Total	0	4	363	0	0	367	69	0	6	0	75	0	697	166	6	869	1311
Apprch %		1.1	98.9	0	0		92	0	8	0		0	80.2	19.1	0.7		
Total %	0	0.3	27.7	0	0	28	5.3	0	0.5	0	5.7	0	53.2	12.7	0.5	66.3	

	Southbound	Halawa Valley Street Westbound				Waiua Place Northbound				Halawa Valley Street Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:30 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 07:00 AM														
07:00 AM	0	0	30	0	30	3	0	1	4	0	66	13	79	113
07:15 AM	0	0	31	0	31	6	0	**2**	**8**	0	61	17	78	117
07:30 AM	0	**1**	36	0	37	**8**	0	0	8	0	67	**18**	85	130
07:45 AM	0	0	**39**	0	**39**	6	0	1	7	0	**96**	15	**111**	**157**
Total Volume	0	1	136	0	137	23	0	4	27	0	290	63	353	517
% App. Total		0.7	99.3	0		85.2	0	14.8		0	82.2	17.8		
PHF	.000	.250	.872	.000	.878	.719	.000	.500	.844	.000	.755	.875	.795	.823

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1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: AH
Counter: D4-5673
Weather: Clear

File Name : HalWai PM
Site Code : 00000003
Start Date : 4/12/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Halawa Valley Street Westbound					Waiua Place Northbound					Halawa Valley Street Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	0	0	44	0	0	44	11	0	0	0	11	0	32	8	0	40	95
03:15 PM	0	2	69	0	0	71	15	0	0	0	15	0	39	10	0	49	135
03:30 PM	0	0	75	0	0	75	20	0	1	0	21	0	38	5	0	43	139
03:45 PM	0	0	66	0	0	66	22	0	0	0	22	0	23	2	0	25	113
Total	0	2	254	0	0	256	68	0	1	0	69	0	132	25	0	157	482
04:00 PM	0	1	68	0	0	69	17	0	0	0	17	0	22	9	0	31	117
04:15 PM	0	0	59	0	0	59	24	0	1	0	25	0	20	6	1	27	111
04:30 PM	0	0	76	0	0	76	23	0	0	0	23	0	16	11	0	27	126
04:45 PM	0	0	30	0	0	30	13	0	0	0	13	0	13	10	0	23	66
Total	0	1	233	0	0	234	77	0	1	0	78	0	71	36	1	108	420
05:00 PM	0	0	70	0	0	70	16	0	0	0	16	0	12	13	2	27	113
05:15 PM	0	0	42	0	0	42	19	0	0	0	19	0	15	4	0	19	80
05:30 PM	0	0	38	0	0	38	7	0	0	2	9	0	6	1	0	7	54
05:45 PM	0	1	33	0	0	34	5	0	0	2	7	0	11	3	0	14	55
Total	0	1	183	0	0	184	47	0	0	4	51	0	44	21	2	67	302
Grand Total	0	4	670	0	0	674	192	0	2	4	198	0	247	82	3	332	1204
Apprch %		0.6	99.4	0	0		97	0	1	2		0	74.4	24.7	0.9		
Total %	0	0.3	55.6	0	0	56	15.9	0	0.2	0.3	16.4	0	20.5	6.8	0.2	27.6	

	Southbound	Halawa Valley Street Westbound				Waiua Place Northbound				Halawa Valley Street Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 03:15 PM														
03:15 PM	0	**2**	69	0	71	15	0	0	15	0	**39**	**10**	**49**	135
03:30 PM	0	0	**75**	0	**75**	20	0	**1**	21	0	38	5	43	**139**
03:45 PM	0	0	66	0	66	**22**	0	0	**22**	0	23	2	25	113
04:00 PM	0	1	68	0	69	17	0	0	17	0	22	9	31	117
Total Volume	0	3	278	0	281	74	0	1	75	0	122	26	148	504
% App. Total		1.1	98.9	0		98.7	0	1.3		0	82.4	17.6		
PHF	.000	.375	.927	.000	.937	.841	.000	.250	.852	.000	.782	.650	.755	.906

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: FS, DY
Counter: D4-3889, D4-5676
Weather: Clear

File Name : HalUlu AM
Site Code : 00000001
Start Date : 4/12/2017
Page No : 1

Groups Printed- Unshifted

	Halawa Valley Street Southbound					Ulune Street Westbound					Northbound	Ulune Street Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	30	56	0	86	0	212	81	0	293	0	98	0	100	0	198	577
06:15 AM	0	17	50	0	67	0	245	100	0	345	0	122	0	107	0	229	641
06:30 AM	0	24	69	0	93	0	210	122	0	332	0	112	0	120	0	232	657
06:45 AM	0	26	77	0	103	0	263	111	0	374	0	107	0	116	0	223	700
Total	0	97	252	0	349	0	930	414	0	1344	0	439	0	443	0	882	2575
07:00 AM	0	26	54	0	80	0	256	81	0	337	0	97	0	141	0	238	655
07:15 AM	0	23	76	0	99	0	268	82	0	350	0	96	0	163	0	259	708
07:30 AM	0	57	100	0	157	0	281	90	0	371	0	114	0	159	0	273	801
07:45 AM	0	23	85	0	108	0	214	104	0	318	0	180	0	147	0	327	753
Total	0	129	315	0	444	0	1019	357	0	1376	0	487	0	610	0	1097	2917
08:00 AM	0	23	89	0	112	0	237	97	1	335	0	95	0	109	0	204	651
08:15 AM	0	24	83	0	107	0	221	76	0	297	0	116	0	109	0	225	629
08:30 AM	0	29	69	1	99	0	214	74	0	288	0	79	0	107	0	186	573
08:45 AM	0	33	67	0	100	0	209	70	0	279	0	76	0	111	0	187	566
Total	0	109	308	1	418	0	881	317	1	1199	0	366	0	436	0	802	2419
Grand Total	0	335	875	1	1211	0	2830	1088	1	3919	0	1292	0	1489	0	2781	7911
Apprch %	0	27.7	72.3	0.1		0	72.2	27.8	0			46.5	0	53.5	0		
Total %	0	4.2	11.1	0	15.3	0	35.8	13.8	0	49.5	0	16.3	0	18.8	0	35.2	

	Halawa Valley Street Southbound				Ulune Street Westbound				Northbound	Ulune Street Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 07:00 AM														
07:00 AM	0	26	54	80	0	256	81	337	0	97	0	141	238	655
07:15 AM	0	23	76	99	0	268	82	350	0	96	0	**163**	259	708
07:30 AM	0	**57**	**100**	**157**	0	**281**	90	**371**	0	114	0	159	273	**801**
07:45 AM	0	23	85	108	0	214	**104**	318	0	**180**	0	147	**327**	753
Total Volume	0	129	315	444	0	1019	357	1376	0	487	0	610	1097	2917
% App. Total	0	29.1	70.9		0	74.1	25.9			44.4	0	55.6		
PHF	.000	.566	.788	.707	.000	.907	.858	.927	.000	.676	.000	.936	.839	.910

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: FS, DY
Counter: D4-3889, D4-5676
Weather: Clear

File Name : HalUlu PM
Site Code : 00000001
Start Date : 4/12/2017
Page No : 1

Groups Printed- Unshifted

	Halawa Valley Street Southbound					Ulune Street Westbound					Northbound	Ulune Street Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	0	109	114	0	223	0	176	59	0	235	0	42	0	337	0	379	837
03:15 PM	0	105	111	0	216	0	218	75	0	293	0	54	0	335	0	389	898
03:30 PM	0	182	145	0	327	0	217	57	0	274	0	37	0	289	0	326	927
03:45 PM	0	125	141	3	269	0	231	55	0	286	0	35	0	427	0	462	1017
Total	0	521	511	3	1035	0	842	246	0	1088	0	168	0	1388	0	1556	3679
04:00 PM	0	153	135	0	288	0	207	68	0	275	0	64	0	273	0	337	900
04:15 PM	0	141	96	0	237	0	200	71	0	271	0	33	0	297	0	330	838
04:30 PM	0	163	164	1	328	0	202	74	0	276	0	30	0	282	0	312	916
04:45 PM	0	116	84	0	200	0	269	74	0	343	0	47	0	327	0	374	917
Total	0	573	479	1	1053	0	878	287	0	1165	0	174	0	1179	0	1353	3571
05:00 PM	0	148	137	0	285	0	262	65	0	327	0	37	0	311	0	348	960
05:15 PM	0	134	88	0	222	0	245	76	1	322	0	48	0	276	0	324	868
05:30 PM	0	94	91	0	185	0	218	51	0	269	0	39	0	294	0	333	787
05:45 PM	0	88	78	0	166	0	273	70	1	344	0	46	0	191	0	237	747
Total	0	464	394	0	858	0	998	262	2	1262	0	170	0	1072	0	1242	3362
Grand Total	0	1558	1384	4	2946	0	2718	795	2	3515	0	512	0	3639	0	4151	10612
Apprch %	0	52.9	47	0.1		0	77.3	22.6	0.1			12.3	0	87.7	0		
Total %	0	14.7	13	0	27.8	0	25.6	7.5	0	33.1	0	4.8	0	34.3	0	39.1	

	Halawa Valley Street Southbound				Ulune Street Westbound				Northbound	Ulune Street Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 03:15 PM														
03:15 PM	0	105	111	216	0	218	**75**	**293**	0	54	0	335	389	898
03:30 PM	0	**182**	**145**	**327**	0	217	57	274	0	37	0	289	326	927
03:45 PM	0	125	141	266	0	**231**	55	286	0	35	0	**427**	**462**	**1014**
04:00 PM	0	153	135	288	0	207	68	275	0	**64**	0	273	337	900
Total Volume	0	565	532	1097	0	873	255	1128	0	190	0	1324	1514	3739
% App. Total	0	51.5	48.5		0	77.4	22.6			12.5	0	87.5		
PHF	.000	.776	.917	.839	.000	.945	.850	.962	.000	.742	.000	.775	.819	.922

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: YS
Counter: D4-5677
Weather: Clear

File Name : HalKoa AM
Site Code : 00000000
Start Date : 4/12/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Halawa Valley Street Westbound					Koaha Place Northbound					Halawa Valley Street Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	0	20	0	0	20	16	0	1	0	17	0	17	25	0	42	79
06:15 AM	0	0	3	0	0	3	19	0	3	0	22	0	12	22	0	34	59
06:30 AM	0	0	7	0	0	7	39	0	0	0	39	0	12	39	0	51	97
06:45 AM	0	0	8	0	0	8	26	0	1	0	27	0	14	38	0	52	87
Total	0	0	38	0	0	38	100	0	5	0	105	0	55	124	0	179	322
07:00 AM	0	2	5	0	0	7	20	0	1	0	21	0	9	32	0	41	69
07:15 AM	0	0	5	0	0	5	26	0	1	0	27	0	7	41	0	48	80
07:30 AM	0	0	5	0	0	5	18	0	3	0	21	0	14	20	0	34	60
07:45 AM	0	0	14	0	0	14	24	0	1	0	25	0	20	37	0	57	96
Total	0	2	29	0	0	31	88	0	6	0	94	0	50	130	0	180	305
08:00 AM	0	1	3	0	0	4	19	0	1	0	20	0	6	28	0	34	58
08:15 AM	0	1	7	0	0	8	18	0	0	0	18	0	14	25	0	39	65
08:30 AM	0	0	3	0	0	3	11	0	1	0	12	0	9	13	0	22	37
08:45 AM	0	0	3	0	0	3	22	0	1	0	23	0	9	24	0	33	59
Total	0	2	16	0	0	18	70	0	3	0	73	0	38	90	0	128	219
Grand Total	0	4	83	0	0	87	258	0	14	0	272	0	143	344	0	487	846
Apprch %		4.6	95.4	0	0		94.9	0	5.1	0		0	29.4	70.6	0		
Total %	0	0.5	9.8	0	0	10.3	30.5	0	1.7	0	32.2	0	16.9	40.7	0	57.6	

	Southbound	Halawa Valley Street Westbound				Koaha Place Northbound				Halawa Valley Street Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 06:30 AM														
06:30 AM	0	0	7	0	7	**39**	0	0	**39**	0	12	39	51	**97**
06:45 AM	0	0	**8**	0	**8**	26	0	**1**	27	0	**14**	38	**52**	87
07:00 AM	0	**2**	5	0	7	20	0	1	21	0	9	32	41	69
07:15 AM	0	0	5	0	5	26	0	1	27	0	7	**41**	48	80
Total Volume	0	2	25	0	27	111	0	3	114	0	42	150	192	333
% App. Total		7.4	92.6	0		97.4	0	2.6		0	21.9	78.1		
PHF	.000	.250	.781	.000	.844	.712	.000	.750	.731	.000	.750	.915	.923	.858

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: YS
Counter: D4-5677
Weather: Clear

File Name : HalKoa PM
Site Code : 00000000
Start Date : 4/12/2017
Page No : 1

Groups Printed- Unshifted

	Southbound	Halawa Valley Street Westbound					Koaha Place Northbound					Halawa Valley Street Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	0	0	10	0	0	10	18	0	0	0	18	0	2	10	0	12	40
03:15 PM	0	0	11	0	0	11	28	0	0	0	28	0	4	9	0	13	52
03:30 PM	0	0	11	0	0	11	20	0	0	0	20	0	1	11	0	12	43
03:45 PM	0	0	10	0	0	10	30	0	0	0	30	0	1	8	0	9	49
Total	0	0	42	0	0	42	96	0	0	0	96	0	8	38	0	46	184
04:00 PM	0	0	9	0	0	9	33	0	0	0	33	0	2	11	0	13	55
04:15 PM	0	0	2	0	0	2	23	0	0	0	23	0	0	6	0	6	31
04:30 PM	0	0	6	0	0	6	17	0	0	0	17	0	0	4	0	4	27
04:45 PM	0	0	7	0	0	7	18	0	0	0	18	0	0	7	0	7	32
Total	0	0	24	0	0	24	91	0	0	0	91	0	2	28	0	30	145
05:00 PM	0	1	14	0	0	15	41	0	0	0	41	0	2	5	0	7	63
05:15 PM	0	1	13	0	0	14	21	0	0	0	21	0	1	6	0	7	42
05:30 PM	0	0	3	0	0	3	14	0	0	0	14	0	2	0	0	2	19
05:45 PM	0	0	6	0	0	6	17	0	0	0	17	0	2	3	0	5	28
Total	0	2	36	0	0	38	93	0	0	0	93	0	7	14	0	21	152
Grand Total	0	2	102	0	0	104	280	0	0	0	280	0	17	80	0	97	481
Apprch %		1.9	98.1	0	0		100	0	0	0		0	17.5	82.5	0		
Total %	0	0.4	21.2	0	0	21.6	58.2	0	0	0	58.2	0	3.5	16.6	0	20.2	

	Southbound	Halawa Valley Street Westbound				Koaha Place Northbound				Halawa Valley Street Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 03:15 PM														
03:15 PM	0	0	**11**	0	**11**	28	0	0	28	0	**4**	9	**13**	52
03:30 PM	0	0	11	0	11	20	0	0	20	0	1	**11**	12	43
03:45 PM	0	0	10	0	10	30	0	0	30	0	1	8	9	49
04:00 PM	0	0	9	0	9	**33**	0	0	**33**	0	2	11	13	**55**
Total Volume	0	0	41	0	41	111	0	0	111	0	8	39	47	199
% App. Total		0	100	0		100	0	0		0	17	83		
PHF	.000	.000	.932	.000	.932	.841	.000	.000	.841	.000	.500	.886	.904	.905

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: GH, BE
Counter: TU-0650, D4-3890
Weather: Clear

File Name : Hallwa AM
Site Code : 00000002
Start Date : 4/12/2017
Page No : 1

Groups Printed- Unshifted

	Iwaiwa Street Southbound					Halawa Valley Street Westbound					Northbound	Halawa Valley Street Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	4	0	38	1	43	0	45	4	1	50	0	81	98	0	0	179	272
06:15 AM	1	0	23	1	25	0	43	0	0	43	0	101	109	0	0	210	278
06:30 AM	2	0	34	0	36	0	56	0	0	56	0	94	123	0	0	217	309
06:45 AM	3	0	43	1	47	0	49	1	0	50	0	97	113	0	0	210	307
Total	10	0	138	3	151	0	193	5	1	199	0	373	443	0	0	816	1166
07:00 AM	5	0	40	1	46	0	44	2	0	46	0	76	99	0	0	175	267
07:15 AM	4	0	38	0	42	0	54	4	0	58	0	85	95	0	0	180	280
07:30 AM	5	0	55	0	60	0	67	2	0	69	0	75	110	0	0	185	314
07:45 AM	5	0	55	0	60	0	47	4	0	51	0	121	134	0	0	255	366
Total	19	0	188	1	208	0	212	12	0	224	0	357	438	0	0	795	1227
08:00 AM	6	0	50	0	56	0	45	3	0	48	0	102	98	0	0	200	304
08:15 AM	2	0	64	1	67	0	43	5	0	48	0	91	90	0	0	181	296
08:30 AM	4	0	57	0	61	0	35	5	0	40	0	76	75	0	0	151	252
08:45 AM	4	0	46	0	50	0	53	6	0	59	0	64	80	0	0	144	253
Total	16	0	217	1	234	0	176	19	0	195	0	333	343	0	0	676	1105
Grand Total	45	0	543	5	593	0	581	36	1	618	0	1063	1224	0	0	2287	3498
Apprch %	7.6	0	91.6	0.8		0	94	5.8	0.2			46.5	53.5	0	0		
Total %	1.3	0	15.5	0.1	17	0	16.6	1	0	17.7	0	30.4	35	0	0	65.4	

	Iwaiwa Street Southbound				Halawa Valley Street Westbound				Northbound	Halawa Valley Street Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 07:30 AM														
07:30 AM	5	0	55	60	0	**67**	2	**69**	0	75	110	0	185	314
07:45 AM	5	0	55	60	0	47	4	51	0	**121**	**134**	0	**255**	**366**
08:00 AM	**6**	0	50	56	0	45	3	48	0	102	98	0	200	304
08:15 AM	2	0	**64**	**66**	0	43	**5**	48	0	91	90	0	181	295
Total Volume	18	0	224	242	0	202	14	216	0	389	432	0	821	1279
% App. Total	7.4	0	92.6		0	93.5	6.5			47.4	52.6	0		
PHF	.750	.000	.875	.917	.000	.754	.700	.783	.000	.804	.806	.000	.805	.874

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: GH, BE
Counter: TU-0650, D4-3890
Weather: Clear

File Name : Hallwa PM
Site Code : 00000002
Start Date : 4/12/2017
Page No : 1

Groups Printed- Unshifted

	Iwaiwa Street Southbound					Halawa Valley Street Westbound					Northbound	Halawa Valley Street Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	4	0	126	1	131	0	79	3	0	82	0	45	53	0	0	98	311
03:15 PM	3	0	85	1	89	0	111	4	0	115	0	60	65	0	0	125	329
03:30 PM	4	0	145	0	149	0	132	3	0	135	0	39	51	0	1	91	375
03:45 PM	11	0	78	5	94	0	138	1	0	139	0	51	41	0	0	92	325
Total	22	0	434	7	463	0	460	11	0	471	0	195	210	0	1	406	1340
04:00 PM	5	0	100	0	105	0	127	4	0	131	0	50	63	0	0	113	349
04:15 PM	5	0	77	0	82	0	123	6	0	129	0	51	52	0	0	103	314
04:30 PM	6	0	118	1	125	0	149	5	0	154	0	50	42	0	0	92	371
04:45 PM	4	0	66	3	73	0	102	8	0	110	0	66	42	0	0	108	291
Total	20	0	361	4	385	0	501	23	0	524	0	217	199	0	0	416	1325
05:00 PM	3	0	156	0	159	0	117	5	0	122	0	53	34	0	0	87	368
05:15 PM	3	0	60	1	64	0	96	5	0	101	0	47	53	0	0	100	265
05:30 PM	1	0	78	0	79	0	84	5	0	89	0	50	29	0	0	79	247
05:45 PM	1	0	73	0	74	0	72	1	0	73	0	53	41	0	0	94	241
Total	8	0	367	1	376	0	369	16	0	385	0	203	157	0	0	360	1121
Grand Total	50	0	1162	12	1224	0	1330	50	0	1380	0	615	566	0	1	1182	3786
Apprch %	4.1	0	94.9	1		0	96.4	3.6	0			52	47.9	0	0.1		
Total %	1.3	0	30.7	0.3	32.3	0	35.1	1.3	0	36.5	0	16.2	14.9	0	0	31.2	

	Iwaiwa Street Southbound				Halawa Valley Street Westbound				Northbound	Halawa Valley Street Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 03:15 PM														
03:15 PM	3	0	85	88	0	111	**4**	115	0	**60**	**65**	0	**125**	328
03:30 PM	4	0	**145**	**149**	0	132	3	135	0	39	51	0	90	**374**
03:45 PM	**11**	0	78	89	0	**138**	1	**139**	0	51	41	0	92	320
04:00 PM	5	0	100	105	0	127	4	131	0	50	63	0	113	349
Total Volume	23	0	408	431	0	508	12	520	0	200	220	0	420	1371
% App. Total	5.3	0	94.7		0	97.7	2.3			47.6	52.4	0		
PHF	.523	.000	.703	.723	.000	.920	.750	.935	.000	.833	.846	.000	.840	.916

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: CK, GH
Counter: D4-5673,TU-2049
Weather: Clear

File Name : KalWCCC AM
Site Code : 00000001
Start Date : 4/25/2017
Page No : 1

Groups Printed- Unshifted

	Women's Correctional Driveway Southbound					Kalanianaole Highway Westbound					Olomana School Driveway Northbound					Kalanianaole Highway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	0	3	0	3	1	424	0	0	425	0	0	0	0	0	4	69	1	0	74	502
06:15 AM	0	0	4	0	4	2	370	1	0	373	0	0	0	0	0	4	91	1	0	96	473
06:30 AM	0	0	4	0	4	2	329	0	0	331	0	0	1	0	1	4	117	3	0	124	460
06:45 AM	0	0	0	0	0	2	288	0	0	290	0	0	0	0	0	2	114	2	0	118	408
Total	0	0	11	0	11	7	1411	1	0	1419	0	0	1	0	1	14	391	7	0	412	1843
07:00 AM	1	0	0	0	1	0	312	2	0	314	0	0	0	0	0	0	151	7	0	158	473
07:15 AM	2	0	1	0	3	1	357	2	0	360	0	0	0	0	0	2	187	7	0	196	559
07:30 AM	0	0	4	0	4	6	322	1	1	330	4	0	0	0	4	1	176	10	0	187	525
07:45 AM	0	0	1	0	1	7	307	0	1	315	5	0	2	0	7	6	207	16	0	229	552
Total	3	0	6	0	9	14	1298	5	2	1319	9	0	2	0	11	9	721	40	0	770	2109
08:00 AM	0	0	3	0	3	4	275	2	3	284	4	0	2	0	6	4	191	8	0	203	496
08:15 AM	1	0	2	0	3	0	308	0	0	308	3	0	1	0	4	4	157	5	0	166	481
08:30 AM	0	0	1	0	1	3	273	0	0	276	1	0	1	0	2	5	192	2	0	199	478
08:45 AM	1	0	0	0	1	0	204	2	0	206	4	0	1	0	5	3	150	3	0	156	368
Total	2	0	6	0	8	7	1060	4	3	1074	12	0	5	0	17	16	690	18	0	724	1823
Grand Total	5	0	23	0	28	28	3769	10	5	3812	21	0	8	0	29	39	1802	65	0	1906	5775
Apprch %	17.9	0	82.1	0		0.7	98.9	0.3	0.1		72.4	0	27.6	0		2	94.5	3.4	0		
Total %	0.1	0	0.4	0	0.5	0.5	65.3	0.2	0.1	66	0.4	0	0.1	0	0.5	0.7	31.2	1.1	0	33	

	Women's Correctional Driveway Southbound				Kalanianaole Highway Westbound				Olomana School Driveway Northbound				Kalanianaole Highway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	**2**	0	1	3	1	**357**	**2**	**360**	0	0	0	0	2	187	7	196	**559**
07:30 AM	0	0	**4**	**4**	6	322	1	329	4	0	0	4	1	176	10	187	524
07:45 AM	0	0	1	1	**7**	307	0	314	**5**	0	**2**	**7**	**6**	**207**	**16**	**229**	551
08:00 AM	0	0	3	3	4	275	2	281	4	0	2	6	4	191	8	203	493
Total Volume	2	0	9	11	18	1261	5	1284	13	0	4	17	13	761	41	815	2127
% App. Total	18.2	0	81.8		1.4	98.2	0.4		76.5	0	23.5		1.6	93.4	5		
PHF	.250	.000	.563	.688	.643	.883	.625	.892	.650	.000	.500	.607	.542	.919	.641	.890	.951

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: GH
Counter: TU-2049
Weather: Clear

File Name : KalWCCC PM
Site Code : 00000001
Start Date : 4/25/2017
Page No : 1

Groups Printed- Unshifted

	Women's Correctional Driveway Southbound					Kalanianaole Highway Westbound					Olomana School Driveway Northbound					Kalanianaole Highway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	0	0	7	0	7	0	220	1	14	235	12	0	5	0	17	5	292	0	0	297	556
03:15 PM	0	0	2	0	2	1	173	0	0	174	5	0	3	0	8	1	353	1	0	355	539
03:30 PM	1	0	3	0	4	0	206	0	0	206	2	0	2	0	4	1	336	1	0	338	552
03:45 PM	1	0	2	0	3	0	233	1	0	234	8	0	0	0	8	2	338	0	0	340	585
Total	2	0	14	0	16	1	832	2	14	849	27	0	10	0	37	9	1319	2	0	1330	2232
04:00 PM	0	0	8	0	8	0	236	0	0	236	6	0	1	0	7	3	316	2	0	321	572
04:15 PM	0	0	1	0	1	0	202	1	0	203	6	0	0	0	6	1	333	0	0	334	544
04:30 PM	1	0	7	0	8	0	182	0	0	182	3	0	1	0	4	1	362	0	0	363	557
04:45 PM	0	0	0	0	0	0	216	0	0	216	0	0	0	0	0	0	339	0	0	339	555
Total	1	0	16	0	17	0	836	1	0	837	15	0	2	0	17	5	1350	2	0	1357	2228
05:00 PM	0	0	1	0	1	0	199	0	0	199	0	0	0	0	0	1	369	0	0	370	570
05:15 PM	0	0	0	0	0	0	221	0	0	221	0	0	1	0	1	0	364	0	0	364	586
05:30 PM	0	0	1	0	1	0	205	0	0	205	1	0	0	0	1	2	352	0	0	354	561
05:45 PM	0	0	0	0	0	0	200	0	0	200	1	0	0	0	1	2	337	0	0	339	540
Total	0	0	2	0	2	0	825	0	0	825	2	0	1	0	3	5	1422	0	0	1427	2257
Grand Total	3	0	32	0	35	1	2493	3	14	2511	44	0	13	0	57	19	4091	4	0	4114	6717
Apprch %	8.6	0	91.4	0		0	99.3	0.1	0.6		77.2	0	22.8	0		0.5	99.4	0.1	0		
Total %	0	0	0.5	0	0.5	0	37.1	0	0.2	37.4	0.7	0	0.2	0	0.8	0.3	60.9	0.1	0	61.2	

	Women's Correctional Driveway Southbound				Kalanianaole Highway Westbound				Olomana School Driveway Northbound				Kalanianaole Highway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:45 PM																	
04:45 PM	0	0	0	0	0	216	0	216	0	0	0	0	0	339	0	339	555
05:00 PM	0	0	**1**	**1**	0	199	0	199	0	0	0	0	1	**369**	0	**370**	570
05:15 PM	0	0	0	0	0	**221**	0	**221**	0	0	**1**	**1**	0	364	0	364	**586**
05:30 PM	0	0	1	1	0	205	0	205	**1**	0	0	1	**2**	352	0	354	561
Total Volume	0	0	2	2	0	841	0	841	1	0	1	2	3	1424	0	1427	2272
% App. Total	0	0	100		0	100	0		50	0	50		0.2	99.8	0		
PHF	.000	.000	.500	.500	.000	.951	.000	.951	.250	.000	.250	.500	.375	.965	.000	.964	.969

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: BE, YS
Counter: TU-0649, TU-2050
Weather: Clear

File Name : KalUlu AM
Site Code : 00000002
Start Date : 4/25/2017
Page No : 1

Groups Printed- Unshifted

	Ulupii Street Southbound					Kalanianaole Highway Westbound					Ulupii Street Northbound					Kalanianaole Highway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	4	1	4	0	9	2	384	2	0	388	0	2	0	0	2	4	71	3	0	78	477
06:15 AM	3	2	3	0	8	5	357	8	0	370	0	0	2	0	2	2	94	1	0	97	477
06:30 AM	2	1	3	0	6	25	381	5	0	411	1	0	1	0	2	1	117	6	0	124	543
06:45 AM	2	0	1	0	3	14	326	12	0	352	0	3	6	0	9	2	101	9	0	112	476
Total	11	4	11	0	26	46	1448	27	0	1521	1	5	9	0	15	9	383	19	0	411	1973
07:00 AM	4	3	3	0	10	14	278	3	0	295	2	6	11	0	19	3	148	10	0	161	485
07:15 AM	5	5	1	0	11	30	307	6	0	343	3	7	12	0	22	3	179	9	0	191	567
07:30 AM	5	6	1	21	33	35	306	30	0	371	9	9	16	3	37	3	167	19	0	189	630
07:45 AM	6	6	7	16	35	25	292	34	1	352	3	10	10	9	32	2	199	8	0	209	628
Total	20	20	12	37	89	104	1183	73	1	1361	17	32	49	12	110	11	693	46	0	750	2310
08:00 AM	7	2	16	0	25	9	267	23	0	299	4	4	7	0	15	1	177	3	0	181	520
08:15 AM	15	8	16	0	39	6	301	31	0	338	0	2	6	0	8	5	146	2	0	153	538
08:30 AM	4	4	3	1	12	3	277	13	0	293	1	1	2	0	4	2	172	4	0	178	487
08:45 AM	2	1	1	0	4	0	205	2	0	207	3	1	4	0	8	2	154	3	0	159	378
Total	28	15	36	1	80	18	1050	69	0	1137	8	8	19	0	35	10	649	12	0	671	1923
Grand Total	59	39	59	38	195	168	3681	169	1	4019	26	45	77	12	160	30	1725	77	0	1832	6206
Apprch %	30.3	20	30.3	19.5		4.2	91.6	4.2	0		16.2	28.1	48.1	7.5		1.6	94.2	4.2	0		
Total %	1	0.6	1	0.6	3.1	2.7	59.3	2.7	0	64.8	0.4	0.7	1.2	0.2	2.6	0.5	27.8	1.2	0	29.5	

	Ulupii Street Southbound				Kalanianaole Highway Westbound				Ulupii Street Northbound				Kalanianaole Highway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	5	5	1	11	30	**307**	6	343	3	7	12	22	**3**	179	9	191	567
07:30 AM	5	**6**	1	12	**35**	306	30	**371**	**9**	9	**16**	**34**	3	167	**19**	189	**606**
07:45 AM	6	6	7	19	25	292	**34**	351	3	**10**	10	23	2	**199**	8	**209**	602
08:00 AM	**7**	2	**16**	**25**	9	267	23	299	4	4	7	15	1	177	3	181	520
Total Volume	23	19	25	67	99	1172	93	1364	19	30	45	94	9	722	39	770	2295
% App. Total	34.3	28.4	37.3		7.3	85.9	6.8		20.2	31.9	47.9		1.2	93.8	5.1		
PHF	.821	.792	.391	.670	.707	.954	.684	.919	.528	.750	.703	.691	.750	.907	.513	.921	.947

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counted By: DY, YS
Counter: TU-0649, TU-2050
Weather: Clear

File Name : KalUlu PM
Site Code : 00000002
Start Date : 4/25/2017
Page No : 1

Groups Printed- Unshifted

	Ulupii Street Southbound					Kalanianaole Highway Westbound					Ulupii Street Northbound					Kalanianaole Highway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	12	4	4	2	22	1	194	4	0	199	8	2	6	0	16	10	292	3	1	306	543
03:15 PM	12	1	4	0	17	5	159	4	0	168	8	4	11	0	23	6	332	2	0	340	548
03:30 PM	20	0	16	1	37	5	171	13	0	189	7	4	7	0	18	5	311	9	0	325	569
03:45 PM	10	1	5	0	16	4	251	3	0	258	5	2	9	0	16	7	330	6	0	343	633
Total	54	6	29	3	92	15	775	24	0	814	28	12	33	0	73	28	1265	20	1	1314	2293
04:00 PM	21	1	2	0	24	7	207	4	0	218	6	5	7	0	18	2	306	4	0	312	572
04:15 PM	7	1	2	0	10	6	218	6	0	230	8	5	4	0	17	4	323	7	0	334	591
04:30 PM	10	0	4	0	14	8	154	8	0	170	11	3	8	0	22	4	346	11	0	361	567
04:45 PM	4	0	5	0	9	4	298	7	0	309	3	2	4	0	9	4	340	4	0	348	675
Total	42	2	13	0	57	25	877	25	0	927	28	15	23	0	66	14	1315	26	0	1355	2405
05:00 PM	14	0	6	1	21	3	194	10	0	207	4	6	6	0	16	4	357	8	0	369	613
05:15 PM	13	2	5	0	20	3	214	7	0	224	5	4	6	0	15	4	345	5	0	354	613
05:30 PM	17	0	2	1	20	12	180	5	0	197	3	2	8	0	13	7	334	4	0	345	575
05:45 PM	8	0	5	0	13	6	179	7	0	192	5	4	6	1	16	5	330	5	0	340	561
Total	52	2	18	2	74	24	767	29	0	820	17	16	26	1	60	20	1366	22	0	1408	2362
Grand Total	148	10	60	5	223	64	2419	78	0	2561	73	43	82	1	199	62	3946	68	1	4077	7060
Apprch %	66.4	4.5	26.9	2.2		2.5	94.5	3	0		36.7	21.6	41.2	0.5		1.5	96.8	1.7	0		
Total %	2.1	0.1	0.8	0.1	3.2	0.9	34.3	1.1	0	36.3	1	0.6	1.2	0	2.8	0.9	55.9	1	0	57.7	

	Ulupii Street Southbound				Kalanianaole Highway Westbound				Ulupii Street Northbound				Kalanianaole Highway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:45 PM																	
04:45 PM	4	0	5	9	4	**298**	7	**309**	3	2	4	9	4	340	4	348	**675**
05:00 PM	14	0	**6**	**20**	3	194	**10**	207	4	**6**	6	**16**	4	**357**	**8**	**369**	612
05:15 PM	13	**2**	5	20	3	214	7	224	**5**	4	6	15	4	345	5	354	613
05:30 PM	**17**	0	2	19	**12**	180	5	197	3	2	**8**	13	**7**	334	4	345	574
Total Volume	48	2	18	68	22	886	29	937	15	14	24	53	19	1376	21	1416	2474
% App. Total	70.6	2.9	26.5		2.3	94.6	3.1		28.3	26.4	45.3		1.3	97.2	1.5		
PHF	.706	.250	.750	.850	.458	.743	.725	.758	.750	.583	.750	.828	.679	.964	.656	.959	.916

APPENDIX B

LEVEL OF SERVICE DEFINITIONS

LEVEL OF SERVICE DEFINITIONS

LEVEL-OF-SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS

Level of Service (LOS) for signalized intersections is defined in terms of delay, which is a measure of driver discomfort, frustration, fuel consumption, and increased travel time. Specifically, level-of-service (LOS) criteria are stated in terms of the average control delay per vehicle, typically a 15-min analysis period. The criteria are given in the following table.

Table 1: Level-of-Service Criteria for Signalized Intersections

Level of Service	Control Delay per Vehicle (sec/veh)
A	≤10.0
B	>10.0 and ≤20.0
C	>20.0 and ≤35.0
D	>35.0 and ≤55.0
E	>55.0 and ≤80.0
F	>80.0

Delay is a complex measure and depends on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group.

Level of Service A describes operations with low control delay, up to 10 sec per vehicle. This level of service occurs when progression is extremely favorable and most vehicles arrive during the green phase. Many vehicles do not stop at all. Short cycle lengths may tend to contribute to low delay values.

Level of Service B describes operations with control delay greater than 10 and up to 20 sec per vehicle. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of delay.

Level of Service C describes operations with control delay greater than 20 and up to 35 sec per vehicle. These higher delays may result from only fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. Cycle failure occurs when a given green phase does not serve queued vehicles and overflows occur. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.

Level of Service D describes operations with control delay greater than 35 and up to 55 sec per vehicle. At level of service D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

"Highway Capacity Manual," Transportation Research Board, 2000.

Level of Service E describes operation with control delay greater than 55 and up to 80 sec per vehicle. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent.

Level of Service F describes operations with control delay in excess of 80 sec per vehicle. This level, considered to be unacceptable to most drivers, often occurs with oversaturation, that is, when arrival flow rates exceed the capacity lane groups. It may also occur at high v/c ratios with many individual cycle failures. Poor progression and long cycle lengths may also contribute significantly to high delay levels.

"Highway Capacity Manual," Transportation Research Board, 2000.

LEVEL OF SERVICE DEFINITIONS

LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS

Level of Service (LOS) criteria are given in Table 1. As used here, control delay is defined as the total elapsed time from the time a vehicle stops at the end of the queue to the time required for the vehicle to travel from the last-in-queue position to the first-in-queue position, including deceleration of vehicles from free-flow speed to the speed of vehicles in the queue.

The average total delay for any particular minor movement is a function of the service rate or capacity of the approach and the degree of saturation. If the degree of saturation is greater than about 0.9, average control delay is significantly affected by the length of the analysis period.

Table 1: Level-of-Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (Sec/Veh)
A	≤10.0
B	>10.0 and ≤15.0
C	>15.0 and ≤25.0
D	>25.0 and ≤35.0
E	>35.0 and ≤50.0
F	>50.0

"Highway Capacity Manual," Transportation Research Board, 2000.

APPENDIX C

CAPACITY ANALYSIS CALCULATIONS
EXISTING PEAK HOUR TRAFFIC ANALYSIS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	65	2011	20	10	610	65	0	1	4	38	4	11
Future Volume (vph)	65	2011	20	10	610	65	0	1	4	38	4	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00			0.97			1.00	1.00
Flpb, ped/bikes	0.99	1.00		1.00	1.00			1.00			0.98	1.00
Frt	1.00	1.00		1.00	0.99			0.89			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00			0.96	1.00
Satd. Flow (prot)	1756	5078		1770	3475			1616			1745	1583
Flt Permitted	0.39	1.00		0.08	1.00			1.00			0.74	1.00
Satd. Flow (perm)	720	5078		140	3475			1616			1355	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	66	2052	20	10	622	66	0	1	4	39	4	11
RTOR Reduction (vph)	0	0	0	0	5	0	0	4	0	0	0	10
Lane Group Flow (vph)	66	2072	0	10	683	0	0	1	0	0	43	1
Confl. Peds. (#/hr)	13					13			25	25		
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	Perm
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	68.3	68.3		68.3	68.3			10.1			10.1	10.1
Effective Green, g (s)	68.3	68.3		68.3	68.3			10.1			10.1	10.1
Actuated g/C Ratio	0.77	0.77		0.77	0.77			0.11			0.11	0.11
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	3.0
Lane Grp Cap (vph)	556	3923		108	2684			184			154	180
v/s Ratio Prot		c0.41			0.20			0.00				
v/s Ratio Perm	0.09			0.07							c0.03	0.00
v/c Ratio	0.12	0.53		0.09	0.25			0.01			0.28	0.01
Uniform Delay, d1	2.5	3.9		2.5	2.8			34.7			35.8	34.7
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Incremental Delay, d2	0.1	0.1		0.4	0.1			0.0			1.0	0.0
Delay (s)	2.6	4.0		2.8	2.9			34.7			36.8	34.7
Level of Service	A	A		A	A			C			D	C
Approach Delay (s)		3.9			2.9			34.7			36.4	
Approach LOS		A			A			C			D	

Intersection Summary			
HCM 2000 Control Delay	4.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	88.4	Sum of lost time (s)	10.0
Intersection Capacity Utilization	71.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	82	2006	2	3	1124	54	14	7	4	57	2	33
Future Volume (vph)	82	2006	2	3	1124	54	14	7	4	57	2	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	1.00
Frt	1.00	1.00		1.00	0.99			0.98			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97			0.95	1.00
Satd. Flow (prot)	1766	5084		1769	3510			1766			1755	1583
Flt Permitted	0.21	1.00		0.07	1.00			0.84			0.71	1.00
Satd. Flow (perm)	389	5084		140	3510			1531			1315	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	84	2047	2	3	1147	55	14	7	4	58	2	34
RTOR Reduction (vph)	0	0	0	0	2	0	0	3	0	0	0	29
Lane Group Flow (vph)	84	2049	0	3	1200	0	0	22	0	0	60	5
Confl. Peds. (#/hr)	9		1	1		9			14	14		
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	67.6	67.6		67.6	67.6			12.6			12.6	12.6
Effective Green, g (s)	67.6	67.6		67.6	67.6			12.6			12.6	12.6
Actuated g/C Ratio	0.75	0.75		0.75	0.75			0.14			0.14	0.14
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	3.0
Lane Grp Cap (vph)	291	3810		104	2630			213			183	221
v/s Ratio Prot		c0.40			0.34							
v/s Ratio Perm	0.22			0.02				0.01			c0.05	0.00
v/c Ratio	0.29	0.54		0.03	0.46			0.10			0.33	0.02
Uniform Delay, d1	3.6	4.7		2.9	4.3			33.9			35.0	33.5
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Incremental Delay, d2	0.6	0.1		0.1	0.1			0.2			1.1	0.0
Delay (s)	4.2	4.9		3.0	4.4			34.1			36.0	33.5
Level of Service	A	A		A	A			C			D	C
Approach Delay (s)		4.9			4.4			34.1			35.1	
Approach LOS		A			A			C			D	

Intersection Summary			
HCM 2000 Control Delay	5.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	90.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	69.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑		↰		↱	↰	↱	
Traffic Volume (vph)	0	1527	460	35	380	0	141	0	73	32	71	60
Future Volume (vph)	0	1527	460	35	380	0	141	0	73	32	71	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00		1.00	1.00	1.00	
Frpb, ped/bikes		1.00	0.93	1.00	1.00		1.00		0.97	1.00	0.99	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		0.99		1.00	0.99	1.00	
Frt		1.00	0.85	1.00	1.00		1.00		0.85	1.00	0.93	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00	0.95	1.00	
Satd. Flow (prot)		3539	1472	1764	3539		1749		1542	1744	1714	
Flt Permitted		1.00	1.00	0.10	1.00		0.63		1.00	0.95	1.00	
Satd. Flow (perm)		3539	1472	191	3539		1152		1542	1744	1714	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1624	489	37	404	0	150	0	78	34	76	64
RTOR Reduction (vph)	0	0	152	0	0	0	0	0	24	0	27	0
Lane Group Flow (vph)	0	1624	337	37	404	0	150	0	54	34	113	0
Confl. Peds. (#/hr)	50		50	50		50	15		15	15		15
Turn Type		NA	Perm	Perm	NA		Perm		Perm	Perm	NA	
Protected Phases		2			6						4	
Permitted Phases			2	6			8		8	4		
Actuated Green, G (s)		63.1	63.1	63.1	63.1		18.4		18.4	18.4	18.4	
Effective Green, g (s)		63.1	63.1	63.1	63.1		18.4		18.4	18.4	18.4	
Actuated g/C Ratio		0.69	0.69	0.69	0.69		0.20		0.20	0.20	0.20	
Clearance Time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)		2440	1015	131	2440		231		310	350	344	
v/s Ratio Prot		c0.46			0.11						0.07	
v/s Ratio Perm			0.23	0.19			c0.13		0.04	0.02		
v/c Ratio		0.67	0.33	0.28	0.17		0.65		0.17	0.10	0.33	
Uniform Delay, d1		8.1	5.7	5.5	5.0		33.6		30.3	29.8	31.3	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00	1.00	1.00	
Incremental Delay, d2		0.7	0.2	1.2	0.0		6.2		0.3	0.1	0.6	
Delay (s)		8.8	5.9	6.7	5.0		39.8		30.5	29.9	31.8	
Level of Service		A	A	A	A		D		C	C	C	
Approach Delay (s)		8.2			5.1			36.6			31.4	
Approach LOS		A			A			D			C	

Intersection Summary			
HCM 2000 Control Delay	11.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	91.5	Sum of lost time (s)	10.0
Intersection Capacity Utilization	76.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1774	361	22	973	0	311	0	199	41	27	87
Future Volume (vph)	0	1774	361	22	973	0	311	0	199	41	27	87
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00		1.00	1.00	1.00	
Frpb, ped/bikes		1.00	0.93	1.00	1.00		1.00		0.97	1.00	0.98	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		0.99		1.00	0.98	1.00	
Frt		1.00	0.85	1.00	1.00		1.00		0.85	1.00	0.89	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00	0.95	1.00	
Satd. Flow (prot)		3539	1473	1770	3539		1747		1541	1743	1616	
Flt Permitted		1.00	1.00	0.06	1.00		0.66		1.00	0.95	1.00	
Satd. Flow (perm)		3539	1473	109	3539		1222		1541	1743	1616	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1887	384	23	1035	0	331	0	212	44	29	93
RTOR Reduction (vph)	0	0	123	0	0	0	0	0	13	0	62	0
Lane Group Flow (vph)	0	1887	261	23	1035	0	331	0	199	44	60	0
Confl. Peds. (#/hr)	40		40	40		40	13		13	13		13
Turn Type		NA	Perm	Perm	NA		Perm		Perm	Perm	NA	
Protected Phases		2			6						4	
Permitted Phases			2	6			8		8	4		
Actuated Green, G (s)		68.5	68.5	68.5	68.5		34.4		34.4	34.4	34.4	
Effective Green, g (s)		68.5	68.5	68.5	68.5		34.4		34.4	34.4	34.4	
Actuated g/C Ratio		0.61	0.61	0.61	0.61		0.30		0.30	0.30	0.30	
Clearance Time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)		2147	893	66	2147		372		469	531	492	
v/s Ratio Prot		c0.53			0.29						0.04	
v/s Ratio Perm			0.18	0.21			c0.27		0.13	0.03		
v/c Ratio		0.88	0.29	0.35	0.48		0.89		0.43	0.08	0.12	
Uniform Delay, d1		18.7	10.6	11.1	12.3		37.4		31.4	28.0	28.3	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00	1.00	1.00	
Incremental Delay, d2		4.5	0.2	3.2	0.2		21.9		0.6	0.1	0.1	
Delay (s)		23.2	10.8	14.2	12.5		59.3		32.0	28.1	28.5	
Level of Service		C	B	B	B		E		C	C	C	
Approach Delay (s)		21.1			12.5			48.7			28.4	
Approach LOS		C			B			D			C	

Intersection Summary			
HCM 2000 Control Delay	22.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	112.9	Sum of lost time (s)	10.0
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	31	3485	136	0	1326	70	31	67	73	91	129	39
Future Volume (vph)	31	3485	136	0	1326	70	31	67	73	91	129	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.86			0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00			1.00		1.00	0.97		1.00	1.00	
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		0.97	1.00	
Frt	1.00	0.99			0.99		1.00	0.92		1.00	0.96	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1597	5751			3167		1597	1503		1542	1622	
Flt Permitted	0.95	1.00			1.00		0.39	1.00		0.48	1.00	
Satd. Flow (perm)	1597	5751			3167		654	1503		773	1622	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	32	3630	142	0	1381	73	32	70	76	95	134	41
RTOR Reduction (vph)	0	3	0	0	2	0	0	1	0	0	8	0
Lane Group Flow (vph)	32	3769	0	0	1452	0	32	145	0	95	167	0
Confl. Peds. (#/hr)	1					1			33	33		
Heavy Vehicles (%)	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Turn Type	Prot	NA			NA		Perm	NA		Perm	NA	
Protected Phases	5	2			6			8			4	
Permitted Phases							8			4		
Actuated Green, G (s)	4.1	112.3			103.2		20.5	20.5		20.5	20.5	
Effective Green, g (s)	4.1	112.3			103.2		20.5	20.5		20.5	20.5	
Actuated g/C Ratio	0.03	0.79			0.72		0.14	0.14		0.14	0.14	
Clearance Time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	45	4522			2288		93	215		110	232	
v/s Ratio Prot	0.02	c0.66			0.46			0.10			0.10	
v/s Ratio Perm							0.05			c0.12		
v/c Ratio	0.71	0.83			0.63		0.34	0.68		0.86	0.72	
Uniform Delay, d1	68.8	9.5			10.1		55.1	58.0		59.8	58.4	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	41.4	1.4			0.6		2.2	8.1		46.0	10.5	
Delay (s)	110.1	10.9			10.7		57.3	66.1		105.8	68.9	
Level of Service	F	B			B		E	E		F	E	
Approach Delay (s)		11.7			10.7			64.5			81.9	
Approach LOS		B			B			E			F	

Intersection Summary			
HCM 2000 Control Delay	16.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	142.8	Sum of lost time (s)	15.0
Intersection Capacity Utilization	90.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↱		↰	↑↑↱		↰	↱		↰	↱	
Traffic Volume (vph)	44	2238	62	44	2554	79	102	135	62	59	97	35
Future Volume (vph)	44	2238	62	44	2554	79	102	135	62	59	97	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.97		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		0.96	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1597	4563		1597	4570		1597	1561		1535	1614	
Flt Permitted	0.95	1.00		0.95	1.00		0.48	1.00		0.31	1.00	
Satd. Flow (perm)	1597	4563		1597	4570		814	1561		496	1614	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	45	2284	63	45	2606	81	104	138	63	60	99	36
RTOR Reduction (vph)	0	1	0	0	1	0	0	7	0	0	6	0
Lane Group Flow (vph)	45	2346	0	45	2686	0	104	194	0	60	129	0
Confl. Peds. (#/hr)			9						35	35		
Heavy Vehicles (%)	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8			4		
Actuated Green, G (s)	9.1	151.9		9.1	151.9		33.3	33.3		33.3	33.3	
Effective Green, g (s)	9.1	151.9		9.1	151.9		33.3	33.3		33.3	33.3	
Actuated g/C Ratio	0.04	0.73		0.04	0.73		0.16	0.16		0.16	0.16	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	69	3311		69	3316		129	248		78	256	
v/s Ratio Prot	c0.03	0.51		0.03	c0.59			0.12			0.08	
v/s Ratio Perm							c0.13			0.12		
v/c Ratio	0.65	0.71		0.65	0.81		0.81	0.78		0.77	0.50	
Uniform Delay, d1	98.5	16.2		98.5	19.1		84.9	84.5		84.3	80.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	20.0	0.7		20.0	1.5		29.5	14.8		35.7	1.6	
Delay (s)	118.5	16.9		118.5	20.6		114.4	99.4		120.0	82.0	
Level of Service	F	B		F	C		F	F		F	F	
Approach Delay (s)		18.8			22.3			104.5			93.7	
Approach LOS		B			C			F			F	

Intersection Summary			
HCM 2000 Control Delay	27.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	209.3	Sum of lost time (s)	15.0
Intersection Capacity Utilization	89.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	85	395	566	221	348	452
Future Volume (vph)	85	395	566	221	348	452
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1549	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	3539	1549	1770	3539
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	91	425	609	238	374	486
RTOR Reduction (vph)	0	352	0	168	0	0
Lane Group Flow (vph)	91	73	609	70	374	486
Confl. Peds. (#/hr)				1		
Turn Type	Prot	Perm	NA	Perm	Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	10.7	10.7	18.3	18.3	18.6	41.9
Effective Green, g (s)	10.7	10.7	18.3	18.3	18.6	41.9
Actuated g/C Ratio	0.17	0.17	0.29	0.29	0.30	0.67
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	302	270	1034	452	525	2368
v/s Ratio Prot	c0.05		c0.17		c0.21	0.14
v/s Ratio Perm		0.05		0.04		
v/c Ratio	0.30	0.27	0.59	0.15	0.71	0.21
Uniform Delay, d1	22.7	22.6	18.9	16.4	19.6	4.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.5	0.9	0.2	4.5	0.0
Delay (s)	23.2	23.1	19.8	16.6	24.2	4.0
Level of Service	C	C	B	B	C	A
Approach Delay (s)	23.1		18.9			12.8
Approach LOS	C		B			B

Intersection Summary			
HCM 2000 Control Delay	17.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	62.6	Sum of lost time (s)	15.0
Intersection Capacity Utilization	52.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↑	↱	↰	↑↑
Traffic Volume (vph)	144	144	436	118	427	659
Future Volume (vph)	144	144	436	118	427	659
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1549	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	3539	1549	1770	3539
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	145	145	440	119	431	666
RTOR Reduction (vph)	0	117	0	90	0	0
Lane Group Flow (vph)	145	28	440	29	431	666
Confl. Peds. (#/hr)				1		
Turn Type	Prot	Perm	NA	Perm	Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	12.8	12.8	16.3	16.3	23.3	44.6
Effective Green, g (s)	12.8	12.8	16.3	16.3	23.3	44.6
Actuated g/C Ratio	0.19	0.19	0.24	0.24	0.35	0.66
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	336	300	855	374	611	2341
v/s Ratio Prot	c0.08		c0.12		c0.24	0.19
v/s Ratio Perm		0.02		0.02		
v/c Ratio	0.43	0.09	0.51	0.08	0.71	0.28
Uniform Delay, d1	24.1	22.5	22.1	19.7	19.1	4.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	0.1	0.5	0.1	3.7	0.1
Delay (s)	25.0	22.6	22.7	19.8	22.8	4.8
Level of Service	C	C	C	B	C	A
Approach Delay (s)	23.8		22.0			11.9
Approach LOS	C		C			B

Intersection Summary			
HCM 2000 Control Delay	16.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	67.4	Sum of lost time (s)	15.0
Intersection Capacity Utilization	56.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱		↰	↑		
Traffic Volume (veh/h)	363	173	222	469	0	0
Future Volume (Veh/h)	363	173	222	469	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	386	184	236	499	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	537					
pX, platoon unblocked						
vC, conflicting volume			570		1449	478
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			570		1449	478
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			76		100	100
cM capacity (veh/h)			1002		110	587

Direction, Lane #	EB 1	WB 1	WB 2
Volume Total	570	236	499
Volume Left	0	236	0
Volume Right	184	0	0
cSH	1700	1002	1700
Volume to Capacity	0.34	0.24	0.29
Queue Length 95th (ft)	0	23	0
Control Delay (s)	0.0	9.7	0.0
Lane LOS		A	
Approach Delay (s)	0.0	3.1	
Approach LOS			

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	48.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	255	282	359	315	0	0
Future Volume (Veh/h)	255	282	359	315	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	287	317	403	354	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	537					
pX, platoon unblocked						
vC, conflicting volume			604		1606	446
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			604		1606	446
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			59		100	100
cM capacity (veh/h)			974		68	613

Direction, Lane #	EB 1	WB 1	WB 2
Volume Total	604	403	354
Volume Left	0	403	0
Volume Right	317	0	0
cSH	1700	974	1700
Volume to Capacity	0.36	0.41	0.21
Queue Length 95th (ft)	0	51	0
Control Delay (s)	0.0	11.3	0.0
Lane LOS		B	
Approach Delay (s)	0.0	6.0	
Approach LOS			

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	57.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑↑	↰	↱
Traffic Volume (veh/h)	363	0	0	488	203	304
Future Volume (Veh/h)	363	0	0	488	203	304
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	386	0	0	519	216	323
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1031					
pX, platoon unblocked						
vC, conflicting volume			386		646	386
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			386		646	386
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		47	47
cM capacity (veh/h)			1169		405	612

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	386	260	260	216	323
Volume Left	0	0	0	216	0
Volume Right	0	0	0	0	323
cSH	1700	1700	1700	405	612
Volume to Capacity	0.23	0.15	0.15	0.53	0.53
Queue Length 95th (ft)	0	0	0	76	77
Control Delay (s)	0.0	0.0	0.0	23.6	17.3
Lane LOS				C	C
Approach Delay (s)	0.0	0.0		19.8	
Approach LOS				C	

Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	48.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑↑	↰	↱
Traffic Volume (veh/h)	255	0	0	535	139	240
Future Volume (Veh/h)	255	0	0	535	139	240
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	271	0	0	569	148	255
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1031					
pX, platoon unblocked						
vC, conflicting volume			271		556	271
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			271		556	271
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		68	65
cM capacity (veh/h)			1289		461	727

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	271	284	284	148	255
Volume Left	0	0	0	148	0
Volume Right	0	0	0	0	255
cSH	1700	1700	1700	461	727
Volume to Capacity	0.16	0.17	0.17	0.32	0.35
Queue Length 95th (ft)	0	0	0	34	39
Control Delay (s)	0.0	0.0	0.0	16.4	12.6
Lane LOS				C	B
Approach Delay (s)	0.0	0.0		14.0	
Approach LOS				B	

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	57.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	51	223	156	1	79	3	126	0	2	0	0	2
Future Volume (Veh/h)	51	223	156	1	79	3	126	0	2	0	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	61	265	186	1	94	4	150	0	2	0	0	2
Pedestrians					3			1				
Lane Width (ft)					12.0			12.0				
Walking Speed (ft/s)					3.5			3.5				
Percent Blockage					0			0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	98			452			532	581	230	358	672	49
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	98			452			532	581	230	358	672	49
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			100			64	100	100	100	100	100
cM capacity (veh/h)	1493			1104			415	406	770	551	360	1009

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1
Volume Total	194	318	1	63	35	150	2	2
Volume Left	61	0	1	0	0	150	0	0
Volume Right	0	186	0	0	4	0	2	2
cSH	1493	1700	1104	1700	1700	415	770	1009
Volume to Capacity	0.04	0.19	0.00	0.04	0.02	0.36	0.00	0.00
Queue Length 95th (ft)	3	0	0	0	0	40	0	0
Control Delay (s)	2.6	0.0	8.3	0.0	0.0	18.5	9.7	8.6
Lane LOS	A		A			C	A	A
Approach Delay (s)	1.0		0.1			18.4		8.6
Approach LOS						C		A

Intersection Summary				
Average Delay	4.3			
Intersection Capacity Utilization	36.3%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	27	70	15	3	172	5	162	0	3	0	0	4
Future Volume (Veh/h)	27	70	15	3	172	5	162	0	3	0	0	4
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	31	80	17	3	198	6	186	0	3	0	0	5
Pedestrians					1							
Lane Width (ft)					12.0							
Walking Speed (ft/s)					3.5							
Percent Blockage					0							
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	204			97			260	360	50	313	366	102
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	204			97			260	360	50	313	366	102
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			100			72	100	100	100	100	99
cM capacity (veh/h)	1365			1494			655	551	1007	602	547	933

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1
Volume Total	71	57	3	132	72	186	3	5
Volume Left	31	0	3	0	0	186	0	0
Volume Right	0	17	0	0	6	0	3	5
cSH	1365	1700	1494	1700	1700	655	1007	933
Volume to Capacity	0.02	0.03	0.00	0.08	0.04	0.28	0.00	0.01
Queue Length 95th (ft)	2	0	0	0	0	29	0	0
Control Delay (s)	3.5	0.0	7.4	0.0	0.0	12.7	8.6	8.9
Lane LOS	A		A			B	A	A
Approach Delay (s)	1.9		0.1			12.6		8.9
Approach LOS						B		A

Intersection Summary			
Average Delay	5.1		
Intersection Capacity Utilization	33.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	487	0	610	0	1049	357	0	0	0	0	129	315
Future Volume (vph)	487	0	610	0	1049	357	0	0	0	0	129	315
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		4.0		5.0						5.0	5.0
Lane Util. Factor	1.00		1.00		0.91						1.00	1.00
Frt	1.00		0.85		0.96						1.00	0.85
Flt Protected	0.95		1.00		1.00						1.00	1.00
Satd. Flow (prot)	1583		1583		4750						1667	1417
Flt Permitted	0.95		1.00		1.00						1.00	1.00
Satd. Flow (perm)	1583		1583		4750						1667	1417
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	535	0	670	0	1153	392	0	0	0	0	142	346
RTOR Reduction (vph)	0	0	0	0	40	0	0	0	0	0	0	300
Lane Group Flow (vph)	535	0	670	0	1505	0	0	0	0	0	142	46
Heavy Vehicles (%)	14%	2%	2%	2%	2%	14%	2%	2%	2%	14%	14%	14%
Turn Type	Prot		Free		NA						NA	Perm
Protected Phases	5				6						4	
Permitted Phases			Free									4
Actuated Green, G (s)	49.5		132.8		50.8						17.5	17.5
Effective Green, g (s)	49.5		132.8		50.8						17.5	17.5
Actuated g/C Ratio	0.37		1.00		0.38						0.13	0.13
Clearance Time (s)	5.0				5.0						5.0	5.0
Vehicle Extension (s)	3.0				3.0						3.0	3.0
Lane Grp Cap (vph)	590		1583		1817						219	186
v/s Ratio Prot	c0.34				c0.32						c0.09	
v/s Ratio Perm			0.42									0.03
v/c Ratio	0.91		0.42		0.83						0.65	0.25
Uniform Delay, d1	39.5		0.0		37.1						54.7	51.7
Progression Factor	1.00		1.00		1.00						1.00	1.00
Incremental Delay, d2	17.6		0.8		3.3						6.5	0.7
Delay (s)	57.0		0.8		40.3						61.2	52.4
Level of Service	E		A		D						E	D
Approach Delay (s)		25.8			40.3			0.0			55.0	
Approach LOS		C			D			A			D	

Intersection Summary			
HCM 2000 Control Delay	37.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	132.8	Sum of lost time (s)	15.0
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰		↱		↑↑↱						↑	↱
Traffic Volume (vph)	190	0	1324	0	873	255	0	0	0	0	565	532
Future Volume (vph)	190	0	1324	0	873	255	0	0	0	0	565	532
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		4.0		5.0						5.0	5.0
Lane Util. Factor	1.00		1.00		0.91						1.00	1.00
Frpb, ped/bikes	1.00		1.00		0.99						1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00						1.00	1.00
Frt	1.00		0.85		0.97						1.00	0.85
Flt Protected	0.95		1.00		1.00						1.00	1.00
Satd. Flow (prot)	1583		1583		4756						1667	1417
Flt Permitted	0.95		1.00		1.00						1.00	1.00
Satd. Flow (perm)	1583		1583		4756						1667	1417
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	207	0	1439	0	949	277	0	0	0	0	614	578
RTOR Reduction (vph)	0	0	0	0	29	0	0	0	0	0	0	213
Lane Group Flow (vph)	207	0	1439	0	1197	0	0	0	0	0	614	365
Confl. Peds. (#/hr)						3						
Heavy Vehicles (%)	14%	2%	2%	2%	2%	14%	2%	2%	2%	14%	14%	14%
Turn Type	Prot		Free		NA						NA	Perm
Protected Phases	5				6						4	
Permitted Phases			Free									4
Actuated Green, G (s)	25.4		153.1		47.2						65.5	65.5
Effective Green, g (s)	25.4		153.1		47.2						65.5	65.5
Actuated g/C Ratio	0.17		1.00		0.31						0.43	0.43
Clearance Time (s)	5.0				5.0						5.0	5.0
Vehicle Extension (s)	3.0				3.0						3.0	3.0
Lane Grp Cap (vph)	262		1583		1466						713	606
v/s Ratio Prot	0.13				0.25						0.37	
v/s Ratio Perm			c0.91									0.26
v/c Ratio	0.79		0.91		0.82						0.86	0.60
Uniform Delay, d1	61.3		0.0		48.9						39.7	33.7
Progression Factor	1.00		1.00		1.00						1.00	1.00
Incremental Delay, d2	14.9		9.3		3.6						10.4	1.7
Delay (s)	76.2		9.3		52.6						50.1	35.4
Level of Service	E		A		D						D	D
Approach Delay (s)		17.7			52.6			0.0			43.0	
Approach LOS		B			D			A			D	

Intersection Summary			
HCM 2000 Control Delay	35.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	153.1	Sum of lost time (s)	15.0
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	389	432	202	14	18	224
Future Volume (vph)	389	432	202	14	18	224
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1583	1667	1650		1583	1417
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1583	1667	1650		1583	1417
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	447	497	232	16	21	257
RTOR Reduction (vph)	0	0	3	0	0	223
Lane Group Flow (vph)	447	497	245	0	21	34
Confl. Peds. (#/hr)				1		
Heavy Vehicles (%)	14%	14%	14%	14%	14%	14%
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	22.7	42.7	15.0		7.9	7.9
Effective Green, g (s)	22.7	42.7	15.0		7.9	7.9
Actuated g/C Ratio	0.37	0.70	0.25		0.13	0.13
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	592	1174	408		206	184
v/s Ratio Prot	c0.28	0.30	c0.15		0.01	
v/s Ratio Perm						c0.02
v/c Ratio	0.76	0.42	0.60		0.10	0.18
Uniform Delay, d1	16.5	3.8	20.2		23.2	23.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	5.4	0.2	2.5		0.2	0.5
Delay (s)	22.0	4.0	22.6		23.4	24.0
Level of Service	C	A	C		C	C
Approach Delay (s)		12.5	22.6		23.9	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	16.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	60.6	Sum of lost time (s)	15.0
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰	↱
Traffic Volume (vph)	200	220	508	12	23	408
Future Volume (vph)	200	220	508	12	23	408
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1583	1667	1660		1583	1417
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1583	1667	1660		1583	1417
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	220	242	558	13	25	448
RTOR Reduction (vph)	0	0	1	0	0	389
Lane Group Flow (vph)	220	242	570	0	25	59
Confl. Peds. (#/hr)				6		
Heavy Vehicles (%)	14%	14%	14%	14%	14%	14%
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	16.9	55.0	33.1		9.8	9.8
Effective Green, g (s)	16.9	55.0	33.1		9.8	9.8
Actuated g/C Ratio	0.23	0.74	0.44		0.13	0.13
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	357	1225	734		207	185
v/s Ratio Prot	c0.14	0.15	c0.34		0.02	
v/s Ratio Perm						c0.04
v/c Ratio	0.62	0.20	0.78		0.12	0.32
Uniform Delay, d1	26.0	3.1	17.7		28.7	29.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.1	0.1	5.2		0.3	1.0
Delay (s)	29.2	3.1	22.9		29.0	30.5
Level of Service	C	A	C		C	C
Approach Delay (s)		15.5	22.9		30.4	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	23.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	74.8	Sum of lost time (s)	15.0
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	290	63	1	136	23	4
Future Volume (Veh/h)	290	63	1	136	23	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	354	77	1	166	28	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			431		560	392
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			431		560	392
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			100		94	99
cM capacity (veh/h)			1067		469	631

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	431	167	33
Volume Left	0	1	28
Volume Right	77	0	5
cSH	1700	1067	488
Volume to Capacity	0.25	0.00	0.07
Queue Length 95th (ft)	0	0	5
Control Delay (s)	0.0	0.1	12.9
Lane LOS		A	B
Approach Delay (s)	0.0	0.1	12.9
Approach LOS			B

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	29.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	122	26	3	278	74	1
Future Volume (Veh/h)	122	26	3	278	74	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	134	29	3	305	81	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			163		460	148
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			163		460	148
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			100		85	100
cM capacity (veh/h)			1346		537	867

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	163	308	82
Volume Left	0	3	81
Volume Right	29	0	1
cSH	1700	1346	540
Volume to Capacity	0.10	0.00	0.15
Queue Length 95th (ft)	0	0	13
Control Delay (s)	0.0	0.1	12.9
Lane LOS		A	B
Approach Delay (s)	0.0	0.1	12.9
Approach LOS			B

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	27.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	42	150	2	25	111	3
Future Volume (Veh/h)	42	150	2	25	111	3
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	49	174	2	29	129	3
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			223		169	136
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			223		169	136
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			100		84	100
cM capacity (veh/h)			1278		793	882

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	223	31	132
Volume Left	0	2	129
Volume Right	174	0	3
cSH	1700	1278	795
Volume to Capacity	0.13	0.00	0.17
Queue Length 95th (ft)	0	0	15
Control Delay (s)	0.0	0.5	10.4
Lane LOS		A	B
Approach Delay (s)	0.0	0.5	10.4
Approach LOS			B

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	24.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	8	39	0	41	111	0
Future Volume (Veh/h)	8	39	0	41	111	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	9	43	0	45	122	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			52		76	30
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			52		76	30
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			100		86	100
cM capacity (veh/h)			1480		899	1010

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	52	45	122
Volume Left	0	0	122
Volume Right	43	0	0
cSH	1700	1480	899
Volume to Capacity	0.03	0.00	0.14
Queue Length 95th (ft)	0	0	12
Control Delay (s)	0.0	0.0	9.6
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.6
Approach LOS			A

Intersection Summary			
Average Delay	5.4		
Intersection Capacity Utilization	16.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	487	0	610	0	1049	357	0	0	0	0	129	315
Future Volume (vph)	487	0	610	0	1049	357	0	0	0	0	129	315
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		4.0		5.0						5.0	5.0
Lane Util. Factor	1.00		1.00		0.91						1.00	1.00
Frt	1.00		0.85		0.96						1.00	0.85
Flt Protected	0.95		1.00		1.00						1.00	1.00
Satd. Flow (prot)	1583		1583		4750						1667	1417
Flt Permitted	0.95		1.00		1.00						1.00	1.00
Satd. Flow (perm)	1583		1583		4750						1667	1417
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	535	0	670	0	1153	392	0	0	0	0	142	346
RTOR Reduction (vph)	0	0	0	0	40	0	0	0	0	0	0	300
Lane Group Flow (vph)	535	0	670	0	1505	0	0	0	0	0	142	46
Heavy Vehicles (%)	14%	2%	2%	2%	2%	14%	2%	2%	2%	14%	14%	14%
Turn Type	Prot		Free		NA						NA	Perm
Protected Phases	5				6						4	
Permitted Phases			Free									4
Actuated Green, G (s)	49.5		132.8		50.8						17.5	17.5
Effective Green, g (s)	49.5		132.8		50.8						17.5	17.5
Actuated g/C Ratio	0.37		1.00		0.38						0.13	0.13
Clearance Time (s)	5.0				5.0						5.0	5.0
Vehicle Extension (s)	3.0				3.0						3.0	3.0
Lane Grp Cap (vph)	590		1583		1817						219	186
v/s Ratio Prot	c0.34				c0.32						c0.09	
v/s Ratio Perm			0.42									0.03
v/c Ratio	0.91		0.42		0.83						0.65	0.25
Uniform Delay, d1	39.5		0.0		37.1						54.7	51.7
Progression Factor	1.00		1.00		1.00						1.00	1.00
Incremental Delay, d2	17.6		0.8		3.3						6.5	0.7
Delay (s)	57.0		0.8		40.3						61.2	52.4
Level of Service	E		A		D						E	D
Approach Delay (s)		25.8			40.3			0.0			55.0	
Approach LOS		C			D			A			D	

Intersection Summary			
HCM 2000 Control Delay	37.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	132.8	Sum of lost time (s)	15.0
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰		↱		↑↑↱						↑	↱
Traffic Volume (vph)	190	0	1324	0	873	255	0	0	0	0	565	532
Future Volume (vph)	190	0	1324	0	873	255	0	0	0	0	565	532
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		4.0		5.0						5.0	5.0
Lane Util. Factor	1.00		1.00		0.91						1.00	1.00
Frpb, ped/bikes	1.00		1.00		0.99						1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00						1.00	1.00
Frt	1.00		0.85		0.97						1.00	0.85
Flt Protected	0.95		1.00		1.00						1.00	1.00
Satd. Flow (prot)	1583		1583		4756						1667	1417
Flt Permitted	0.95		1.00		1.00						1.00	1.00
Satd. Flow (perm)	1583		1583		4756						1667	1417
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	207	0	1439	0	949	277	0	0	0	0	614	578
RTOR Reduction (vph)	0	0	0	0	29	0	0	0	0	0	0	213
Lane Group Flow (vph)	207	0	1439	0	1197	0	0	0	0	0	614	365
Confl. Peds. (#/hr)						3						
Heavy Vehicles (%)	14%	2%	2%	2%	2%	14%	2%	2%	2%	14%	14%	14%
Turn Type	Prot		Free		NA						NA	Perm
Protected Phases	5				6						4	
Permitted Phases			Free									4
Actuated Green, G (s)	25.4		153.1		47.2						65.5	65.5
Effective Green, g (s)	25.4		153.1		47.2						65.5	65.5
Actuated g/C Ratio	0.17		1.00		0.31						0.43	0.43
Clearance Time (s)	5.0				5.0						5.0	5.0
Vehicle Extension (s)	3.0				3.0						3.0	3.0
Lane Grp Cap (vph)	262		1583		1466						713	606
v/s Ratio Prot	0.13				0.25						0.37	
v/s Ratio Perm			c0.91									0.26
v/c Ratio	0.79		0.91		0.82						0.86	0.60
Uniform Delay, d1	61.3		0.0		48.9						39.7	33.7
Progression Factor	1.00		1.00		1.00						1.00	1.00
Incremental Delay, d2	14.9		9.3		3.6						10.4	1.7
Delay (s)	76.2		9.3		52.6						50.1	35.4
Level of Service	E		A		D						D	D
Approach Delay (s)		17.7			52.6			0.0			43.0	
Approach LOS		B			D			A			D	

Intersection Summary			
HCM 2000 Control Delay	35.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	153.1	Sum of lost time (s)	15.0
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	389	432	202	14	18	224
Future Volume (vph)	389	432	202	14	18	224
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1583	1667	1650		1583	1417
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1583	1667	1650		1583	1417
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	447	497	232	16	21	257
RTOR Reduction (vph)	0	0	3	0	0	223
Lane Group Flow (vph)	447	497	245	0	21	34
Confl. Peds. (#/hr)				1		
Heavy Vehicles (%)	14%	14%	14%	14%	14%	14%
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	22.7	42.7	15.0		7.9	7.9
Effective Green, g (s)	22.7	42.7	15.0		7.9	7.9
Actuated g/C Ratio	0.37	0.70	0.25		0.13	0.13
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	592	1174	408		206	184
v/s Ratio Prot	c0.28	0.30	c0.15		0.01	
v/s Ratio Perm						c0.02
v/c Ratio	0.76	0.42	0.60		0.10	0.18
Uniform Delay, d1	16.5	3.8	20.2		23.2	23.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	5.4	0.2	2.5		0.2	0.5
Delay (s)	22.0	4.0	22.6		23.4	24.0
Level of Service	C	A	C		C	C
Approach Delay (s)		12.5	22.6		23.9	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	16.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	60.6	Sum of lost time (s)	15.0
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	200	220	508	12	23	408
Future Volume (vph)	200	220	508	12	23	408
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1583	1667	1660		1583	1417
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1583	1667	1660		1583	1417
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	220	242	558	13	25	448
RTOR Reduction (vph)	0	0	1	0	0	389
Lane Group Flow (vph)	220	242	570	0	25	59
Confl. Peds. (#/hr)				6		
Heavy Vehicles (%)	14%	14%	14%	14%	14%	14%
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	16.9	55.0	33.1		9.8	9.8
Effective Green, g (s)	16.9	55.0	33.1		9.8	9.8
Actuated g/C Ratio	0.23	0.74	0.44		0.13	0.13
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	357	1225	734		207	185
v/s Ratio Prot	c0.14	0.15	c0.34		0.02	
v/s Ratio Perm						c0.04
v/c Ratio	0.62	0.20	0.78		0.12	0.32
Uniform Delay, d1	26.0	3.1	17.7		28.7	29.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.1	0.1	5.2		0.3	1.0
Delay (s)	29.2	3.1	22.9		29.0	30.5
Level of Service	C	A	C		C	C
Approach Delay (s)		15.5	22.9		30.4	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	23.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	74.8	Sum of lost time (s)	15.0
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	722	39	99	1172	93	19	30	45	23	19	25
Future Volume (Veh/h)	9	722	39	99	1172	93	19	30	45	23	19	25
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	9	760	41	104	1234	98	20	32	47	24	20	26
Pedestrians					1			12				
Lane Width (ft)					12.0			12.0				
Walking Speed (ft/s)					3.5			3.5				
Percent Blockage					0			1				
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1332			813			1672	2350	414	1953	2322	666
vC1, stage 1 conf vol							810	810		1491	1491	
vC2, stage 2 conf vol							861	1540		462	831	
vCu, unblocked vol	1332			813			1672	2350	414	1953	2322	666
tC, single (s)	4.1			4.1			*6.5	*5.5	*5.9	*6.5	*5.5	*5.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			87			92	84	93	85	90	95
cM capacity (veh/h)	514			800			247	206	654	160	208	487

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	9	507	294	104	823	509	99	70
Volume Left	9	0	0	104	0	0	20	24
Volume Right	0	0	41	0	0	98	47	26
cSH	514	1700	1700	800	1700	1700	322	234
Volume to Capacity	0.02	0.30	0.17	0.13	0.48	0.30	0.31	0.30
Queue Length 95th (ft)	1	0	0	11	0	0	32	30
Control Delay (s)	12.1	0.0	0.0	10.2	0.0	0.0	21.1	26.8
Lane LOS	B			B			C	D
Approach Delay (s)	0.1			0.7			21.1	26.8
Approach LOS							C	D

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	55.1%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	19	1376	21	22	886	29	15	14	24	48	2	18
Future Volume (Veh/h)	19	1376	21	22	886	29	15	14	24	48	2	18
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	21	1496	23	24	963	32	16	15	26	52	2	20
Pedestrians											1	
Lane Width (ft)											12.0	
Walking Speed (ft/s)											3.5	
Percent Blockage											0	
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	996			1519			2100	2594	760	1852	2589	498
vC1, stage 1 conf vol							1550	1550		1028	1028	
vC2, stage 2 conf vol							550	1044		824	1561	
vCu, unblocked vol	996			1519			2100	2594	760	1852	2589	498
tC, single (s)	4.1			4.1			*6.5	*5.5	*5.9	*6.5	*5.5	*5.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			94			90	93	94	78	99	97
cM capacity (veh/h)	690			435			168	212	434	235	201	597

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	21	997	522	24	642	353	57	74
Volume Left	21	0	0	24	0	0	16	52
Volume Right	0	0	23	0	0	32	26	20
cSH	690	1700	1700	435	1700	1700	252	279
Volume to Capacity	0.03	0.59	0.31	0.06	0.38	0.21	0.23	0.26
Queue Length 95th (ft)	2	0	0	4	0	0	21	26
Control Delay (s)	10.4	0.0	0.0	13.7	0.0	0.0	23.4	22.5
Lane LOS	B			B			C	C
Approach Delay (s)	0.1			0.3			23.4	22.5
Approach LOS							C	C

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	53.9%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑↱			✣			✣	
Traffic Volume (veh/h)	13	761	41	18	1261	5	13	0	4	2	0	9
Future Volume (Veh/h)	13	761	41	18	1261	5	13	0	4	2	0	9
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	14	801	43	19	1327	5	14	0	4	2	0	9
Pedestrians					5							
Lane Width (ft)					12.0							
Walking Speed (ft/s)					3.5							
Percent Blockage					0							
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1332			801			1540	2199	406	1805	2196	666
vC1, stage 1 conf vol							829	829		1368	1368	
vC2, stage 2 conf vol							710	1370		438	829	
vCu, unblocked vol	1332			801			1540	2199	406	1805	2196	666
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	*6.5	6.5	*5.9
tC, 2 stage (s)							5.5	5.5		5.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			98			96	100	99	99	100	98
cM capacity (veh/h)	514			818			315	170	666	211	178	487

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	14	400	400	43	19	885	447	18	11
Volume Left	14	0	0	0	19	0	0	14	2
Volume Right	0	0	0	43	0	0	5	4	9
cSH	514	1700	1700	1700	818	1700	1700	357	393
Volume to Capacity	0.03	0.24	0.24	0.03	0.02	0.52	0.26	0.05	0.03
Queue Length 95th (ft)	2	0	0	0	2	0	0	4	2
Control Delay (s)	12.2	0.0	0.0	0.0	9.5	0.0	0.0	15.6	14.4
Lane LOS	B				A			C	B
Approach Delay (s)	0.2				0.1			15.6	14.4
Approach LOS								C	B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	46.6%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	1424	0	0	841	0	1	0	1	0	0	2
Future Volume (Veh/h)	3	1424	0	0	841	0	1	0	1	0	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	3	1468	0	0	867	0	1	0	1	0	0	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	867			1468			1910	2341	734	1608	2341	434
vC1, stage 1 conf vol							1474	1474		867	867	
vC2, stage 2 conf vol							436	867		741	1474	
vCu, unblocked vol	867			1468			1910	2341	734	1608	2341	434
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	7.5	6.5	*5.9
tC, 2 stage (s)							5.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			99	100	100	100	100	100
cM capacity (veh/h)	772			456			192	165	448	243	165	646

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	3	734	734	0	0	578	289	2	2
Volume Left	3	0	0	0	0	0	0	1	0
Volume Right	0	0	0	0	0	0	0	1	2
cSH	772	1700	1700	1700	1700	1700	1700	269	646
Volume to Capacity	0.00	0.43	0.43	0.00	0.00	0.34	0.17	0.01	0.00
Queue Length 95th (ft)	0	0	0	0	0	0	0	1	0
Control Delay (s)	9.7	0.0	0.0	0.0	0.0	0.0	0.0	18.5	10.6
Lane LOS	A							C	B
Approach Delay (s)	0.0				0.0			18.5	10.6
Approach LOS								C	B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	49.4%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

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APPENDIX D

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2023 PEAK HOUR TRAFFIC
ANALYSIS WITHOUT ALTERNATIVE 1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	67	2072	21	10	629	67	0	1	4	39	4	11
Future Volume (vph)	67	2072	21	10	629	67	0	1	4	39	4	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00			0.97			1.00	1.00
Flpb, ped/bikes	0.99	1.00		1.00	1.00			1.00			0.98	1.00
Frt	1.00	1.00		1.00	0.99			0.89			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00			0.96	1.00
Satd. Flow (prot)	1756	5078		1770	3475			1615			1744	1583
Flt Permitted	0.38	1.00		0.07	1.00			1.00			0.74	1.00
Satd. Flow (perm)	702	5078		129	3475			1615			1353	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	68	2114	21	10	642	68	0	1	4	40	4	11
RTOR Reduction (vph)	0	0	0	0	4	0	0	4	0	0	0	10
Lane Group Flow (vph)	68	2135	0	10	706	0	0	1	0	0	44	1
Confl. Peds. (#/hr)	13					13			25	25		
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	Perm
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	70.5	70.5		70.5	70.5			10.3			10.3	10.3
Effective Green, g (s)	70.5	70.5		70.5	70.5			10.3			10.3	10.3
Actuated g/C Ratio	0.78	0.78		0.78	0.78			0.11			0.11	0.11
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	3.0
Lane Grp Cap (vph)	545	3942		100	2698			183			153	179
v/s Ratio Prot		c0.42			0.20			0.00				
v/s Ratio Perm	0.10			0.08							c0.03	0.00
v/c Ratio	0.12	0.54		0.10	0.26			0.01			0.29	0.01
Uniform Delay, d1	2.5	3.9		2.5	2.8			35.7			36.9	35.7
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Incremental Delay, d2	0.1	0.2		0.4	0.1			0.0			1.0	0.0
Delay (s)	2.6	4.1		2.9	2.9			35.7			37.9	35.7
Level of Service	A	A		A	A			D			D	D
Approach Delay (s)		4.0			2.9			35.7			37.5	
Approach LOS		A			A			D			D	

Intersection Summary			
HCM 2000 Control Delay	4.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	90.8	Sum of lost time (s)	10.0
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	84	2067	2	3	1158	56	14	7	4	59	2	34
Future Volume (vph)	84	2067	2	3	1158	56	14	7	4	59	2	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	1.00
Frt	1.00	1.00		1.00	0.99			0.98			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97			0.95	1.00
Satd. Flow (prot)	1766	5084		1769	3509			1766			1755	1583
Flt Permitted	0.20	1.00		0.07	1.00			0.84			0.71	1.00
Satd. Flow (perm)	371	5084		129	3509			1530			1315	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	86	2109	2	3	1182	57	14	7	4	60	2	35
RTOR Reduction (vph)	0	0	0	0	2	0	0	3	0	0	0	30
Lane Group Flow (vph)	86	2111	0	3	1237	0	0	22	0	0	62	5
Confl. Peds. (#/hr)	9		1	1		9			14	14		
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	69.3	69.3		69.3	69.3			12.8			12.8	12.8
Effective Green, g (s)	69.3	69.3		69.3	69.3			12.8			12.8	12.8
Actuated g/C Ratio	0.75	0.75		0.75	0.75			0.14			0.14	0.14
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	3.0
Lane Grp Cap (vph)	279	3825		97	2640			212			182	220
v/s Ratio Prot		c0.42			0.35							
v/s Ratio Perm	0.23			0.02				0.01			c0.05	0.00
v/c Ratio	0.31	0.55		0.03	0.47			0.10			0.34	0.02
Uniform Delay, d1	3.7	4.8		2.9	4.4			34.6			35.8	34.2
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Incremental Delay, d2	0.6	0.2		0.1	0.1			0.2			1.1	0.0
Delay (s)	4.3	5.0		3.0	4.5			34.8			37.0	34.3
Level of Service	A	A		A	A			C			D	C
Approach Delay (s)		5.0			4.5			34.8			36.0	
Approach LOS		A			A			C			D	

Intersection Summary			
HCM 2000 Control Delay	5.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	92.1	Sum of lost time (s)	10.0
Intersection Capacity Utilization	70.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑		↰		↱	↰	↱	
Traffic Volume (vph)	0	1573	474	36	392	0	145	0	75	33	73	62
Future Volume (vph)	0	1573	474	36	392	0	145	0	75	33	73	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00		1.00	1.00	1.00	
Frpb, ped/bikes		1.00	0.93	1.00	1.00		1.00		0.97	1.00	0.99	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		0.99		1.00	0.99	1.00	
Frt		1.00	0.85	1.00	1.00		1.00		0.85	1.00	0.93	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00	0.95	1.00	
Satd. Flow (prot)		3539	1468	1770	3539		1749		1541	1743	1714	
Flt Permitted		1.00	1.00	0.09	1.00		0.61		1.00	0.95	1.00	
Satd. Flow (perm)		3539	1468	176	3539		1124		1541	1743	1714	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1673	504	38	417	0	154	0	80	35	78	66
RTOR Reduction (vph)	0	0	155	0	0	0	0	0	22	0	27	0
Lane Group Flow (vph)	0	1673	349	38	417	0	154	0	58	35	117	0
Confl. Peds. (#/hr)	50		50	50		50	15		15	15		15
Turn Type		NA	Perm	Perm	NA		Perm		Perm	Perm	NA	
Protected Phases		2			6						4	
Permitted Phases			2	6			8		8	4		
Actuated Green, G (s)		65.8	65.8	65.8	65.8		19.3		19.3	19.3	19.3	
Effective Green, g (s)		65.8	65.8	65.8	65.8		19.3		19.3	19.3	19.3	
Actuated g/C Ratio		0.69	0.69	0.69	0.69		0.20		0.20	0.20	0.20	
Clearance Time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)		2448	1015	121	2448		228		312	353	347	
v/s Ratio Prot		c0.47			0.12						0.07	
v/s Ratio Perm			0.24	0.22			c0.14		0.04	0.02		
v/c Ratio		0.68	0.34	0.31	0.17		0.68		0.18	0.10	0.34	
Uniform Delay, d1		8.6	5.9	5.8	5.1		35.0		31.4	30.8	32.4	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00	1.00	1.00	
Incremental Delay, d2		0.8	0.2	1.5	0.0		7.7		0.3	0.1	0.6	
Delay (s)		9.4	6.1	7.3	5.1		42.7		31.7	31.0	33.0	
Level of Service		A	A	A	A		D		C	C	C	
Approach Delay (s)		8.6			5.3			38.9			32.6	
Approach LOS		A			A			D			C	

Intersection Summary			
HCM 2000 Control Delay	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	95.1	Sum of lost time (s)	10.0
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑		↰		↱	↰	↱	
Traffic Volume (vph)	0	1828	372	23	1003	0	320	0	205	42	28	90
Future Volume (vph)	0	1828	372	23	1003	0	320	0	205	42	28	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00		1.00	1.00	1.00	
Frpb, ped/bikes		1.00	0.93	1.00	1.00		1.00		0.97	1.00	0.98	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		0.99		1.00	0.98	1.00	
Frt		1.00	0.85	1.00	1.00		1.00		0.85	1.00	0.89	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00	0.95	1.00	
Satd. Flow (prot)		3539	1470	1770	3539		1747		1540	1742	1616	
Flt Permitted		1.00	1.00	0.06	1.00		0.66		1.00	0.95	1.00	
Satd. Flow (perm)		3539	1470	105	3539		1206		1540	1742	1616	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1945	396	24	1067	0	340	0	218	45	30	96
RTOR Reduction (vph)	0	0	125	0	0	0	0	0	13	0	60	0
Lane Group Flow (vph)	0	1945	271	24	1067	0	340	0	205	45	66	0
Confl. Peds. (#/hr)	40		40	40		40	13		13	13		13
Turn Type		NA	Perm	Perm	NA		Perm		Perm	Perm	NA	
Protected Phases		2			6						4	
Permitted Phases			2	6			8		8	4		
Actuated Green, G (s)		70.7	70.7	70.7	70.7		35.4		35.4	35.4	35.4	
Effective Green, g (s)		70.7	70.7	70.7	70.7		35.4		35.4	35.4	35.4	
Actuated g/C Ratio		0.61	0.61	0.61	0.61		0.30		0.30	0.30	0.30	
Clearance Time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)		2155	895	63	2155		367		469	531	492	
v/s Ratio Prot		c0.55			0.30						0.04	
v/s Ratio Perm			0.18	0.23			c0.28		0.13	0.03		
v/c Ratio		0.90	0.30	0.38	0.50		0.93		0.44	0.08	0.13	
Uniform Delay, d1		19.7	10.9	11.6	12.7		39.1		32.4	28.8	29.2	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00	1.00	1.00	
Incremental Delay, d2		5.7	0.2	3.8	0.2		28.8		0.7	0.1	0.1	
Delay (s)		25.5	11.1	15.4	12.9		67.9		33.0	28.9	29.4	
Level of Service		C	B	B	B		E		C	C	C	
Approach Delay (s)		23.0			12.9			54.3			29.2	
Approach LOS		C			B			D			C	

Intersection Summary			
HCM 2000 Control Delay	24.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	116.1	Sum of lost time (s)	10.0
Intersection Capacity Utilization	84.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑↑↱			↑↱		↰	↱		↰	↱	
Traffic Volume (vph)	32	3591	140	0	1366	72	32	69	75	94	133	40
Future Volume (vph)	32	3591	140	0	1366	72	32	69	75	94	133	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.86			0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00			1.00		1.00	0.97		1.00	1.00	
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		0.97	1.00	
Frt	1.00	0.99			0.99		1.00	0.92		1.00	0.97	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1597	5751			3167		1597	1503		1542	1623	
Flt Permitted	0.95	1.00			1.00		0.38	1.00		0.47	1.00	
Satd. Flow (perm)	1597	5751			3167		635	1503		761	1623	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	33	3741	146	0	1423	75	33	72	78	98	139	42
RTOR Reduction (vph)	0	3	0	0	2	0	0	1	0	0	8	0
Lane Group Flow (vph)	33	3884	0	0	1496	0	33	149	0	98	173	0
Confl. Peds. (#/hr)	1					1			33	33		
Heavy Vehicles (%)	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Turn Type	Prot	NA			NA		Perm	NA		Perm	NA	
Protected Phases	5	2			6			8			4	
Permitted Phases							8			4		
Actuated Green, G (s)	4.1	112.3			103.2		21.0	21.0		21.0	21.0	
Effective Green, g (s)	4.1	112.3			103.2		21.0	21.0		21.0	21.0	
Actuated g/C Ratio	0.03	0.78			0.72		0.15	0.15		0.15	0.15	
Clearance Time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	45	4506			2280		93	220		111	237	
v/s Ratio Prot	0.02	c0.68			0.47			0.10			0.11	
v/s Ratio Perm							0.05			c0.13		
v/c Ratio	0.73	0.86			0.66		0.35	0.68		0.88	0.73	
Uniform Delay, d1	69.1	10.3			10.6		55.1	57.9		59.9	58.5	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	46.2	1.9			0.7		2.3	8.0		50.5	11.0	
Delay (s)	115.3	12.2			11.3		57.4	66.0		110.4	69.5	
Level of Service	F	B			B		E	E		F	E	
Approach Delay (s)		13.1			11.3			64.4			83.9	
Approach LOS		B			B			E			F	

Intersection Summary			
HCM 2000 Control Delay	17.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	143.3	Sum of lost time (s)	15.0
Intersection Capacity Utilization	92.0%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	45	2306	64	45	2632	81	105	139	64	61	100	36
Future Volume (vph)	45	2306	64	45	2632	81	105	139	64	61	100	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.97		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		0.96	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1597	4563		1597	4570		1597	1560		1536	1614	
Flt Permitted	0.95	1.00		0.95	1.00		0.47	1.00		0.29	1.00	
Satd. Flow (perm)	1597	4563		1597	4570		791	1560		466	1614	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	46	2353	65	46	2686	83	107	142	65	62	102	37
RTOR Reduction (vph)	0	1	0	0	1	0	0	8	0	0	6	0
Lane Group Flow (vph)	46	2417	0	46	2768	0	107	199	0	62	133	0
Confl. Peds. (#/hr)			9						35	35		
Heavy Vehicles (%)	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8			4		
Actuated Green, G (s)	9.2	155.8		9.2	155.8		34.0	34.0		34.0	34.0	
Effective Green, g (s)	9.2	155.8		9.2	155.8		34.0	34.0		34.0	34.0	
Actuated g/C Ratio	0.04	0.73		0.04	0.73		0.16	0.16		0.16	0.16	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	68	3322		68	3327		125	247		74	256	
v/s Ratio Prot	c0.03	0.53		0.03	c0.61			0.13			0.08	
v/s Ratio Perm							c0.14			0.13		
v/c Ratio	0.68	0.73		0.68	0.83		0.86	0.81		0.84	0.52	
Uniform Delay, d1	100.9	16.8		100.9	20.1		87.6	86.8		87.3	82.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	23.5	0.8		23.5	1.9		40.2	17.3		53.0	1.8	
Delay (s)	124.4	17.6		124.4	22.0		127.8	104.2		140.3	84.3	
Level of Service	F	B		F	C		F	F		F	F	
Approach Delay (s)		19.6			23.6			112.2			101.6	
Approach LOS		B			C			F			F	

Intersection Summary			
HCM 2000 Control Delay	29.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	214.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	90.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

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APPENDIX E

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2023 PEAK HOUR TRAFFIC
ANALYSIS WITH ALTERNATIVE 1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	67	2072	30	14	629	67	1	1	8	39	4	11
Future Volume (vph)	67	2072	30	14	629	67	1	1	8	39	4	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00			0.97			1.00	1.00
Flpb, ped/bikes	0.99	1.00		1.00	1.00			1.00			0.98	1.00
Frt	1.00	1.00		1.00	0.99			0.89			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00			0.96	1.00
Satd. Flow (prot)	1756	5074		1770	3475			1607			1744	1583
Flt Permitted	0.38	1.00		0.07	1.00			0.98			0.74	1.00
Satd. Flow (perm)	702	5074		128	3475			1576			1346	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	68	2114	31	14	642	68	1	1	8	40	4	11
RTOR Reduction (vph)	0	1	0	0	4	0	0	7	0	0	0	10
Lane Group Flow (vph)	68	2144	0	14	706	0	0	3	0	0	44	1
Confl. Peds. (#/hr)	13					13			25	25		
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	70.6	70.6		70.6	70.6			10.3			10.3	10.3
Effective Green, g (s)	70.6	70.6		70.6	70.6			10.3			10.3	10.3
Actuated g/C Ratio	0.78	0.78		0.78	0.78			0.11			0.11	0.11
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	3.0
Lane Grp Cap (vph)	545	3940		99	2698			178			152	179
v/s Ratio Prot		c0.42			0.20							
v/s Ratio Perm	0.10			0.11				0.00			c0.03	0.00
v/c Ratio	0.12	0.54		0.14	0.26			0.02			0.29	0.01
Uniform Delay, d1	2.5	3.9		2.5	2.8			35.8			36.9	35.8
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Incremental Delay, d2	0.1	0.2		0.7	0.1			0.0			1.1	0.0
Delay (s)	2.6	4.1		3.2	2.9			35.8			38.0	35.8
Level of Service	A	A		A	A			D			D	D
Approach Delay (s)		4.0			2.9			35.8			37.6	
Approach LOS		A			A			D			D	

Intersection Summary			
HCM 2000 Control Delay	4.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	90.9	Sum of lost time (s)	10.0
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	84	2067	3	3	1158	56	27	7	13	59	2	34
Future Volume (vph)	84	2067	3	3	1158	56	27	7	13	59	2	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00			0.99			1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	1.00
Frt	1.00	1.00		1.00	0.99			0.96			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.97			0.95	1.00
Satd. Flow (prot)	1766	5084		1769	3509			1732			1755	1583
Flt Permitted	0.20	1.00		0.07	1.00			0.81			0.70	1.00
Satd. Flow (perm)	371	5084		129	3509			1441			1284	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	86	2109	3	3	1182	57	28	7	13	60	2	35
RTOR Reduction (vph)	0	0	0	0	2	0	0	11	0	0	0	30
Lane Group Flow (vph)	86	2112	0	3	1237	0	0	37	0	0	62	5
Confl. Peds. (#/hr)	9		1	1		9			14	14		
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	68.7	68.7		68.7	68.7			12.8			12.8	12.8
Effective Green, g (s)	68.7	68.7		68.7	68.7			12.8			12.8	12.8
Actuated g/C Ratio	0.75	0.75		0.75	0.75			0.14			0.14	0.14
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	3.0
Lane Grp Cap (vph)	278	3817		96	2634			201			179	221
v/s Ratio Prot		c0.42			0.35							
v/s Ratio Perm	0.23			0.02				0.03			c0.05	0.00
v/c Ratio	0.31	0.55		0.03	0.47			0.18			0.35	0.02
Uniform Delay, d1	3.7	4.9		2.9	4.4			34.7			35.6	34.0
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Incremental Delay, d2	0.6	0.2		0.1	0.1			0.4			1.2	0.0
Delay (s)	4.3	5.0		3.0	4.5			35.2			36.7	34.0
Level of Service	A	A		A	A			D			D	C
Approach Delay (s)		5.0			4.5			35.2			35.7	
Approach LOS		A			A			D			D	

Intersection Summary			
HCM 2000 Control Delay	6.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	91.5	Sum of lost time (s)	10.0
Intersection Capacity Utilization	71.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑		↰		↱	↰	↳	
Traffic Volume (vph)	0	1576	475	36	395	0	146	0	75	33	73	62
Future Volume (vph)	0	1576	475	36	395	0	146	0	75	33	73	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00		1.00	1.00	1.00	
Frpb, ped/bikes		1.00	0.93	1.00	1.00		1.00		0.97	1.00	0.99	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		0.99		1.00	0.99	1.00	
Frt		1.00	0.85	1.00	1.00		1.00		0.85	1.00	0.93	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00	0.95	1.00	
Satd. Flow (prot)		3539	1468	1770	3539		1749		1541	1743	1714	
Flt Permitted		1.00	1.00	0.09	1.00		0.61		1.00	0.95	1.00	
Satd. Flow (perm)		3539	1468	175	3539		1122		1541	1743	1714	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1677	505	38	420	0	155	0	80	35	78	66
RTOR Reduction (vph)	0	0	155	0	0	0	0	0	22	0	27	0
Lane Group Flow (vph)	0	1677	350	38	420	0	155	0	58	35	117	0
Confl. Peds. (#/hr)	50		50	50		50	15		15	15		15
Turn Type		NA	Perm	Perm	NA		Perm		Perm	Perm	NA	
Protected Phases		2			6						4	
Permitted Phases			2	6			8		8	4		
Actuated Green, G (s)		66.1	66.1	66.1	66.1		19.4		19.4	19.4	19.4	
Effective Green, g (s)		66.1	66.1	66.1	66.1		19.4		19.4	19.4	19.4	
Actuated g/C Ratio		0.69	0.69	0.69	0.69		0.20		0.20	0.20	0.20	
Clearance Time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)		2449	1016	121	2449		227		313	354	348	
v/s Ratio Prot		c0.47			0.12						0.07	
v/s Ratio Perm			0.24	0.22			c0.14		0.04	0.02		
v/c Ratio		0.68	0.34	0.31	0.17		0.68		0.18	0.10	0.34	
Uniform Delay, d1		8.6	5.9	5.8	5.1		35.2		31.5	30.9	32.5	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00	1.00	1.00	
Incremental Delay, d2		0.8	0.2	1.5	0.0		8.2		0.3	0.1	0.6	
Delay (s)		9.4	6.1	7.3	5.2		43.4		31.8	31.1	33.1	
Level of Service		A	A	A	A		D		C	C	C	
Approach Delay (s)		8.7			5.3			39.4			32.7	
Approach LOS		A			A			D			C	

Intersection Summary			
HCM 2000 Control Delay	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	95.5	Sum of lost time (s)	10.0
Intersection Capacity Utilization	78.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↱	↰	↑↑		↰		↱	↰	↑↱	
Traffic Volume (vph)	0	1837	372	23	1003	0	320	0	205	42	28	90
Future Volume (vph)	0	1837	372	23	1003	0	320	0	205	42	28	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00		1.00	1.00	1.00	
Frpb, ped/bikes		1.00	0.93	1.00	1.00		1.00		0.97	1.00	0.98	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		0.99		1.00	0.98	1.00	
Frt		1.00	0.85	1.00	1.00		1.00		0.85	1.00	0.89	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00	0.95	1.00	
Satd. Flow (prot)		3539	1470	1770	3539		1747		1540	1742	1616	
Flt Permitted		1.00	1.00	0.06	1.00		0.66		1.00	0.95	1.00	
Satd. Flow (perm)		3539	1470	105	3539		1205		1540	1742	1616	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1954	396	24	1067	0	340	0	218	45	30	96
RTOR Reduction (vph)	0	0	124	0	0	0	0	0	13	0	60	0
Lane Group Flow (vph)	0	1954	272	24	1067	0	340	0	205	45	66	0
Confl. Peds. (#/hr)	40		40	40		40	13		13	13		13
Turn Type		NA	Perm	Perm	NA		Perm		Perm	Perm	NA	
Protected Phases		2			6						4	
Permitted Phases			2	6			8		8	4		
Actuated Green, G (s)		70.8	70.8	70.8	70.8		35.4		35.4	35.4	35.4	
Effective Green, g (s)		70.8	70.8	70.8	70.8		35.4		35.4	35.4	35.4	
Actuated g/C Ratio		0.61	0.61	0.61	0.61		0.30		0.30	0.30	0.30	
Clearance Time (s)		5.0	5.0	5.0	5.0		5.0		5.0	5.0	5.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)		2156	895	63	2156		367		469	530	492	
v/s Ratio Prot		c0.55			0.30						0.04	
v/s Ratio Perm			0.18	0.23			c0.28		0.13	0.03		
v/c Ratio		0.91	0.30	0.38	0.49		0.93		0.44	0.08	0.13	
Uniform Delay, d1		19.8	10.9	11.5	12.7		39.1		32.4	28.8	29.3	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00	1.00	1.00	
Incremental Delay, d2		5.9	0.2	3.8	0.2		28.8		0.7	0.1	0.1	
Delay (s)		25.8	11.1	15.4	12.9		67.9		33.1	28.9	29.4	
Level of Service		C	B	B	B		E		C	C	C	
Approach Delay (s)		23.3			12.9			54.3			29.3	
Approach LOS		C			B			D			C	

Intersection Summary			
HCM 2000 Control Delay	25.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	116.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	85.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	3591	140	0	1366	73	32	69	75	95	133	40
Future Volume (vph)	32	3591	140	0	1366	73	32	69	75	95	133	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.86			0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00			1.00		1.00	0.97		1.00	1.00	
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		0.97	1.00	
Frt	1.00	0.99			0.99		1.00	0.92		1.00	0.97	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	6372			3508		1770	1667		1711	1798	
Flt Permitted	0.95	1.00			1.00		0.37	1.00		0.46	1.00	
Satd. Flow (perm)	1770	6372			3508		682	1667		830	1798	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	33	3741	146	0	1423	76	33	72	78	99	139	42
RTOR Reduction (vph)	0	3	0	0	2	0	0	1	0	0	8	0
Lane Group Flow (vph)	33	3884	0	0	1497	0	33	149	0	99	173	0
Confl. Peds. (#/hr)	1					1			33	33		
Turn Type	Prot	NA			NA		Perm	NA		Perm	NA	
Protected Phases	5	2			6			8			4	
Permitted Phases							8			4		
Actuated Green, G (s)	4.1	111.4			102.3		19.9	19.9		19.9	19.9	
Effective Green, g (s)	4.1	111.4			102.3		19.9	19.9		19.9	19.9	
Actuated g/C Ratio	0.03	0.79			0.72		0.14	0.14		0.14	0.14	
Clearance Time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	51	5023			2539		96	234		116	253	
v/s Ratio Prot	0.02	c0.61			0.43			0.09			0.10	
v/s Ratio Perm							0.05			c0.12		
v/c Ratio	0.65	0.77			0.59		0.34	0.64		0.85	0.68	
Uniform Delay, d1	67.9	8.1			9.4		54.8	57.3		59.3	57.7	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	24.8	0.8			0.4		2.1	5.6		42.0	7.5	
Delay (s)	92.7	8.9			9.7		56.9	62.9		101.2	65.2	
Level of Service	F	A			A		E	E		F	E	
Approach Delay (s)		9.6			9.7			61.8			77.9	
Approach LOS		A			A			E			E	

Intersection Summary			
HCM 2000 Control Delay	14.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	141.3	Sum of lost time (s)	15.0
Intersection Capacity Utilization	92.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	45	2306	64	45	2632	81	105	139	64	61	100	36
Future Volume (vph)	45	2306	64	45	2632	81	105	139	64	61	100	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.97		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		0.96	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5055		1770	5062		1770	1730		1704	1788	
Flt Permitted	0.95	1.00		0.95	1.00		0.46	1.00		0.27	1.00	
Satd. Flow (perm)	1770	5055		1770	5062		858	1730		482	1788	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	46	2353	65	46	2686	83	107	142	65	62	102	37
RTOR Reduction (vph)	0	1	0	0	1	0	0	8	0	0	6	0
Lane Group Flow (vph)	46	2417	0	46	2768	0	107	199	0	62	133	0
Confl. Peds. (#/hr)			9						35	35		
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			8			4	
Permitted Phases							8			4		
Actuated Green, G (s)	8.6	150.5		8.6	150.5		30.8	30.8		30.8	30.8	
Effective Green, g (s)	8.6	150.5		8.6	150.5		30.8	30.8		30.8	30.8	
Actuated g/C Ratio	0.04	0.73		0.04	0.73		0.15	0.15		0.15	0.15	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	74	3712		74	3718		128	260		72	268	
v/s Ratio Prot	c0.03	0.48		0.03	c0.55			0.12			0.07	
v/s Ratio Perm							0.12			c0.13		
v/c Ratio	0.62	0.65		0.62	0.74		0.84	0.77		0.86	0.50	
Uniform Delay, d1	96.5	13.8		96.5	15.9		84.6	83.6		85.0	79.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	15.1	0.4		15.1	0.8		35.3	12.7		60.9	1.4	
Delay (s)	111.7	14.3		111.7	16.8		119.9	96.3		145.9	81.4	
Level of Service	F	B		F	B		F	F		F	F	
Approach Delay (s)		16.1			18.3			104.3			101.3	
Approach LOS		B			B			F			F	

Intersection Summary			
HCM 2000 Control Delay	24.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	204.9	Sum of lost time (s)	15.0
Intersection Capacity Utilization	90.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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APPENDIX F

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2023 PEAK HOUR TRAFFIC
ANALYSIS WITHOUT ALTERNATIVE 2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↑	↱	↰	↑↑
Traffic Volume (vph)	88	407	583	228	359	466
Future Volume (vph)	88	407	583	228	359	466
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1549	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	3539	1549	1770	3539
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	95	438	627	245	386	501
RTOR Reduction (vph)	0	363	0	173	0	0
Lane Group Flow (vph)	95	75	627	72	386	501
Confl. Peds. (#/hr)				1		
Turn Type	Prot	Perm	NA	Perm	Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	10.9	10.9	18.6	18.6	19.0	42.6
Effective Green, g (s)	10.9	10.9	18.6	18.6	19.0	42.6
Actuated g/C Ratio	0.17	0.17	0.29	0.29	0.30	0.67
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	303	271	1036	453	529	2374
v/s Ratio Prot	c0.05		c0.18		c0.22	0.14
v/s Ratio Perm		0.05		0.05		
v/c Ratio	0.31	0.28	0.61	0.16	0.73	0.21
Uniform Delay, d1	23.0	22.9	19.3	16.6	19.9	4.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.6	1.0	0.2	5.0	0.0
Delay (s)	23.6	23.4	20.3	16.8	25.0	4.1
Level of Service	C	C	C	B	C	A
Approach Delay (s)	23.5		19.3			13.1
Approach LOS	C		B			B

Intersection Summary			
HCM 2000 Control Delay	17.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	63.5	Sum of lost time (s)	15.0
Intersection Capacity Utilization	53.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↑	↱	↰	↑↑
Traffic Volume (vph)	148	148	449	122	440	679
Future Volume (vph)	148	148	449	122	440	679
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1549	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	3539	1549	1770	3539
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	149	149	454	123	444	686
RTOR Reduction (vph)	0	121	0	93	0	0
Lane Group Flow (vph)	149	28	454	30	444	686
Confl. Peds. (#/hr)				1		
Turn Type	Prot	Perm	NA	Perm	Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	13.1	13.1	16.9	16.9	24.3	46.2
Effective Green, g (s)	13.1	13.1	16.9	16.9	24.3	46.2
Actuated g/C Ratio	0.19	0.19	0.24	0.24	0.35	0.67
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	334	299	863	377	620	2359
v/s Ratio Prot	c0.08		c0.13		c0.25	0.19
v/s Ratio Perm		0.02		0.02		
v/c Ratio	0.45	0.09	0.53	0.08	0.72	0.29
Uniform Delay, d1	24.9	23.2	22.7	20.2	19.5	4.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	0.1	0.6	0.1	3.9	0.1
Delay (s)	25.8	23.3	23.3	20.3	23.4	4.8
Level of Service	C	C	C	C	C	A
Approach Delay (s)	24.6		22.7			12.2
Approach LOS	C		C			B

Intersection Summary			
HCM 2000 Control Delay	17.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	69.3	Sum of lost time (s)	15.0
Intersection Capacity Utilization	57.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	374	178	229	483	0	0
Future Volume (Veh/h)	374	178	229	483	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	398	189	244	514	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	537					
pX, platoon unblocked						
vC, conflicting volume			587		1494	492
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			587		1494	492
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			75		100	100
cM capacity (veh/h)			988		102	576

Direction, Lane #	EB 1	WB 1	WB 2
Volume Total	587	244	514
Volume Left	0	244	0
Volume Right	189	0	0
cSH	1700	988	1700
Volume to Capacity	0.35	0.25	0.30
Queue Length 95th (ft)	0	24	0
Control Delay (s)	0.0	9.8	0.0
Lane LOS		A	
Approach Delay (s)	0.0	3.2	
Approach LOS			

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	49.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	263	291	370	325	0	0
Future Volume (Veh/h)	263	291	370	325	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	296	327	416	365	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	537					
pX, platoon unblocked						
vC, conflicting volume			623		1656	460
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			623		1656	460
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			57		100	100
cM capacity (veh/h)			958		61	602

Direction, Lane #	EB 1	WB 1	WB 2
Volume Total	623	416	365
Volume Left	0	416	0
Volume Right	327	0	0
cSH	1700	958	1700
Volume to Capacity	0.37	0.43	0.21
Queue Length 95th (ft)	0	56	0
Control Delay (s)	0.0	11.6	0.0
Lane LOS		B	
Approach Delay (s)	0.0	6.2	
Approach LOS			

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	58.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑↑	↰	↱
Traffic Volume (veh/h)	374	0	0	503	209	313
Future Volume (Veh/h)	374	0	0	503	209	313
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	398	0	0	535	222	333
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1031					
pX, platoon unblocked						
vC, conflicting volume			398		666	398
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			398		666	398
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		43	45
cM capacity (veh/h)			1157		393	601

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	398	268	268	222	333
Volume Left	0	0	0	222	0
Volume Right	0	0	0	0	333
cSH	1700	1700	1700	393	601
Volume to Capacity	0.23	0.16	0.16	0.57	0.55
Queue Length 95th (ft)	0	0	0	84	85
Control Delay (s)	0.0	0.0	0.0	25.4	18.2
Lane LOS				D	C
Approach Delay (s)	0.0	0.0		21.1	
Approach LOS				C	

Intersection Summary			
Average Delay	7.9		
Intersection Capacity Utilization	49.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑↑	↰	↱
Traffic Volume (veh/h)	263	0	0	551	143	247
Future Volume (Veh/h)	263	0	0	551	143	247
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	280	0	0	586	152	263
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1031					
pX, platoon unblocked						
vC, conflicting volume			280		573	280
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			280		573	280
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		66	63
cM capacity (veh/h)			1280		450	717

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	280	293	293	152	263
Volume Left	0	0	0	152	0
Volume Right	0	0	0	0	263
cSH	1700	1700	1700	450	717
Volume to Capacity	0.16	0.17	0.17	0.34	0.37
Queue Length 95th (ft)	0	0	0	37	42
Control Delay (s)	0.0	0.0	0.0	17.0	12.9
Lane LOS				C	B
Approach Delay (s)	0.0	0.0		14.4	
Approach LOS				B	

Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	58.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	53	230	161	1	81	3	130	0	2	0	0	2
Future Volume (Veh/h)	53	230	161	1	81	3	130	0	2	0	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	63	274	192	1	96	4	155	0	2	0	0	2
Pedestrians					3			1				
Lane Width (ft)					12.0			12.0				
Walking Speed (ft/s)					3.5			3.5				
Percent Blockage					0			0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	100			467			549	599	237	368	693	50
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	100			467			549	599	237	368	693	50
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			100			62	100	100	100	100	100
cM capacity (veh/h)	1490			1090			403	395	762	541	349	1008

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1
Volume Total	200	329	1	64	36	155	2	2
Volume Left	63	0	1	0	0	155	0	0
Volume Right	0	192	0	0	4	0	2	2
cSH	1490	1700	1090	1700	1700	403	762	1008
Volume to Capacity	0.04	0.19	0.00	0.04	0.02	0.38	0.00	0.00
Queue Length 95th (ft)	3	0	0	0	0	44	0	0
Control Delay (s)	2.6	0.0	8.3	0.0	0.0	19.4	9.7	8.6
Lane LOS	A		A			C	A	A
Approach Delay (s)	1.0		0.1			19.3		8.6
Approach LOS						C		A

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	37.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	72	15	3	177	5	167	0	3	0	0	4
Future Volume (Veh/h)	28	72	15	3	177	5	167	0	3	0	0	4
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	32	83	17	3	203	6	192	0	3	0	0	5
Pedestrians					1							
Lane Width (ft)					12.0							
Walking Speed (ft/s)					3.5							
Percent Blockage					0							
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	209			100			268	370	51	322	376	104
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	209			100			268	370	51	322	376	104
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			100			70	100	100	100	100	99
cM capacity (veh/h)	1359			1490			647	544	1005	594	540	930

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1
Volume Total	74	58	3	135	74	192	3	5
Volume Left	32	0	3	0	0	192	0	0
Volume Right	0	17	0	0	6	0	3	5
cSH	1359	1700	1490	1700	1700	647	1005	930
Volume to Capacity	0.02	0.03	0.00	0.08	0.04	0.30	0.00	0.01
Queue Length 95th (ft)	2	0	0	0	0	31	0	0
Control Delay (s)	3.5	0.0	7.4	0.0	0.0	12.9	8.6	8.9
Lane LOS	A		A			B	A	A
Approach Delay (s)	1.9		0.1			12.8		8.9
Approach LOS						B		A

Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	34.3%	ICU Level of Service	A
Analysis Period (min)	15		

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APPENDIX G

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2023 PEAK HOUR TRAFFIC
ANALYSIS WITH ALTERNATIVE 2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	100	460	583	261	411	466
Future Volume (vph)	100	460	583	261	411	466
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1549	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	3539	1549	1770	3539
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	108	495	627	281	442	501
RTOR Reduction (vph)	0	410	0	202	0	0
Lane Group Flow (vph)	108	85	627	79	442	501
Confl. Peds. (#/hr)				1		
Turn Type	Prot	Perm	NA	Perm	Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	11.6	11.6	19.1	19.1	22.0	46.1
Effective Green, g (s)	11.6	11.6	19.1	19.1	22.0	46.1
Actuated g/C Ratio	0.17	0.17	0.28	0.28	0.32	0.68
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	303	271	998	437	575	2409
v/s Ratio Prot	c0.06		c0.18		c0.25	0.14
v/s Ratio Perm		0.05		0.05		
v/c Ratio	0.36	0.31	0.63	0.18	0.77	0.21
Uniform Delay, d1	24.8	24.6	21.2	18.4	20.6	4.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	0.7	1.2	0.2	6.1	0.0
Delay (s)	25.5	25.2	22.4	18.6	26.7	4.1
Level of Service	C	C	C	B	C	A
Approach Delay (s)	25.3		21.3			14.7
Approach LOS	C		C			B

Intersection Summary			
HCM 2000 Control Delay	19.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	67.7	Sum of lost time (s)	15.0
Intersection Capacity Utilization	56.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑↑	↱	↰	↑↑
Traffic Volume (vph)	165	165	449	122	441	679
Future Volume (vph)	165	165	449	122	441	679
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1549	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	3539	1549	1770	3539
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	167	167	454	123	445	686
RTOR Reduction (vph)	0	135	0	93	0	0
Lane Group Flow (vph)	167	32	454	30	445	686
Confl. Peds. (#/hr)				1		
Turn Type	Prot	Perm	NA	Perm	Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	13.7	13.7	17.1	17.1	24.6	46.7
Effective Green, g (s)	13.7	13.7	17.1	17.1	24.6	46.7
Actuated g/C Ratio	0.19	0.19	0.24	0.24	0.35	0.66
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	344	308	859	376	618	2347
v/s Ratio Prot	c0.09		c0.13		c0.25	0.19
v/s Ratio Perm		0.02		0.02		
v/c Ratio	0.49	0.11	0.53	0.08	0.72	0.29
Uniform Delay, d1	25.2	23.3	23.1	20.6	19.9	4.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.1	0.2	0.6	0.1	4.1	0.1
Delay (s)	26.3	23.5	23.7	20.7	24.0	5.0
Level of Service	C	C	C	C	C	A
Approach Delay (s)	24.9		23.1			12.5
Approach LOS	C		C			B

Intersection Summary			
HCM 2000 Control Delay	17.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	70.4	Sum of lost time (s)	15.0
Intersection Capacity Utilization	58.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	459	178	282	547	0	0
Future Volume (Veh/h)	459	178	282	547	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	488	189	300	582	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	537					
pX, platoon unblocked						
vC, conflicting volume			677		1764	582
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			677		1764	582
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			67		100	100
cM capacity (veh/h)			915		62	513

Direction, Lane #	EB 1	WB 1	WB 2
Volume Total	677	300	582
Volume Left	0	300	0
Volume Right	189	0	0
cSH	1700	915	1700
Volume to Capacity	0.40	0.33	0.34
Queue Length 95th (ft)	0	36	0
Control Delay (s)	0.0	10.8	0.0
Lane LOS		B	
Approach Delay (s)	0.0	3.7	
Approach LOS			

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	264	291	435	358	0	0
Future Volume (Veh/h)	264	291	435	358	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	297	327	489	402	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	537					
pX, platoon unblocked						
vC, conflicting volume			624		1840	460
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			624		1840	460
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			49		100	100
cM capacity (veh/h)			957		41	601

Direction, Lane #	EB 1	WB 1	WB 2
Volume Total	624	489	402
Volume Left	0	489	0
Volume Right	327	0	0
cSH	1700	957	1700
Volume to Capacity	0.37	0.51	0.24
Queue Length 95th (ft)	0	75	0
Control Delay (s)	0.0	12.6	0.0
Lane LOS		B	
Approach Delay (s)	0.0	6.9	
Approach LOS			

Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑↑	↰	↱
Traffic Volume (veh/h)	459	0	0	620	209	391
Future Volume (Veh/h)	459	0	0	620	209	391
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	499	0	0	674	227	425
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1031					
pX, platoon unblocked						
vC, conflicting volume			499		836	499
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			499		836	499
tC, single (s)			4.1		*5.9	*5.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		40	29
cM capacity (veh/h)			1061		380	597

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	499	337	337	227	425
Volume Left	0	0	0	227	0
Volume Right	0	0	0	0	425
cSH	1700	1700	1700	380	597
Volume to Capacity	0.29	0.20	0.20	0.60	0.71
Queue Length 95th (ft)	0	0	0	93	146
Control Delay (s)	0.0	0.0	0.0	27.5	24.5
Lane LOS				D	C
Approach Delay (s)	0.0	0.0		25.6	
Approach LOS				D	

Intersection Summary			
Average Delay	9.1		
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑↑	↰	↱
Traffic Volume (veh/h)	264	0	0	649	143	248
Future Volume (Veh/h)	264	0	0	649	143	248
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	281	0	0	690	152	264
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	1031					
pX, platoon unblocked						
vC, conflicting volume			281		626	281
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			281		626	281
tC, single (s)			4.1		*5.9	*5.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		69	66
cM capacity (veh/h)			1278		490	777

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2
Volume Total	281	345	345	152	264
Volume Left	0	0	0	152	0
Volume Right	0	0	0	0	264
cSH	1700	1700	1700	490	777
Volume to Capacity	0.17	0.20	0.20	0.31	0.34
Queue Length 95th (ft)	0	0	0	33	38
Control Delay (s)	0.0	0.0	0.0	15.6	12.0
Lane LOS				C	B
Approach Delay (s)	0.0	0.0		13.3	
Approach LOS				B	

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	53	393	161	1	198	3	130	0	2	0	0	2
Future Volume (Veh/h)	53	393	161	1	198	3	130	0	2	0	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	63	468	192	1	236	4	155	0	2	0	0	2
Pedestrians					3			1				
Lane Width (ft)					12.0			12.0				
Walking Speed (ft/s)					3.5			3.5				
Percent Blockage					0			0				
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	240			661			813	933	334	605	1027	120
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	240			661			813	933	334	605	1027	120
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	7.5	6.5	*5.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	95			100			53	100	100	100	100	100
cM capacity (veh/h)	1324			922			328	252	726	365	221	941

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1
Volume Total	297	426	1	157	83	155	2	2
Volume Left	63	0	1	0	0	155	0	0
Volume Right	0	192	0	0	4	0	2	2
cSH	1324	1700	922	1700	1700	328	726	941
Volume to Capacity	0.05	0.25	0.00	0.09	0.05	0.47	0.00	0.00
Queue Length 95th (ft)	4	0	0	0	0	61	0	0
Control Delay (s)	2.0	0.0	8.9	0.0	0.0	25.5	10.0	8.8
Lane LOS	A		A			D	A	A
Approach Delay (s)	0.8		0.0			25.3		8.8
Approach LOS						D		A

Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	47.0%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	28	74	15	3	275	5	167	3	3	0	0	4
Future Volume (Veh/h)	28	74	15	3	275	5	167	3	3	0	0	4
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	32	85	17	3	316	6	192	3	3	0	0	5
Pedestrians					1							
Lane Width (ft)					12.0							
Walking Speed (ft/s)					3.5							
Percent Blockage					0							
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	322			102			326	486	52	437	491	161
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	322			102			326	486	52	437	491	161
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	7.5	6.5	*5.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			100			70	99	100	100	100	99
cM capacity (veh/h)	1235			1488			645	467	1019	488	463	896

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1
Volume Total	74	60	3	211	111	192	6	5
Volume Left	32	0	3	0	0	192	0	0
Volume Right	0	17	0	0	6	0	3	5
cSH	1235	1700	1488	1700	1700	645	640	896
Volume to Capacity	0.03	0.04	0.00	0.12	0.07	0.30	0.01	0.01
Queue Length 95th (ft)	2	0	0	0	0	31	1	0
Control Delay (s)	3.6	0.0	7.4	0.0	0.0	12.9	10.7	9.0
Lane LOS	A		A			B	B	A
Approach Delay (s)	2.0		0.1			12.9		9.0
Approach LOS						B		A

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	Err%	ICU Level of Service	H
Analysis Period (min)	15		

* User Entered Value

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APPENDIX H

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2023 PEAK HOUR TRAFFIC
ANALYSIS WITHOUT ALTERNATIVE 3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	401	445	208	14	19	231
Future Volume (vph)	401	445	208	14	19	231
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1583	1667	1650		1583	1417
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1583	1667	1650		1583	1417
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	461	511	239	16	22	266
RTOR Reduction (vph)	0	0	2	0	0	232
Lane Group Flow (vph)	461	511	253	0	22	34
Confl. Peds. (#/hr)				1		
Heavy Vehicles (%)	14%	14%	14%	14%	14%	14%
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	23.7	44.0	15.3		8.0	8.0
Effective Green, g (s)	23.7	44.0	15.3		8.0	8.0
Actuated g/C Ratio	0.38	0.71	0.25		0.13	0.13
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	605	1183	407		204	182
v/s Ratio Prot	c0.29	0.31	c0.15		0.01	
v/s Ratio Perm						c0.02
v/c Ratio	0.76	0.43	0.62		0.11	0.19
Uniform Delay, d1	16.7	3.8	20.8		23.8	24.1
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	5.6	0.3	2.9		0.2	0.5
Delay (s)	22.3	4.0	23.7		24.1	24.6
Level of Service	C	A	C		C	C
Approach Delay (s)		12.7	23.7		24.6	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	16.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	62.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	50.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	206	227	523	12	24	420
Future Volume (vph)	206	227	523	12	24	420
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1583	1667	1661		1583	1417
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1583	1667	1661		1583	1417
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	226	249	575	13	26	462
RTOR Reduction (vph)	0	0	1	0	0	403
Lane Group Flow (vph)	226	249	587	0	26	59
Confl. Peds. (#/hr)				6		
Heavy Vehicles (%)	14%	14%	14%	14%	14%	14%
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	17.6	57.2	34.6		9.9	9.9
Effective Green, g (s)	17.6	57.2	34.6		9.9	9.9
Actuated g/C Ratio	0.23	0.74	0.45		0.13	0.13
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	361	1236	745		203	181
v/s Ratio Prot	c0.14	0.15	c0.35		0.02	
v/s Ratio Perm						c0.04
v/c Ratio	0.63	0.20	0.79		0.13	0.33
Uniform Delay, d1	26.8	3.0	18.1		29.8	30.6
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.4	0.1	5.6		0.3	1.1
Delay (s)	30.2	3.1	23.7		30.1	31.6
Level of Service	C	A	C		C	C
Approach Delay (s)		16.0	23.7		31.6	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	23.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	77.1	Sum of lost time (s)	15.0
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	299	65	1	140	24	4
Future Volume (Veh/h)	299	65	1	140	24	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	365	79	1	171	29	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			444		578	404
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			444		578	404
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			100		94	99
cM capacity (veh/h)			1055		458	621

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	444	172	34
Volume Left	0	1	29
Volume Right	79	0	5
cSH	1700	1055	477
Volume to Capacity	0.26	0.00	0.07
Queue Length 95th (ft)	0	0	6
Control Delay (s)	0.0	0.1	13.1
Lane LOS		A	B
Approach Delay (s)	0.0	0.1	13.1
Approach LOS			B

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	29.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	126	27	3	286	76	1
Future Volume (Veh/h)	126	27	3	286	76	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	138	30	3	314	84	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			168		473	153
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			168		473	153
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			100		84	100
cM capacity (veh/h)			1340		527	862

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	168	317	85
Volume Left	0	3	84
Volume Right	30	0	1
cSH	1700	1340	530
Volume to Capacity	0.10	0.00	0.16
Queue Length 95th (ft)	0	0	14
Control Delay (s)	0.0	0.1	13.1
Lane LOS		A	B
Approach Delay (s)	0.0	0.1	13.1
Approach LOS			B

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	28.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	43	155	2	26	114	3
Future Volume (Veh/h)	43	155	2	26	114	3
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	50	180	2	30	133	3
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			230		174	140
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			230		174	140
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			100		83	100
cM capacity (veh/h)			1270		788	877

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	230	32	136
Volume Left	0	2	133
Volume Right	180	0	3
cSH	1700	1270	790
Volume to Capacity	0.14	0.00	0.17
Queue Length 95th (ft)	0	0	15
Control Delay (s)	0.0	0.5	10.5
Lane LOS		A	B
Approach Delay (s)	0.0	0.5	10.5
Approach LOS			B

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	25.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	8	40	0	42	114	0
Future Volume (Veh/h)	8	40	0	42	114	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	9	44	0	46	125	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			53		77	31
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			53		77	31
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			100		86	100
cM capacity (veh/h)			1479		897	1010

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	53	46	125
Volume Left	0	0	125
Volume Right	44	0	0
cSH	1700	1479	897
Volume to Capacity	0.03	0.00	0.14
Queue Length 95th (ft)	0	0	12
Control Delay (s)	0.0	0.0	9.7
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.7
Approach LOS			A

Intersection Summary			
Average Delay	5.4		
Intersection Capacity Utilization	16.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	744	40	102	1208	96	20	31	46	24	20	26
Future Volume (Veh/h)	9	744	40	102	1208	96	20	31	46	24	20	26
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	9	783	42	107	1272	101	21	33	48	25	21	27
Pedestrians					1			12				
Lane Width (ft)					12.0			12.0				
Walking Speed (ft/s)					3.5			3.5				
Percent Blockage					0			1				
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1373			837			1722	2421	426	2012	2392	686
vC1, stage 1 conf vol							834	834		1536	1536	
vC2, stage 2 conf vol							888	1587		475	855	
vCu, unblocked vol	1373			837			1722	2421	426	2012	2392	686
tC, single (s)	4.1			4.1			*6.5	*5.5	*5.9	*6.5	*5.5	*5.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			86			91	83	93	83	89	94
cM capacity (veh/h)	496			784			236	197	645	151	199	475

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	9	522	303	107	848	525	102	73
Volume Left	9	0	0	107	0	0	21	25
Volume Right	0	0	42	0	0	101	48	27
cSH	496	1700	1700	784	1700	1700	308	222
Volume to Capacity	0.02	0.31	0.18	0.14	0.50	0.31	0.33	0.33
Queue Length 95th (ft)	1	0	0	12	0	0	35	34
Control Delay (s)	12.4	0.0	0.0	10.3	0.0	0.0	22.4	28.9
Lane LOS	B			B			C	D
Approach Delay (s)	0.1			0.7			22.4	28.9
Approach LOS							C	D

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	1418	22	23	913	30	15	14	25	49	2	19
Future Volume (Veh/h)	20	1418	22	23	913	30	15	14	25	49	2	19
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	1541	24	25	992	33	16	15	27	53	2	21
Pedestrians											1	
Lane Width (ft)											12.0	
Walking Speed (ft/s)											3.5	
Percent Blockage											0	
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1026			1565			2165	2673	782	1908	2668	514
vC1, stage 1 conf vol							1597	1597		1060	1060	
vC2, stage 2 conf vol							568	1076		849	1609	
vCu, unblocked vol	1026			1565			2165	2673	782	1908	2668	514
tC, single (s)	4.1			4.1			*6.5	*5.5	*5.9	*6.5	*5.5	*5.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			94			90	93	94	76	99	96
cM capacity (veh/h)	672			418			159	203	422	224	191	586

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	22	1027	538	25	661	364	58	76
Volume Left	22	0	0	25	0	0	16	53
Volume Right	0	0	24	0	0	33	27	21
cSH	672	1700	1700	418	1700	1700	243	269
Volume to Capacity	0.03	0.60	0.32	0.06	0.39	0.21	0.24	0.28
Queue Length 95th (ft)	3	0	0	5	0	0	23	28
Control Delay (s)	10.5	0.0	0.0	14.2	0.0	0.0	24.4	23.6
Lane LOS	B			B			C	C
Approach Delay (s)	0.1			0.3			24.4	23.6
Approach LOS							C	C

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	55.4%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	13	784	42	19	1299	5	13	0	4	2	0	9
Future Volume (Veh/h)	13	784	42	19	1299	5	13	0	4	2	0	9
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	14	825	44	20	1367	5	14	0	4	2	0	9
Pedestrians					5							
Lane Width (ft)					12.0							
Walking Speed (ft/s)					3.5							
Percent Blockage					0							
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1372			825			1586	2265	418	1859	2262	686
vC1, stage 1 conf vol							853	853		1410	1410	
vC2, stage 2 conf vol							732	1412		450	853	
vCu, unblocked vol	1372			825			1586	2265	418	1859	2262	686
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	*6.5	6.5	*5.9
tC, 2 stage (s)							5.5	5.5		5.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			98			95	100	99	99	100	98
cM capacity (veh/h)	496			801			305	162	656	201	170	475

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	14	412	412	44	20	911	461	18	11
Volume Left	14	0	0	0	20	0	0	14	2
Volume Right	0	0	0	44	0	0	5	4	9
cSH	496	1700	1700	1700	801	1700	1700	346	381
Volume to Capacity	0.03	0.24	0.24	0.03	0.02	0.54	0.27	0.05	0.03
Queue Length 95th (ft)	2	0	0	0	2	0	0	4	2
Control Delay (s)	12.5	0.0	0.0	0.0	9.6	0.0	0.0	16.0	14.7
Lane LOS	B				A			C	B
Approach Delay (s)	0.2				0.1			16.0	14.7
Approach LOS								C	B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	47.6%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	1467	0	0	867	0	1	0	1	0	0	2
Future Volume (Veh/h)	3	1467	0	0	867	0	1	0	1	0	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	3	1512	0	0	894	0	1	0	1	0	0	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	894			1512			1967	2412	756	1657	2412	447
vC1, stage 1 conf vol							1518	1518		894	894	
vC2, stage 2 conf vol							449	894		763	1518	
vCu, unblocked vol	894			1512			1967	2412	756	1657	2412	447
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	7.5	6.5	*5.9
tC, 2 stage (s)							5.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			99	100	100	100	100	100
cM capacity (veh/h)	755			438			183	157	436	234	157	636

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	3	756	756	0	0	596	298	2	2
Volume Left	3	0	0	0	0	0	0	1	0
Volume Right	0	0	0	0	0	0	0	1	2
cSH	755	1700	1700	1700	1700	1700	1700	258	636
Volume to Capacity	0.00	0.44	0.44	0.00	0.00	0.35	0.18	0.01	0.00
Queue Length 95th (ft)	0	0	0	0	0	0	0	1	0
Control Delay (s)	9.8	0.0	0.0	0.0	0.0	0.0	0.0	19.1	10.7
Lane LOS	A							C	B
Approach Delay (s)	0.0				0.0			19.1	10.7
Approach LOS								C	B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

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APPENDIX I

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2023 PEAK HOUR TRAFFIC
ANALYSIS WITH ALTERNATIVE 3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰		↱		↑↑↱						↑	↱
Traffic Volume (vph)	597	0	629	0	1050	436	0	0	0	0	167	408
Future Volume (vph)	597	0	629	0	1050	436	0	0	0	0	167	408
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		4.0		5.0						5.0	5.0
Lane Util. Factor	1.00		1.00		0.91						1.00	1.00
Frt	1.00		0.85		0.96						1.00	0.85
Flt Protected	0.95		1.00		1.00						1.00	1.00
Satd. Flow (prot)	1770		1583		4862						1863	1583
Flt Permitted	0.95		1.00		1.00						1.00	1.00
Satd. Flow (perm)	1770		1583		4862						1863	1583
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	656	0	691	0	1154	479	0	0	0	0	184	448
RTOR Reduction (vph)	0	0	0	0	56	0	0	0	0	0	0	390
Lane Group Flow (vph)	656	0	691	0	1577	0	0	0	0	0	184	58
Turn Type	Prot		Free		NA						NA	Perm
Protected Phases	5				6						4	
Permitted Phases			Free									4
Actuated Green, G (s)	48.6		123.6		43.9						16.1	16.1
Effective Green, g (s)	48.6		123.6		43.9						16.1	16.1
Actuated g/C Ratio	0.39		1.00		0.36						0.13	0.13
Clearance Time (s)	5.0				5.0						5.0	5.0
Vehicle Extension (s)	3.0				3.0						3.0	3.0
Lane Grp Cap (vph)	695		1583		1726						242	206
v/s Ratio Prot	c0.37				c0.32						c0.10	
v/s Ratio Perm			0.44									0.04
v/c Ratio	0.94		0.44		0.91						0.76	0.28
Uniform Delay, d1	36.2		0.0		38.0						51.9	48.5
Progression Factor	1.00		1.00		1.00						1.00	1.00
Incremental Delay, d2	21.3		0.9		7.9						13.1	0.8
Delay (s)	57.5		0.9		45.9						65.0	49.3
Level of Service	E		A		D						E	D
Approach Delay (s)		28.5			45.9			0.0			53.9	
Approach LOS		C			D			A			D	

Intersection Summary			
HCM 2000 Control Delay	40.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	123.6	Sum of lost time (s)	15.0
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰		↱		↑↑↱						↑	↱
Traffic Volume (vph)	197	0	1364	0	900	264	0	0	0	0	633	595
Future Volume (vph)	197	0	1364	0	900	264	0	0	0	0	633	595
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		4.0		5.0						5.0	5.0
Lane Util. Factor	1.00		1.00		0.91						1.00	1.00
Frpb, ped/bikes	1.00		1.00		0.99						1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00						1.00	1.00
Frt	1.00		0.85		0.97						1.00	0.85
Flt Protected	0.95		1.00		1.00						1.00	1.00
Satd. Flow (prot)	1770		1583		4881						1863	1583
Flt Permitted	0.95		1.00		1.00						1.00	1.00
Satd. Flow (perm)	1770		1583		4881						1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	214	0	1483	0	978	287	0	0	0	0	688	647
RTOR Reduction (vph)	0	0	0	0	29	0	0	0	0	0	0	213
Lane Group Flow (vph)	214	0	1483	0	1236	0	0	0	0	0	688	434
Confl. Peds. (#/hr)						3						
Turn Type	Prot		Free		NA						NA	Perm
Protected Phases	5				6						4	
Permitted Phases			Free									4
Actuated Green, G (s)	23.8		153.5		48.0						66.7	66.7
Effective Green, g (s)	23.8		153.5		48.0						66.7	66.7
Actuated g/C Ratio	0.16		1.00		0.31						0.43	0.43
Clearance Time (s)	5.0				5.0						5.0	5.0
Vehicle Extension (s)	3.0				3.0						3.0	3.0
Lane Grp Cap (vph)	274		1583		1526						809	687
v/s Ratio Prot	0.12				0.25						0.37	
v/s Ratio Perm			c0.94									0.27
v/c Ratio	0.78		0.94		0.81						0.85	0.63
Uniform Delay, d1	62.3		0.0		48.6						38.9	33.8
Progression Factor	1.00		1.00		1.00						1.00	1.00
Incremental Delay, d2	13.4		11.9		3.4						8.5	1.9
Delay (s)	75.8		11.9		51.9						47.5	35.7
Level of Service	E		B		D						D	D
Approach Delay (s)		19.9			51.9			0.0			41.8	
Approach LOS		B			D			A			D	

Intersection Summary			
HCM 2000 Control Delay	36.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	153.5	Sum of lost time (s)	15.0
Intersection Capacity Utilization	79.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	401	608	325	14	19	231
Future Volume (vph)	401	608	325	14	19	231
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1863	1851		1770	1583
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1863	1851		1770	1583
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	461	699	374	16	22	266
RTOR Reduction (vph)	0	0	2	0	0	233
Lane Group Flow (vph)	461	699	388	0	22	33
Confl. Peds. (#/hr)				1		
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	21.2	43.8	17.6		7.5	7.5
Effective Green, g (s)	21.2	43.8	17.6		7.5	7.5
Actuated g/C Ratio	0.35	0.71	0.29		0.12	0.12
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	612	1331	531		216	193
v/s Ratio Prot	c0.26	0.38	c0.21		0.01	
v/s Ratio Perm						c0.02
v/c Ratio	0.75	0.53	0.73		0.10	0.17
Uniform Delay, d1	17.7	4.0	19.7		23.9	24.1
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	5.2	0.4	5.1		0.2	0.4
Delay (s)	23.0	4.4	24.8		24.1	24.5
Level of Service	C	A	C		C	C
Approach Delay (s)		11.8	24.8		24.5	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	61.3	Sum of lost time (s)	15.0
Intersection Capacity Utilization	56.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	206	229	621	12	24	420
Future Volume (vph)	206	229	621	12	24	420
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1863	1857		1770	1583
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1863	1857		1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	224	249	675	13	26	457
RTOR Reduction (vph)	0	0	1	0	0	364
Lane Group Flow (vph)	224	249	687	0	26	93
Confl. Peds. (#/hr)				6		
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	16.2	57.5	36.3		10.6	10.6
Effective Green, g (s)	16.2	57.5	36.3		10.6	10.6
Actuated g/C Ratio	0.21	0.74	0.46		0.14	0.14
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	367	1371	863		240	214
v/s Ratio Prot	c0.13	0.13	c0.37		0.01	
v/s Ratio Perm						c0.06
v/c Ratio	0.61	0.18	0.80		0.11	0.44
Uniform Delay, d1	28.1	3.1	17.8		29.6	31.0
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.0	0.1	5.2		0.2	1.4
Delay (s)	31.1	3.2	22.9		29.8	32.4
Level of Service	C	A	C		C	C
Approach Delay (s)		16.4	22.9		32.3	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	23.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	78.1	Sum of lost time (s)	15.0
Intersection Capacity Utilization	67.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	462	65	1	257	24	4
Future Volume (Veh/h)	462	65	1	257	24	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	563	79	1	313	29	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			642		918	602
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			642		918	602
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		90	99
cM capacity (veh/h)			943		301	499

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	642	314	34
Volume Left	0	1	29
Volume Right	79	0	5
cSH	1700	943	320
Volume to Capacity	0.38	0.00	0.11
Queue Length 95th (ft)	0	0	9
Control Delay (s)	0.0	0.0	17.6
Lane LOS		A	C
Approach Delay (s)	0.0	0.0	17.6
Approach LOS			C

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	38.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	128	27	3	384	76	1
Future Volume (Veh/h)	128	27	3	384	76	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	141	30	3	422	84	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			171		584	156
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			171		584	156
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		82	100
cM capacity (veh/h)			1406		473	890

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	171	425	85
Volume Left	0	3	84
Volume Right	30	0	1
cSH	1700	1406	476
Volume to Capacity	0.10	0.00	0.18
Queue Length 95th (ft)	0	0	16
Control Delay (s)	0.0	0.1	14.2
Lane LOS		A	B
Approach Delay (s)	0.0	0.1	14.2
Approach LOS			B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	33.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	206	155	2	143	114	3
Future Volume (Veh/h)	206	155	2	143	114	3
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	240	180	2	166	133	3
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			420		500	330
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			420		500	330
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		75	100
cM capacity (veh/h)			1139		529	712

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	420	168	136
Volume Left	0	2	133
Volume Right	180	0	3
cSH	1700	1139	532
Volume to Capacity	0.25	0.00	0.26
Queue Length 95th (ft)	0	0	25
Control Delay (s)	0.0	0.1	14.1
Lane LOS		A	B
Approach Delay (s)	0.0	0.1	14.1
Approach LOS			B

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	33.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	10	40	0	140	114	0
Future Volume (Veh/h)	10	40	0	140	114	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	11	44	0	154	125	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			55		187	33
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			55		187	33
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		84	100
cM capacity (veh/h)			1550		802	1041

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	55	154	125
Volume Left	0	0	125
Volume Right	44	0	0
cSH	1700	1550	802
Volume to Capacity	0.03	0.00	0.16
Queue Length 95th (ft)	0	0	14
Control Delay (s)	0.0	0.0	10.3
Lane LOS			B
Approach Delay (s)	0.0	0.0	10.3
Approach LOS			B

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	20.4%	ICU Level of Service	A
Analysis Period (min)	15		

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APPENDIX J

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2023 PEAK HOUR TRAFFIC
ANALYSIS WITHOUT ALTERNATIVE 4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	502	0	629	0	1050	368	0	0	0	0	133	325
Future Volume (vph)	502	0	629	0	1050	368	0	0	0	0	133	325
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		4.0		5.0						5.0	5.0
Lane Util. Factor	1.00		1.00		0.91						1.00	1.00
Frt	1.00		0.85		0.96						1.00	0.85
Flt Protected	0.95		1.00		1.00						1.00	1.00
Satd. Flow (prot)	1583		1583		4743						1667	1417
Flt Permitted	0.95		1.00		1.00						1.00	1.00
Satd. Flow (perm)	1583		1583		4743						1667	1417
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	552	0	691	0	1154	404	0	0	0	0	146	357
RTOR Reduction (vph)	0	0	0	0	40	0	0	0	0	0	0	309
Lane Group Flow (vph)	552	0	691	0	1518	0	0	0	0	0	146	48
Heavy Vehicles (%)	14%	2%	2%	2%	2%	14%	2%	2%	2%	14%	14%	14%
Turn Type	Prot		Free		NA						NA	Perm
Protected Phases	5				6						4	
Permitted Phases			Free									4
Actuated Green, G (s)	50.9		132.6		49.0						17.7	17.7
Effective Green, g (s)	50.9		132.6		49.0						17.7	17.7
Actuated g/C Ratio	0.38		1.00		0.37						0.13	0.13
Clearance Time (s)	5.0				5.0						5.0	5.0
Vehicle Extension (s)	3.0				3.0						3.0	3.0
Lane Grp Cap (vph)	607		1583		1752						222	189
v/s Ratio Prot	c0.35				c0.32						c0.09	
v/s Ratio Perm			0.44									0.03
v/c Ratio	0.91		0.44		0.87						0.66	0.25
Uniform Delay, d1	38.7		0.0		38.8						54.6	51.5
Progression Factor	1.00		1.00		1.00						1.00	1.00
Incremental Delay, d2	17.5		0.9		4.8						6.9	0.7
Delay (s)	56.2		0.9		43.6						61.4	52.2
Level of Service	E		A		D						E	D
Approach Delay (s)		25.4			43.6			0.0			54.9	
Approach LOS		C			D			A			D	

Intersection Summary			
HCM 2000 Control Delay	38.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	132.6	Sum of lost time (s)	15.0
Intersection Capacity Utilization	75.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: Ulune Ext & Halawa Valley St

7/11/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	196	0	1364	0	900	263	0	0	0	0	582	548
Future Volume (vph)	196	0	1364	0	900	263	0	0	0	0	582	548
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		4.0		5.0						5.0	5.0
Lane Util. Factor	1.00		1.00		0.91						1.00	1.00
Frpb, ped/bikes	1.00		1.00		0.99						1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00						1.00	1.00
Frt	1.00		0.85		0.97						1.00	0.85
Flt Protected	0.95		1.00		1.00						1.00	1.00
Satd. Flow (prot)	1583		1583		4755						1667	1417
Flt Permitted	0.95		1.00		1.00						1.00	1.00
Satd. Flow (perm)	1583		1583		4755						1667	1417
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	213	0	1483	0	978	286	0	0	0	0	633	596
RTOR Reduction (vph)	0	0	0	0	29	0	0	0	0	0	0	210
Lane Group Flow (vph)	213	0	1483	0	1235	0	0	0	0	0	633	386
Confl. Peds. (#/hr)						3						
Heavy Vehicles (%)	14%	2%	2%	2%	2%	14%	2%	2%	2%	14%	14%	14%
Turn Type	Prot		Free		NA						NA	Perm
Protected Phases	5				6						4	
Permitted Phases			Free									4
Actuated Green, G (s)	26.3		160.2		50.4						68.5	68.5
Effective Green, g (s)	26.3		160.2		50.4						68.5	68.5
Actuated g/C Ratio	0.16		1.00		0.31						0.43	0.43
Clearance Time (s)	5.0				5.0						5.0	5.0
Vehicle Extension (s)	3.0				3.0						3.0	3.0
Lane Grp Cap (vph)	259		1583		1495						712	605
v/s Ratio Prot	0.13				0.26						0.38	
v/s Ratio Perm			c0.94									0.27
v/c Ratio	0.82		0.94		0.83						0.89	0.64
Uniform Delay, d1	64.7		0.0		50.8						42.3	36.1
Progression Factor	1.00		1.00		1.00						1.00	1.00
Incremental Delay, d2	18.6		11.9		3.9						13.0	2.2
Delay (s)	83.3		11.9		54.7						55.3	38.3
Level of Service	F		B		D						E	D
Approach Delay (s)		20.9			54.7			0.0			47.1	
Approach LOS		C			D			A			D	

Intersection Summary			
HCM 2000 Control Delay	38.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	160.2	Sum of lost time (s)	15.0
Intersection Capacity Utilization	76.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	401	445	208	14	19	231
Future Volume (vph)	401	445	208	14	19	231
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1583	1667	1650		1583	1417
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1583	1667	1650		1583	1417
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	461	511	239	16	22	266
RTOR Reduction (vph)	0	0	2	0	0	232
Lane Group Flow (vph)	461	511	253	0	22	34
Confl. Peds. (#/hr)				1		
Heavy Vehicles (%)	14%	14%	14%	14%	14%	14%
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	23.7	44.0	15.3		8.0	8.0
Effective Green, g (s)	23.7	44.0	15.3		8.0	8.0
Actuated g/C Ratio	0.38	0.71	0.25		0.13	0.13
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	605	1183	407		204	182
v/s Ratio Prot	c0.29	0.31	c0.15		0.01	
v/s Ratio Perm						c0.02
v/c Ratio	0.76	0.43	0.62		0.11	0.19
Uniform Delay, d1	16.7	3.8	20.8		23.8	24.1
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	5.6	0.3	2.9		0.2	0.5
Delay (s)	22.3	4.0	23.7		24.1	24.6
Level of Service	C	A	C		C	C
Approach Delay (s)		12.7	23.7		24.6	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	16.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	62.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	50.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	206	227	523	12	24	420
Future Volume (vph)	206	227	523	12	24	420
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1583	1667	1661		1583	1417
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1583	1667	1661		1583	1417
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	226	249	575	13	26	462
RTOR Reduction (vph)	0	0	1	0	0	403
Lane Group Flow (vph)	226	249	587	0	26	59
Confl. Peds. (#/hr)				6		
Heavy Vehicles (%)	14%	14%	14%	14%	14%	14%
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	17.6	57.2	34.6		9.9	9.9
Effective Green, g (s)	17.6	57.2	34.6		9.9	9.9
Actuated g/C Ratio	0.23	0.74	0.45		0.13	0.13
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	361	1236	745		203	181
v/s Ratio Prot	c0.14	0.15	c0.35		0.02	
v/s Ratio Perm						c0.04
v/c Ratio	0.63	0.20	0.79		0.13	0.33
Uniform Delay, d1	26.8	3.0	18.1		29.8	30.6
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.4	0.1	5.6		0.3	1.1
Delay (s)	30.2	3.1	23.7		30.1	31.6
Level of Service	C	A	C		C	C
Approach Delay (s)		16.0	23.7		31.6	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	23.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	77.1	Sum of lost time (s)	15.0
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	744	40	102	1208	96	20	31	46	24	20	26
Future Volume (Veh/h)	9	744	40	102	1208	96	20	31	46	24	20	26
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	9	783	42	107	1272	101	21	33	48	25	21	27
Pedestrians					1			12				
Lane Width (ft)					12.0			12.0				
Walking Speed (ft/s)					3.5			3.5				
Percent Blockage					0			1				
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1373			837			1722	2421	426	2012	2392	686
vC1, stage 1 conf vol							834	834		1536	1536	
vC2, stage 2 conf vol							888	1587		475	855	
vCu, unblocked vol	1373			837			1722	2421	426	2012	2392	686
tC, single (s)	4.1			4.1			*6.5	*5.5	*5.9	*6.5	*5.5	*5.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			86			91	83	93	83	89	94
cM capacity (veh/h)	496			784			236	197	645	151	199	475

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	9	522	303	107	848	525	102	73
Volume Left	9	0	0	107	0	0	21	25
Volume Right	0	0	42	0	0	101	48	27
cSH	496	1700	1700	784	1700	1700	308	222
Volume to Capacity	0.02	0.31	0.18	0.14	0.50	0.31	0.33	0.33
Queue Length 95th (ft)	1	0	0	12	0	0	35	34
Control Delay (s)	12.4	0.0	0.0	10.3	0.0	0.0	22.4	28.9
Lane LOS	B			B			C	D
Approach Delay (s)	0.1			0.7			22.4	28.9
Approach LOS							C	D

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	1418	22	23	913	30	15	14	25	49	2	19
Future Volume (Veh/h)	20	1418	22	23	913	30	15	14	25	49	2	19
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	1541	24	25	992	33	16	15	27	53	2	21
Pedestrians											1	
Lane Width (ft)											12.0	
Walking Speed (ft/s)											3.5	
Percent Blockage											0	
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1026			1565			2165	2673	782	1908	2668	514
vC1, stage 1 conf vol							1597	1597		1060	1060	
vC2, stage 2 conf vol							568	1076		849	1609	
vCu, unblocked vol	1026			1565			2165	2673	782	1908	2668	514
tC, single (s)	4.1			4.1			*6.5	*5.5	*5.9	*6.5	*5.5	*5.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			94			90	93	94	76	99	96
cM capacity (veh/h)	672			418			159	203	422	224	191	586

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	22	1027	538	25	661	364	58	76
Volume Left	22	0	0	25	0	0	16	53
Volume Right	0	0	24	0	0	33	27	21
cSH	672	1700	1700	418	1700	1700	243	269
Volume to Capacity	0.03	0.60	0.32	0.06	0.39	0.21	0.24	0.28
Queue Length 95th (ft)	3	0	0	5	0	0	23	28
Control Delay (s)	10.5	0.0	0.0	14.2	0.0	0.0	24.4	23.6
Lane LOS	B			B			C	C
Approach Delay (s)	0.1			0.3			24.4	23.6
Approach LOS							C	C

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	55.4%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	13	784	42	19	1299	5	13	0	4	2	0	9
Future Volume (Veh/h)	13	784	42	19	1299	5	13	0	4	2	0	9
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	14	825	44	20	1367	5	14	0	4	2	0	9
Pedestrians					5							
Lane Width (ft)					12.0							
Walking Speed (ft/s)					3.5							
Percent Blockage					0							
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1372			825			1586	2265	418	1859	2262	686
vC1, stage 1 conf vol							853	853		1410	1410	
vC2, stage 2 conf vol							732	1412		450	853	
vCu, unblocked vol	1372			825			1586	2265	418	1859	2262	686
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	*6.5	6.5	*5.9
tC, 2 stage (s)							5.5	5.5		5.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			98			95	100	99	99	100	98
cM capacity (veh/h)	496			801			305	162	656	201	170	475

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	14	412	412	44	20	911	461	18	11
Volume Left	14	0	0	0	20	0	0	14	2
Volume Right	0	0	0	44	0	0	5	4	9
cSH	496	1700	1700	1700	801	1700	1700	346	381
Volume to Capacity	0.03	0.24	0.24	0.03	0.02	0.54	0.27	0.05	0.03
Queue Length 95th (ft)	2	0	0	0	2	0	0	4	2
Control Delay (s)	12.5	0.0	0.0	0.0	9.6	0.0	0.0	16.0	14.7
Lane LOS	B				A			C	B
Approach Delay (s)	0.2				0.1			16.0	14.7
Approach LOS								C	B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	47.6%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	3	1467	0	0	867	0	1	0	1	0	0	2
Future Volume (Veh/h)	3	1467	0	0	867	0	1	0	1	0	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	3	1512	0	0	894	0	1	0	1	0	0	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	894			1512			1967	2412	756	1657	2412	447
vC1, stage 1 conf vol							1518	1518		894	894	
vC2, stage 2 conf vol							449	894		763	1518	
vCu, unblocked vol	894			1512			1967	2412	756	1657	2412	447
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	7.5	6.5	*5.9
tC, 2 stage (s)							5.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			99	100	100	100	100	100
cM capacity (veh/h)	755			438			183	157	436	234	157	636

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	3	756	756	0	0	596	298	2	2
Volume Left	3	0	0	0	0	0	0	1	0
Volume Right	0	0	0	0	0	0	0	1	2
cSH	755	1700	1700	1700	1700	1700	1700	258	636
Volume to Capacity	0.00	0.44	0.44	0.00	0.00	0.35	0.18	0.01	0.00
Queue Length 95th (ft)	0	0	0	0	0	0	0	1	0
Control Delay (s)	9.8	0.0	0.0	0.0	0.0	0.0	0.0	19.1	10.7
Lane LOS	A							C	B
Approach Delay (s)	0.0				0.0			19.1	10.7
Approach LOS								C	B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

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APPENDIX K

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2023 PEAK HOUR TRAFFIC
ANALYSIS WITH ALTERNATIVE 4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰		↱		↑↑↱						↑	↱
Traffic Volume (vph)	597	0	629	0	1050	436	0	0	0	0	167	408
Future Volume (vph)	597	0	629	0	1050	436	0	0	0	0	167	408
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		4.0		5.0						5.0	5.0
Lane Util. Factor	1.00		1.00		0.91						1.00	1.00
Frt	1.00		0.85		0.96						1.00	0.85
Flt Protected	0.95		1.00		1.00						1.00	1.00
Satd. Flow (prot)	1770		1583		4862						1863	1583
Flt Permitted	0.95		1.00		1.00						1.00	1.00
Satd. Flow (perm)	1770		1583		4862						1863	1583
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	656	0	691	0	1154	479	0	0	0	0	184	448
RTOR Reduction (vph)	0	0	0	0	56	0	0	0	0	0	0	390
Lane Group Flow (vph)	656	0	691	0	1577	0	0	0	0	0	184	58
Turn Type	Prot		Free		NA						NA	Perm
Protected Phases	5				6						4	
Permitted Phases			Free									4
Actuated Green, G (s)	48.6		123.6		43.9						16.1	16.1
Effective Green, g (s)	48.6		123.6		43.9						16.1	16.1
Actuated g/C Ratio	0.39		1.00		0.36						0.13	0.13
Clearance Time (s)	5.0				5.0						5.0	5.0
Vehicle Extension (s)	3.0				3.0						3.0	3.0
Lane Grp Cap (vph)	695		1583		1726						242	206
v/s Ratio Prot	c0.37				c0.32						c0.10	
v/s Ratio Perm			0.44									0.04
v/c Ratio	0.94		0.44		0.91						0.76	0.28
Uniform Delay, d1	36.2		0.0		38.0						51.9	48.5
Progression Factor	1.00		1.00		1.00						1.00	1.00
Incremental Delay, d2	21.3		0.9		7.9						13.1	0.8
Delay (s)	57.5		0.9		45.9						65.0	49.3
Level of Service	E		A		D						E	D
Approach Delay (s)		28.5			45.9			0.0			53.9	
Approach LOS		C			D			A			D	

Intersection Summary			
HCM 2000 Control Delay	40.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	123.6	Sum of lost time (s)	15.0
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰		↱		↑↑↱						↑	↱
Traffic Volume (vph)	197	0	1364	0	900	264	0	0	0	0	633	595
Future Volume (vph)	197	0	1364	0	900	264	0	0	0	0	633	595
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		4.0		5.0						5.0	5.0
Lane Util. Factor	1.00		1.00		0.91						1.00	1.00
Frpb, ped/bikes	1.00		1.00		0.99						1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00						1.00	1.00
Frt	1.00		0.85		0.97						1.00	0.85
Flt Protected	0.95		1.00		1.00						1.00	1.00
Satd. Flow (prot)	1770		1583		4881						1863	1583
Flt Permitted	0.95		1.00		1.00						1.00	1.00
Satd. Flow (perm)	1770		1583		4881						1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	214	0	1483	0	978	287	0	0	0	0	688	647
RTOR Reduction (vph)	0	0	0	0	29	0	0	0	0	0	0	213
Lane Group Flow (vph)	214	0	1483	0	1236	0	0	0	0	0	688	434
Confl. Peds. (#/hr)						3						
Turn Type	Prot		Free		NA						NA	Perm
Protected Phases	5				6						4	
Permitted Phases			Free									4
Actuated Green, G (s)	23.8		153.5		48.0						66.7	66.7
Effective Green, g (s)	23.8		153.5		48.0						66.7	66.7
Actuated g/C Ratio	0.16		1.00		0.31						0.43	0.43
Clearance Time (s)	5.0				5.0						5.0	5.0
Vehicle Extension (s)	3.0				3.0						3.0	3.0
Lane Grp Cap (vph)	274		1583		1526						809	687
v/s Ratio Prot	0.12				0.25						0.37	
v/s Ratio Perm			c0.94									0.27
v/c Ratio	0.78		0.94		0.81						0.85	0.63
Uniform Delay, d1	62.3		0.0		48.6						38.9	33.8
Progression Factor	1.00		1.00		1.00						1.00	1.00
Incremental Delay, d2	13.4		11.9		3.4						8.5	1.9
Delay (s)	75.8		11.9		51.9						47.5	35.7
Level of Service	E		B		D						D	D
Approach Delay (s)		19.9			51.9			0.0			41.8	
Approach LOS		B			D			A			D	

Intersection Summary			
HCM 2000 Control Delay	36.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	153.5	Sum of lost time (s)	15.0
Intersection Capacity Utilization	79.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	401	608	325	14	19	231
Future Volume (vph)	401	608	325	14	19	231
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1863	1851		1770	1583
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1863	1851		1770	1583
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	461	699	374	16	22	266
RTOR Reduction (vph)	0	0	2	0	0	233
Lane Group Flow (vph)	461	699	388	0	22	33
Confl. Peds. (#/hr)				1		
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	21.2	43.8	17.6		7.5	7.5
Effective Green, g (s)	21.2	43.8	17.6		7.5	7.5
Actuated g/C Ratio	0.35	0.71	0.29		0.12	0.12
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	612	1331	531		216	193
v/s Ratio Prot	c0.26	0.38	c0.21		0.01	
v/s Ratio Perm						c0.02
v/c Ratio	0.75	0.53	0.73		0.10	0.17
Uniform Delay, d1	17.7	4.0	19.7		23.9	24.1
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	5.2	0.4	5.1		0.2	0.4
Delay (s)	23.0	4.4	24.8		24.1	24.5
Level of Service	C	A	C		C	C
Approach Delay (s)		11.8	24.8		24.5	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	61.3	Sum of lost time (s)	15.0
Intersection Capacity Utilization	56.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	206	229	621	12	24	420
Future Volume (vph)	206	229	621	12	24	420
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1863	1857		1770	1583
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1863	1857		1770	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	224	249	675	13	26	457
RTOR Reduction (vph)	0	0	1	0	0	364
Lane Group Flow (vph)	224	249	687	0	26	93
Confl. Peds. (#/hr)				6		
Turn Type	Prot	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases						4
Actuated Green, G (s)	16.2	57.5	36.3		10.6	10.6
Effective Green, g (s)	16.2	57.5	36.3		10.6	10.6
Actuated g/C Ratio	0.21	0.74	0.46		0.14	0.14
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	367	1371	863		240	214
v/s Ratio Prot	c0.13	0.13	c0.37		0.01	
v/s Ratio Perm						c0.06
v/c Ratio	0.61	0.18	0.80		0.11	0.44
Uniform Delay, d1	28.1	3.1	17.8		29.6	31.0
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.0	0.1	5.2		0.2	1.4
Delay (s)	31.1	3.2	22.9		29.8	32.4
Level of Service	C	A	C		C	C
Approach Delay (s)		16.4	22.9		32.3	
Approach LOS		B	C		C	

Intersection Summary			
HCM 2000 Control Delay	23.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	78.1	Sum of lost time (s)	15.0
Intersection Capacity Utilization	67.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

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APPENDIX L

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2023 PEAK HOUR TRAFFIC
ANALYSIS WITHOUT PROJECT

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	744	40	102	1208	96	20	31	46	24	20	26
Future Volume (Veh/h)	9	744	40	102	1208	96	20	31	46	24	20	26
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	9	783	42	107	1272	101	21	33	48	25	21	27
Pedestrians					1			12				
Lane Width (ft)					12.0			12.0				
Walking Speed (ft/s)					3.5			3.5				
Percent Blockage					0			1				
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1373			837			1722	2421	426	2012	2392	686
vC1, stage 1 conf vol							834	834		1536	1536	
vC2, stage 2 conf vol							888	1587		475	855	
vCu, unblocked vol	1373			837			1722	2421	426	2012	2392	686
tC, single (s)	4.1			4.1			*6.5	*5.5	*5.9	*6.5	*5.5	*5.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			86			91	83	93	83	89	94
cM capacity (veh/h)	496			784			236	197	645	151	199	475

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	9	522	303	107	848	525	102	73
Volume Left	9	0	0	107	0	0	21	25
Volume Right	0	0	42	0	0	101	48	27
cSH	496	1700	1700	784	1700	1700	308	222
Volume to Capacity	0.02	0.31	0.18	0.14	0.50	0.31	0.33	0.33
Queue Length 95th (ft)	1	0	0	12	0	0	35	34
Control Delay (s)	12.4	0.0	0.0	10.3	0.0	0.0	22.4	28.9
Lane LOS	B			B			C	D
Approach Delay (s)	0.1			0.7			22.4	28.9
Approach LOS							C	D

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	1418	22	23	913	30	15	14	25	49	2	19
Future Volume (Veh/h)	20	1418	22	23	913	30	15	14	25	49	2	19
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	1541	24	25	992	33	16	15	27	53	2	21
Pedestrians											1	
Lane Width (ft)											12.0	
Walking Speed (ft/s)											3.5	
Percent Blockage											0	
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1026			1565			2165	2673	782	1908	2668	514
vC1, stage 1 conf vol							1597	1597		1060	1060	
vC2, stage 2 conf vol							568	1076		849	1609	
vCu, unblocked vol	1026			1565			2165	2673	782	1908	2668	514
tC, single (s)	4.1			4.1			*6.5	*5.5	*5.9	*6.5	*5.5	*5.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			94			90	93	94	76	99	96
cM capacity (veh/h)	672			418			159	203	422	224	191	586

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	22	1027	538	25	661	364	58	76
Volume Left	22	0	0	25	0	0	16	53
Volume Right	0	0	24	0	0	33	27	21
cSH	672	1700	1700	418	1700	1700	243	269
Volume to Capacity	0.03	0.60	0.32	0.06	0.39	0.21	0.24	0.28
Queue Length 95th (ft)	3	0	0	5	0	0	23	28
Control Delay (s)	10.5	0.0	0.0	14.2	0.0	0.0	24.4	23.6
Lane LOS	B			B			C	C
Approach Delay (s)	0.1			0.3			24.4	23.6
Approach LOS							C	C

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	55.4%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	13	784	42	19	1299	5	13	0	4	2	0	9
Future Volume (Veh/h)	13	784	42	19	1299	5	13	0	4	2	0	9
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	14	825	44	20	1367	5	14	0	4	2	0	9
Pedestrians					5							
Lane Width (ft)					12.0							
Walking Speed (ft/s)					3.5							
Percent Blockage					0							
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1372			825			1586	2265	418	1859	2262	686
vC1, stage 1 conf vol							853	853		1410	1410	
vC2, stage 2 conf vol							732	1412		450	853	
vCu, unblocked vol	1372			825			1586	2265	418	1859	2262	686
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	*6.5	6.5	*5.9
tC, 2 stage (s)							5.5	5.5		5.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			98			95	100	99	99	100	98
cM capacity (veh/h)	496			801			305	162	656	201	170	475

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	14	412	412	44	20	911	461	18	11
Volume Left	14	0	0	0	20	0	0	14	2
Volume Right	0	0	0	44	0	0	5	4	9
cSH	496	1700	1700	1700	801	1700	1700	346	381
Volume to Capacity	0.03	0.24	0.24	0.03	0.02	0.54	0.27	0.05	0.03
Queue Length 95th (ft)	2	0	0	0	2	0	0	4	2
Control Delay (s)	12.5	0.0	0.0	0.0	9.6	0.0	0.0	16.0	14.7
Lane LOS	B				A			C	B
Approach Delay (s)	0.2				0.1			16.0	14.7
Approach LOS								C	B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	47.6%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↱			✥			✥	
Traffic Volume (veh/h)	3	1467	0	0	867	0	1	0	1	0	0	2
Future Volume (Veh/h)	3	1467	0	0	867	0	1	0	1	0	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	3	1512	0	0	894	0	1	0	1	0	0	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	894			1512			1967	2412	756	1657	2412	447
vC1, stage 1 conf vol							1518	1518		894	894	
vC2, stage 2 conf vol							449	894		763	1518	
vCu, unblocked vol	894			1512			1967	2412	756	1657	2412	447
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	7.5	6.5	*5.9
tC, 2 stage (s)							5.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			99	100	100	100	100	100
cM capacity (veh/h)	755			438			183	157	436	234	157	636

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	3	756	756	0	0	596	298	2	2
Volume Left	3	0	0	0	0	0	0	1	0
Volume Right	0	0	0	0	0	0	0	1	2
cSH	755	1700	1700	1700	1700	1700	1700	258	636
Volume to Capacity	0.00	0.44	0.44	0.00	0.00	0.35	0.18	0.01	0.00
Queue Length 95th (ft)	0	0	0	0	0	0	0	1	0
Control Delay (s)	9.8	0.0	0.0	0.0	0.0	0.0	0.0	19.1	10.7
Lane LOS	A							C	B
Approach Delay (s)	0.0				0.0			19.1	10.7
Approach LOS								C	B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

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APPENDIX M

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2023 PEAK HOUR TRAFFIC
ANALYSIS WITH PROJECT

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	26	9	771	40	102	1227	20	20	31	46	24	20
Future Volume (Veh/h)	26	9	771	40	102	1227	20	20	31	46	24	20
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	27	9	812	42	107	1292	21	21	33	48	25	21
Pedestrians					1			12				
Lane Width (ft)					12.0			12.0				
Walking Speed (ft/s)					3.5			3.5				
Percent Blockage					0			1				
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1399			833			652	1964	424	940	1724	700
vC1, stage 1 conf vol							481	481		837	837	
vC2, stage 2 conf vol							171	1483		103	887	
vCu, unblocked vol	1399			833			652	1964	424	940	1724	700
tC, single (s)	4.1			4.1			*6.5	*5.5	*5.9	*6.5	*5.5	*5.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			95			96	91	95	87	92	96
cM capacity (veh/h)	484			787			516	230	646	374	315	468

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	27	6	815	42	71	1328	75	94
Volume Left	27	0	0	42	0	0	21	48
Volume Right	0	0	812	0	0	1292	33	21
cSH	484	1700	1700	787	1700	1700	409	372
Volume to Capacity	0.06	0.00	0.48	0.05	0.04	0.78	0.18	0.25
Queue Length 95th (ft)	4	0	0	4	0	0	17	25
Control Delay (s)	12.9	0.0	0.0	9.8	0.0	0.0	15.8	17.9
Lane LOS	B			A			C	C
Approach Delay (s)	0.4			0.3			15.8	17.9
Approach LOS							C	C

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	58.2%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	1419	22	23	929	30	15	14	25	49	2	19
Future Volume (Veh/h)	20	1419	22	23	929	30	15	14	25	49	2	19
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	1542	24	25	1010	33	16	15	27	53	2	21
Pedestrians											1	
Lane Width (ft)											12.0	
Walking Speed (ft/s)											3.5	
Percent Blockage											0	
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1044			1566			2175	2692	783	1927	2688	522
vC1, stage 1 conf vol							1598	1598		1078	1078	
vC2, stage 2 conf vol							577	1094		850	1610	
vCu, unblocked vol	1044			1566			2175	2692	783	1927	2688	522
tC, single (s)	4.1			4.1			*6.5	*5.5	*5.9	*6.5	*5.5	*5.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			94			90	93	94	76	99	96
cM capacity (veh/h)	661			418			158	201	422	221	190	580

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	22	1028	538	25	673	370	58	76
Volume Left	22	0	0	25	0	0	16	53
Volume Right	0	0	24	0	0	33	27	21
cSH	661	1700	1700	418	1700	1700	242	266
Volume to Capacity	0.03	0.60	0.32	0.06	0.40	0.22	0.24	0.29
Queue Length 95th (ft)	3	0	0	5	0	0	23	29
Control Delay (s)	10.6	0.0	0.0	14.2	0.0	0.0	24.5	23.9
Lane LOS	B			B			C	C
Approach Delay (s)	0.1			0.3			24.5	23.9
Approach LOS							C	C

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	55.4%	ICU Level of Service	B
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↱			✣			✣	
Traffic Volume (veh/h)	28	40	784	42	19	1299	13	13	0	4	7	0
Future Volume (Veh/h)	28	40	784	42	19	1299	13	13	0	4	7	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	29	42	825	44	20	1367	14	14	0	4	7	0
Pedestrians					5							
Lane Width (ft)					12.0							
Walking Speed (ft/s)					3.5							
Percent Blockage					0							
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1387			42			202	1575	26	882	892	694
vC1, stage 1 conf vol							100	100		792	792	
vC2, stage 2 conf vol							102	1475		91	100	
vCu, unblocked vol	1387			42			202	1575	26	882	892	694
tC, single (s)	4.1			4.1			*6.5	*5.5	6.9	*6.5	*5.5	6.9
tC, 2 stage (s)							5.5	4.5		5.5	4.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			97			98	94	100	99	98	100
cM capacity (veh/h)	490			1565			795	244	1039	407	461	386

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	29	21	21	825	44	13	1374	28	11
Volume Left	29	0	0	0	44	0	0	14	4
Volume Right	0	0	0	825	0	0	1367	0	0
cSH	490	1700	1700	1700	1565	1700	1700	373	440
Volume to Capacity	0.06	0.01	0.01	0.49	0.03	0.01	0.81	0.07	0.02
Queue Length 95th (ft)	5	0	0	0	2	0	0	6	2
Control Delay (s)	12.8	0.0	0.0	0.0	7.4	0.0	0.0	15.4	13.4
Lane LOS	B				A			C	B
Approach Delay (s)	0.4				0.2			15.4	13.4
Approach LOS								C	B

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		

* User Entered Value

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	1467	0	0	867	0	1	0	1	4	0	18
Future Volume (Veh/h)	4	1467	0	0	867	0	1	0	1	4	0	18
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	4	1512	0	0	894	0	1	0	1	4	0	19
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	894			1512			1986	2414	756	1659	2414	447
vC1, stage 1 conf vol							1520	1520		894	894	
vC2, stage 2 conf vol							466	894		765	1520	
vCu, unblocked vol	894			1512			1986	2414	756	1659	2414	447
tC, single (s)	4.1			4.1			*6.5	6.5	*5.9	*6.5	6.5	*5.9
tC, 2 stage (s)							5.5	5.5		5.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			99	100	100	99	100	97
cM capacity (veh/h)	755			438			181	156	436	304	157	636

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	4	756	756	0	0	596	298	2	23
Volume Left	4	0	0	0	0	0	0	1	4
Volume Right	0	0	0	0	0	0	0	1	19
cSH	755	1700	1700	1700	1700	1700	1700	256	535
Volume to Capacity	0.01	0.44	0.44	0.00	0.00	0.35	0.18	0.01	0.04
Queue Length 95th (ft)	0	0	0	0	0	0	0	1	3
Control Delay (s)	9.8	0.0	0.0	0.0	0.0	0.0	0.0	19.2	12.0
Lane LOS	A							C	B
Approach Delay (s)	0.0				0.0			19.2	12.0
Approach LOS								C	B

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	15		

* User Entered Value

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