5.0 PLANNING LEVEL COST ESTIMATES

The Planning Level Cost Estimates for each site consist of acquisition, development, and operation costs, as detailed in the following sections. Development costs can be further broken down into overall development costs incurred during the entire useful life of the site, and initial development costs required to initially get the site up and operating. All costs are presented in 2012 dollars. Once a site is chosen as the proposed landfill site, more detailed cost estimates will be developed in the Conceptual Design phase of this project.

5.1 SITE ACQUISITION COST ESTIMATES

Figure 5-1 through Figure 5-8 display the tax map key information and assessed values of the parcels occupied by the eight potential landfill sites. Based on these land values, Table 5-1 summarizes the estimated site acquisition cost for each site, both in total dollars and in terms of dollars per estimated site life (years). For the Kekaha Mauka and Ma‘alo sites, it is assumed that the County would not need to purchase State lands.

The assessed land values likely underestimate the true purchase costs of the sites, assuming a willing landowner was willing to negotiate.

Table 5-1: Land Acquisition Cost Estimates

Parameter	Kalepa	Kekaha-Mauka	Kipu	Koloa	Kumukumu	Ma‘alo	Pu‘u O Papai	Umi
Potential Landfill Site Size (Acres)	77.6	175.9	145.8	125.4	172.9	270.2	145.7	126.7
Assessed Property Value ($)	157,655	7,806	144,460	108,865	1,416,064	882,663	135,705	486,215
Cost of Site Acquisition [a] ($)	157,655	0	144,460	108,865	1,416,064	0	135,705	486,215
Contingency (25%)	39,414	0	36,115	27,216	354,016	0	33,926	121,554
Subtotal Acquisition Cost ($)	197,069	0	180,575	136,081	1,770,080	0	169,631	607,769
Site Life (years)	26	60	56	69	104	264	95	53
Site Acquisition Cost per Year ($/yr)	6,064	0	2,580	1,578	13,616	0	1,428	9,174

Note: 2012 dollars
[a] It is anticipated that the County would not need to purchase State- or Federally-owned land at Kekaha Mauka or Ma‘alo.

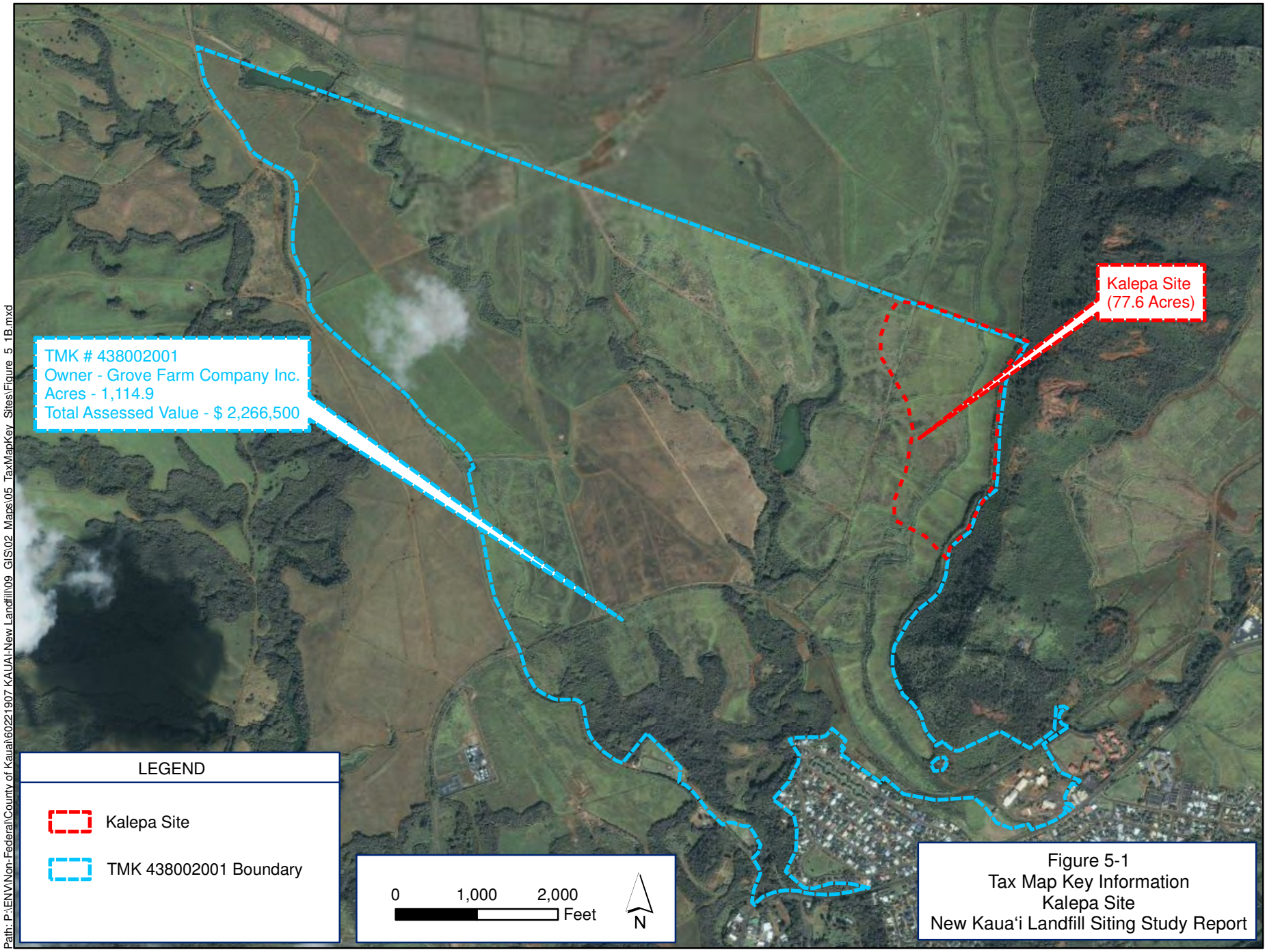

Figure 5-1
Tax Map Key Information
Kalepa Site
New Kaua'i Landfill Siting Study Report

Path: P:\ENV\Non-Federal\County of Kauai\60221907 KAUAI-New Landfill\09_GIS\02_Maps\05_TaxMapKey_Sites\Figure_5_1B.mxd

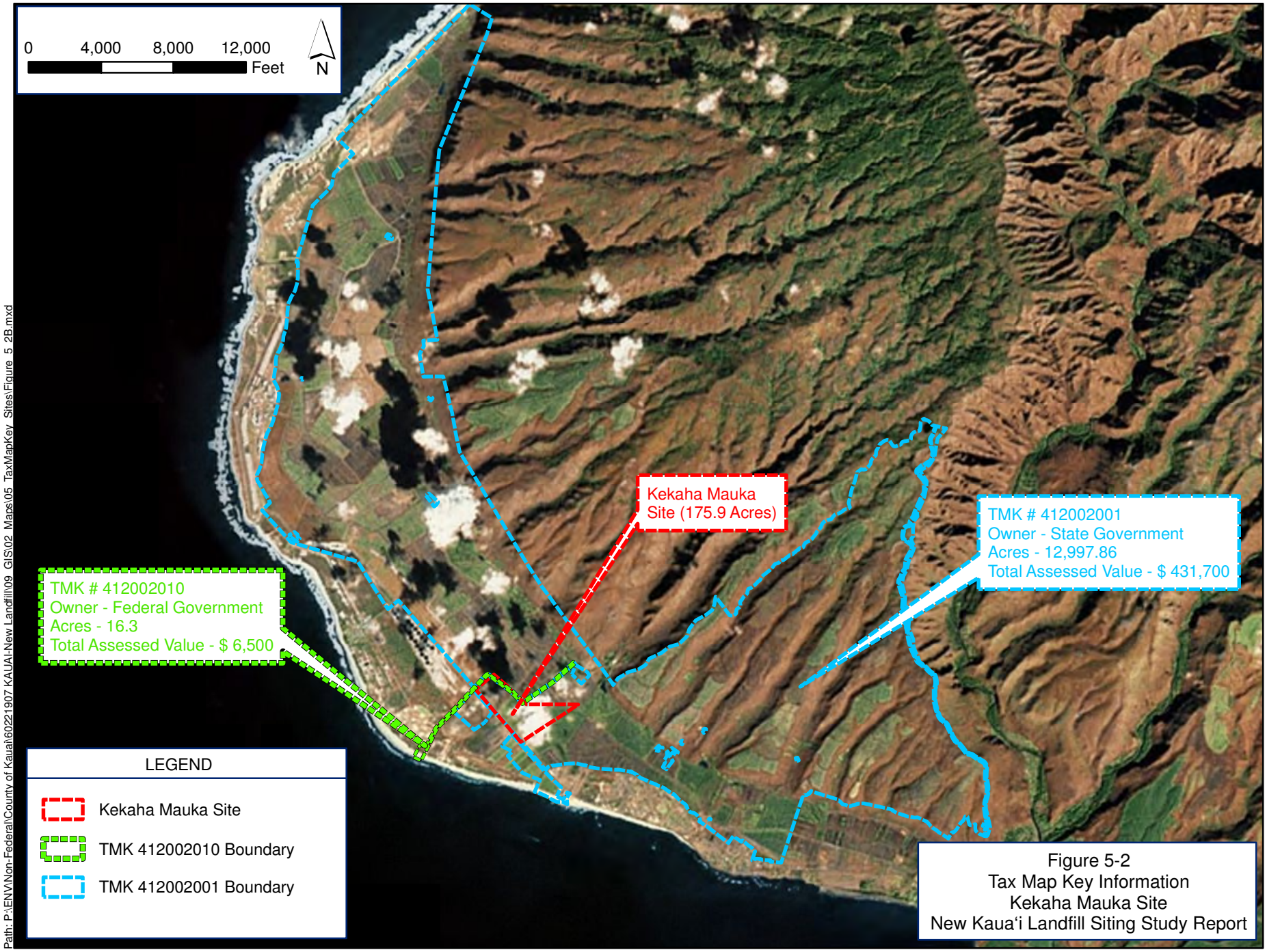

Figure 5-2
Tax Map Key Information
Kekaha Mauka Site
New Kaua'i Landfill Siting Study Report

Path: P:\ENV\Non-Federal\County of Kauai\6021907 KAUAI-New Landfill\09_GIS\02_Maps\05_TaxMapKey_Sites\Figure_5_2B.mxd

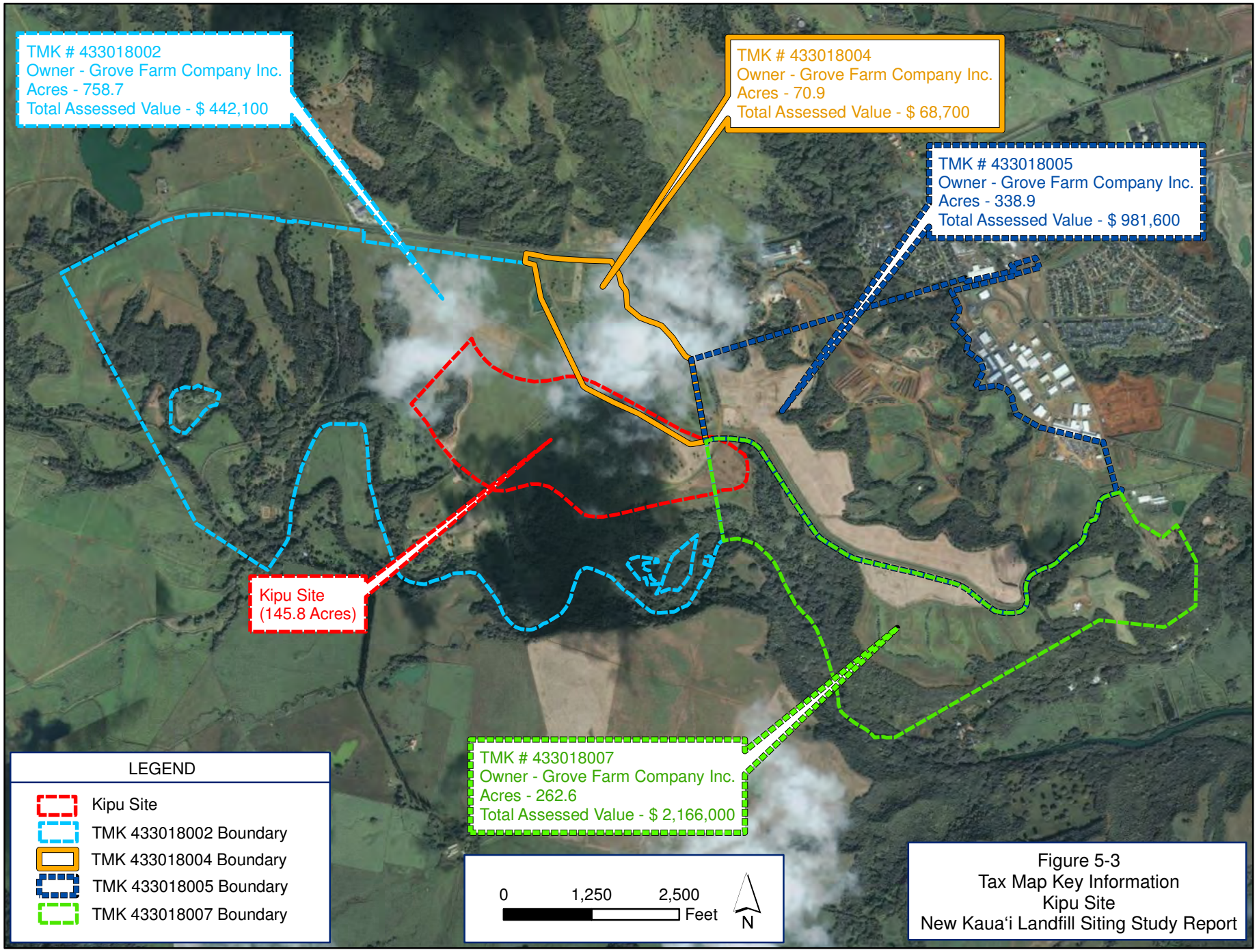

Figure 5-3
Tax Map Key Information
Kipu Site
New Kaua'i Landfill Siting Study Report

Path: P:\ENV\Non-Federal\County of Kauai\60221907 KAUAI-New Landfill\09_GIS\02_Maps\05_TaxMapKey_Sites\Figure_5_3B.mxd

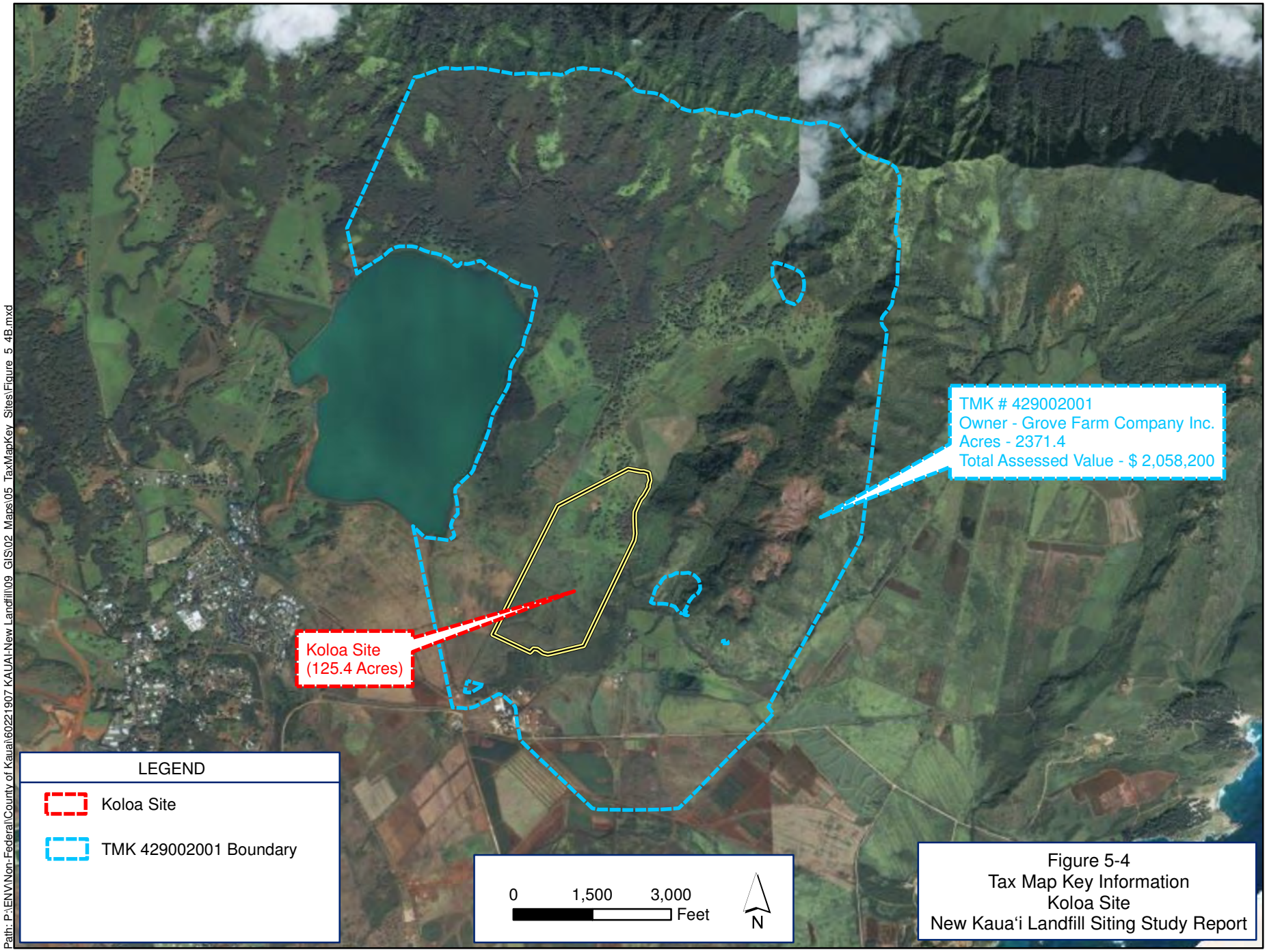

Figure 5-4
Tax Map Key Information
Koloa Site
New Kaua'i Landfill Siting Study Report

Path: P:\ENV\Non-Federal\County of Kauai\60221907 KAUAI-New Landfill\09_GIS\02_Maps\05_TaxMapKey_Sites\Figure_5_4B.mxd

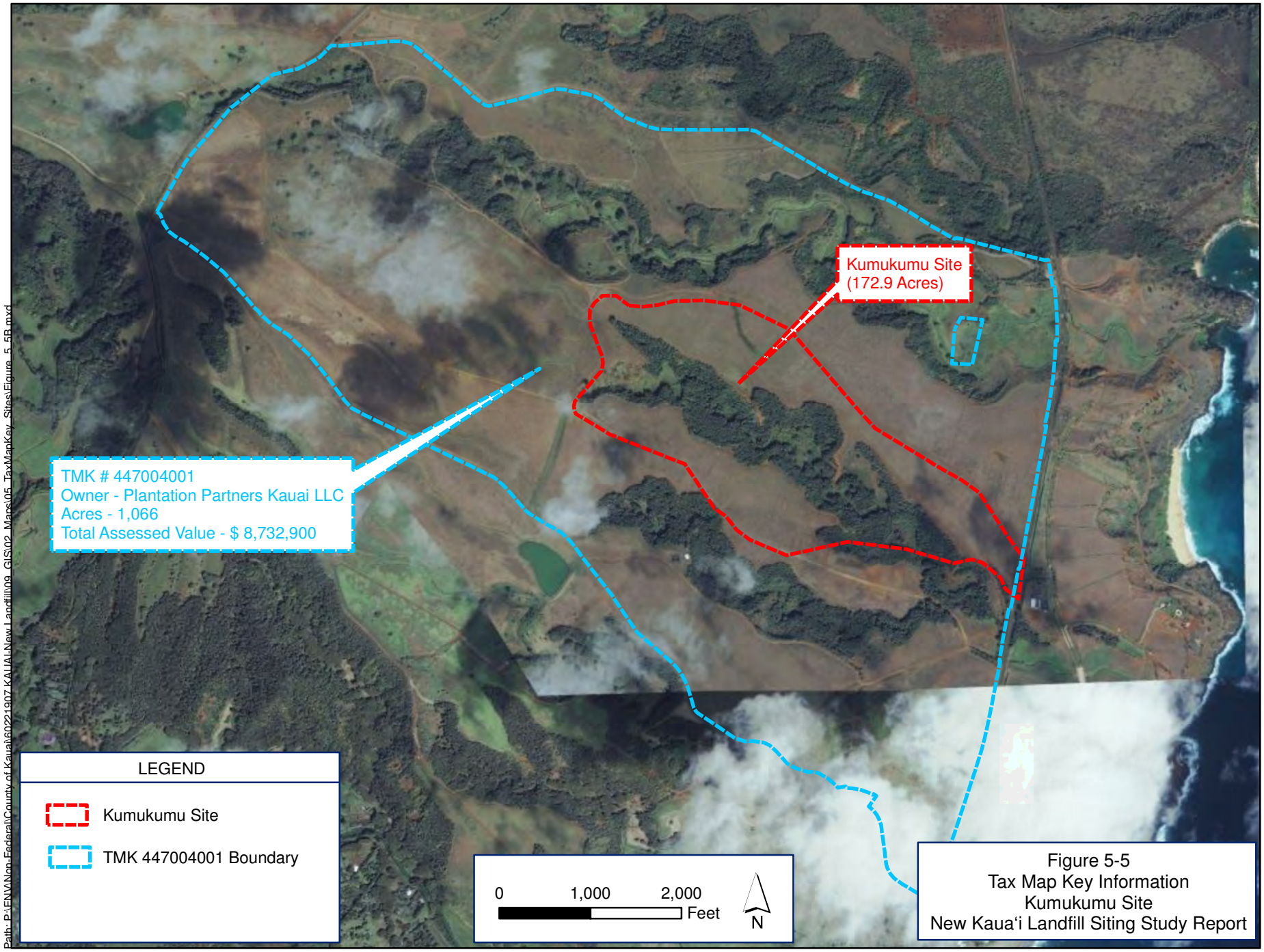

Figure 5-5
Tax Map Key Information
Kumukumu Site
New Kaua'i Landfill Siting Study Report

Path: P:\ENV\Non-Federal\County of Kauai\60221907 KAUAI\New Landfill\09_GIS\02_Maps\05_TaxMapKey_Sites\Figure_5_5B.mxd

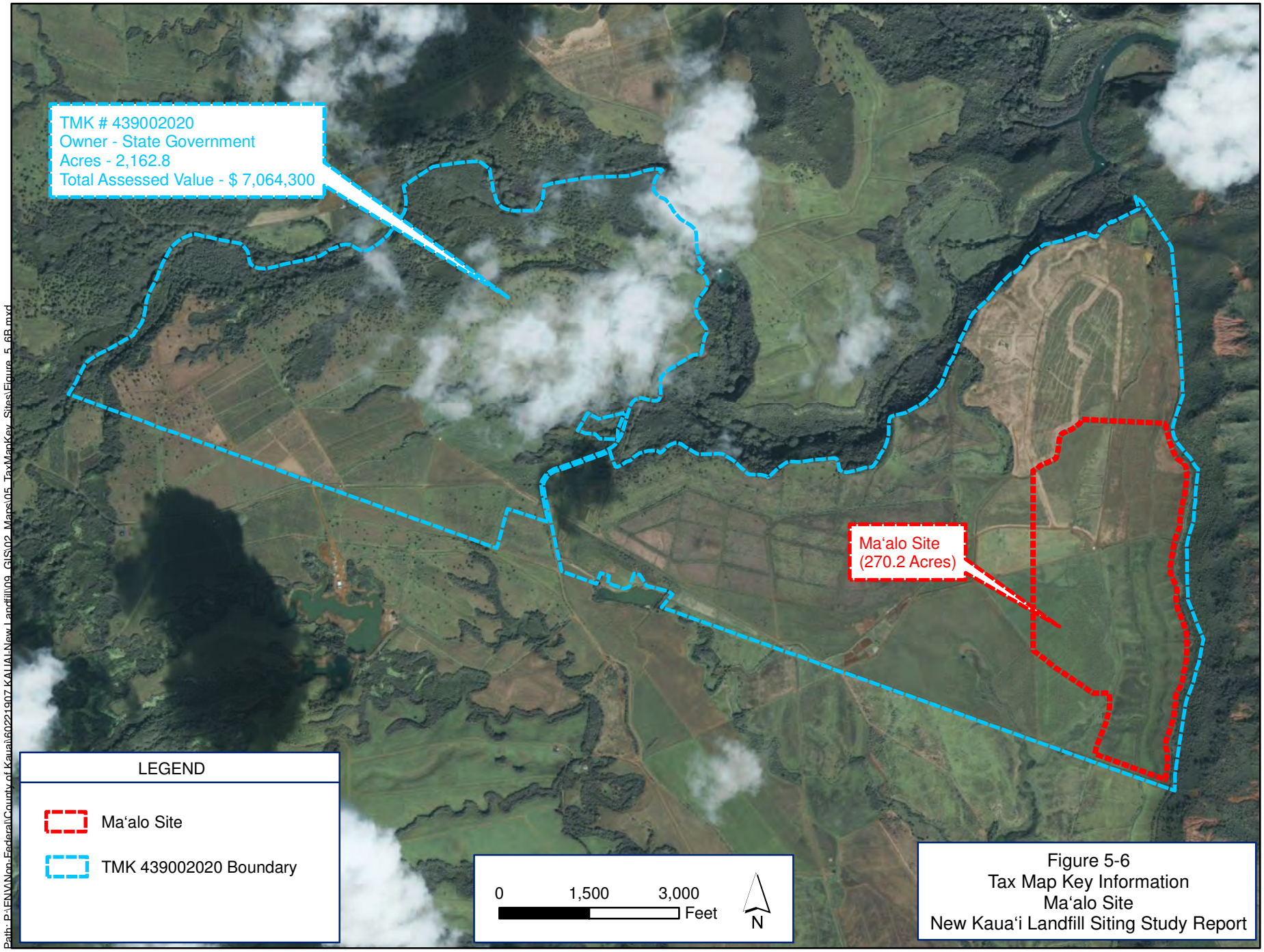

Figure 5-6
Tax Map Key Information
Ma‘alo Site
New Kaua‘i Landfill Siting Study Report

Path: P:\ENV\Non-Federal\County of Kauai\60221907 KAUAI\New Landfill\09_GIS\02_Maps\05_TaxMapKey_Sites\Figure_5_6B.mxd

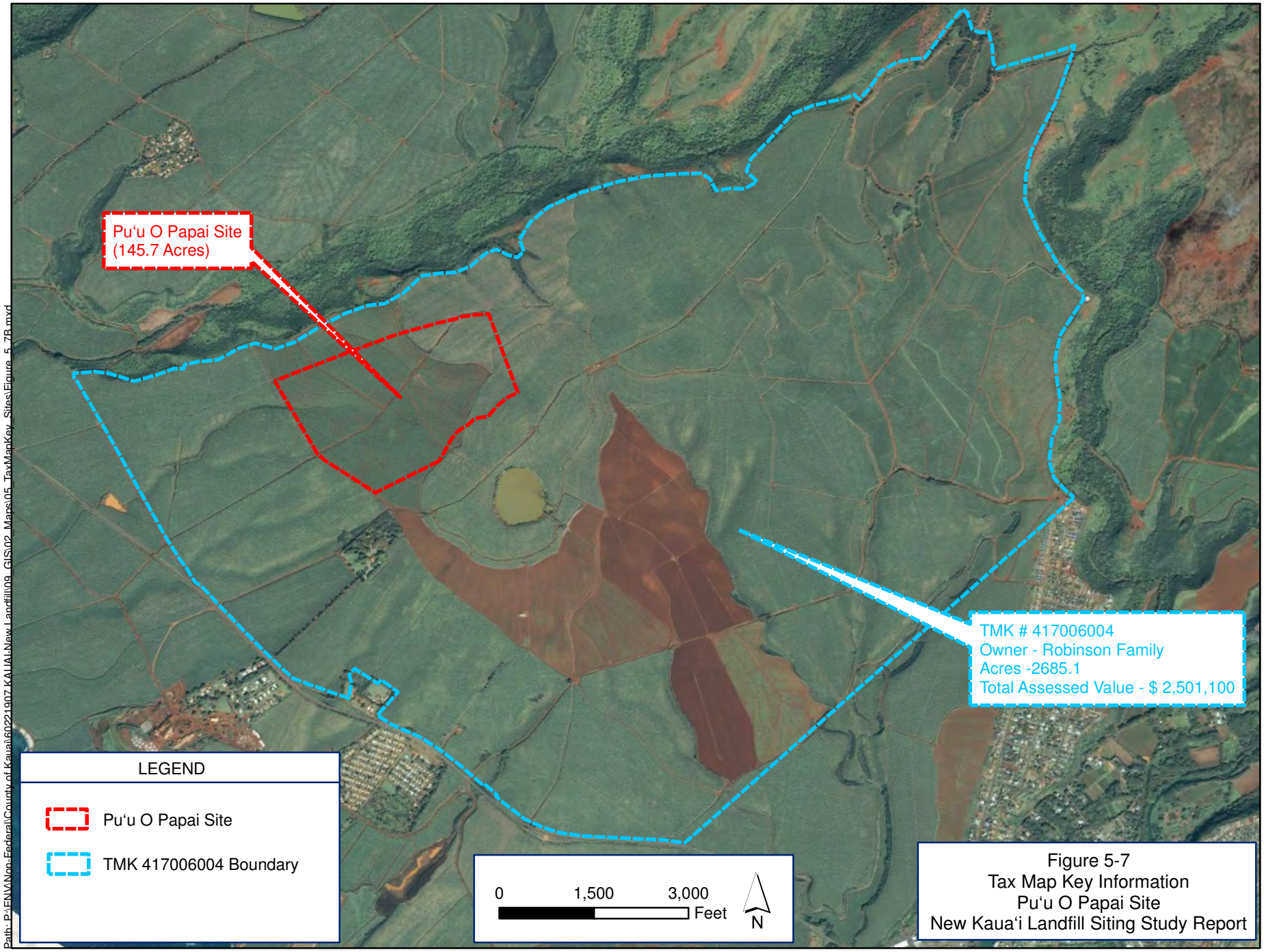

Figure 5-7
Tax Map Key Information
Pu‘u O Papai Site
New Kaua‘i Landfill Siting Study Report

Path: P:\ENV\Non-Federal\County of Kauai\60221907 KAUAI\New Landfill\09_GIS\02_Maps\05_TaxMapKey_Sites\Figure_5_7B.mxd

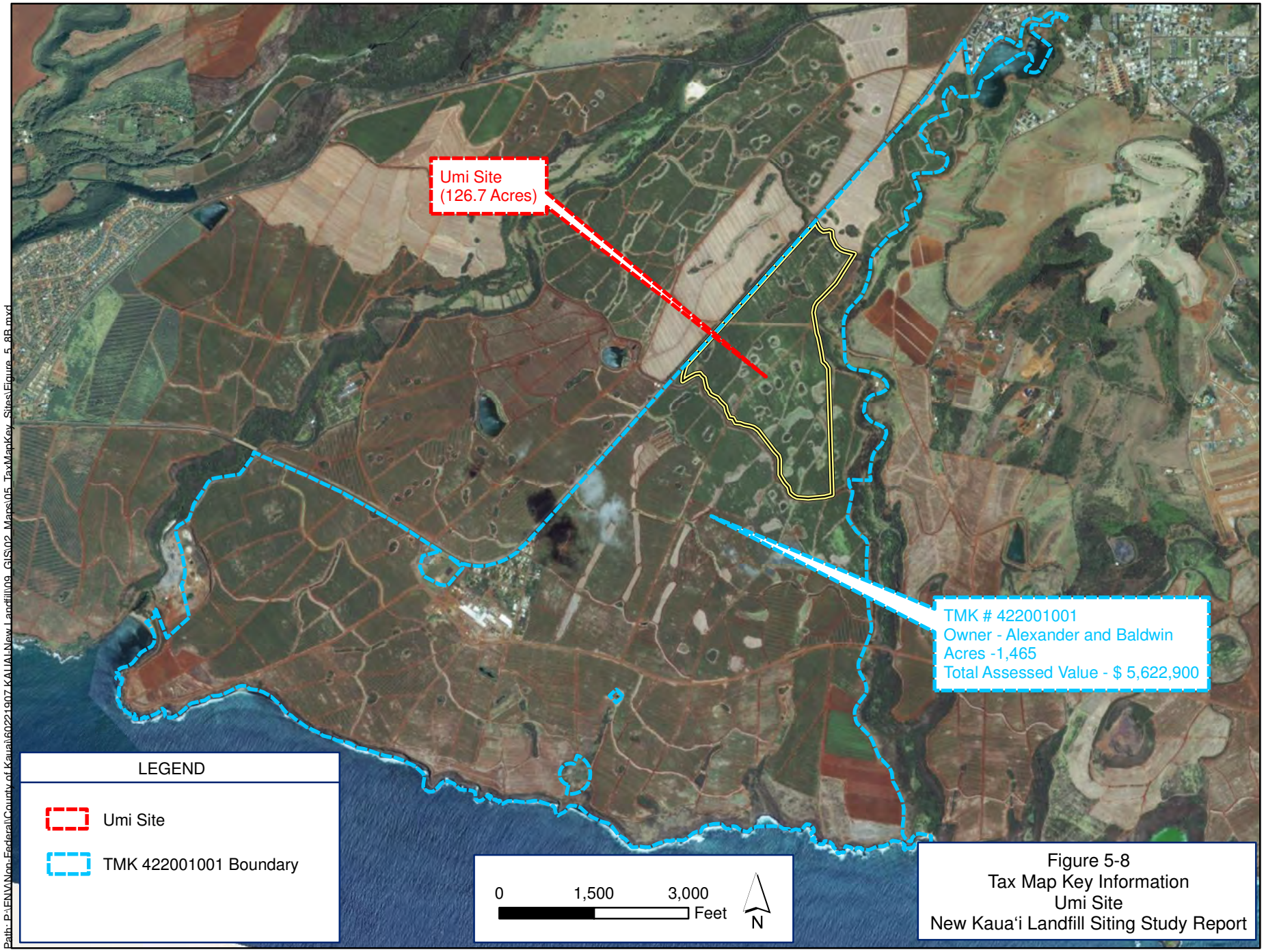

Figure 5-8
Tax Map Key Information
Umi Site
New Kaua'i Landfill Siting Study Report

Path: P:\ENV\Non-Federal\County of Kauai\60221907 KAUAI\New Landfill\09_GIS\02_Maps\05_TaxMapKey_Sites\Figure_5_8B.mxd

5.2 SITE DEVELOPMENT COST ESTIMATES

This siting study has developed planning level site development costs at two stages: initial construction, required prior to receiving waste at the landfill; and final construction, which will be completed subsequent to landfilling all waste over the site's useful lifetime. While the initial development cost estimate is of immediate importance to the County's decision making process, the final development cost, expressed in terms of dollars per year of site operation, is considered a more reasonable basis of comparison for the CCE evaluation. This total, overall cost per year of construction over the entire landfill life presents a clearer picture of the life-cycle costs, and is therefore used in CCE criterion number 20 (cost of development). No interest or discount rates are applied to this economic evaluation; costs estimates are provided in 2012 dollars.

Section 4.3 and Figure 4-1 through Figure 4-16 present the conceptual models for site development, for both initial and final construction. Table 5-2 describes the phasing of the development features presented in Section 4.3, and presents the basis of the cost estimates which follow. Table 5-3 summarizes the initial development cost for each site. Table 5-4 summarizes the final site development cost for each site, both in total dollars and in dollars per year of estimated site life. Costs allowances have been added for design and permitting (12%), and a uniform contingency has been allotted (10%).

The site with the lowest estimated cost of initial site development is Kekaha-Mauka, followed by Koloa and Kipu. The site with the lowest estimated cost of total site development, in terms of dollars per year of site life, is Ma‘alo, followed by Kumukumu and Pu‘u O Papai.

Table 5-2: Phasing of the Development Features and Basis of Cost Estimates

Development Item	Initial Construction	Final Construction	Cost Basis
Clearing and Grubbing	Most areas of the final landfill footprint require clearing and grubbing, except the limit of waste area beyond Cell 1 construction, which are assumed better left vegetated, for erosion control and stormwater retention.	Sometime between the end of cell 1 operations and the end of the useful lifetime, the entire landfill footprint will be cleared and grubbed.	Unit cost is based on a local construction cost estimating database.
Excavation	The cell 1 footprint will be excavated prior to construction.	The entire limits of waste (LOW) will eventually be excavated. For planning purposes all sites are assumed to be excavated 10 ft bgs, except Kekaha Mauka, which is assumed to be excavated 5 ft bgs.	Unit cost is based on a local construction cost estimating database.
Temporary Erosion Control, Dust Control, & BMP Maintenance during construction	This cost is incurred during initial construction.	A smaller cost is incurred for each expansion cell (assumed every five years).	Lump sum cost is based on the recent expansion of the existing Kekaha Phase II landfill.
Subgrade Prep, Install Liner, LFG, Leachate Systems	Initial cost for construction of cell 1.	This cost will be incurred for the entire LOW footprint.	Unit cost is based on the recent expansion of the existing Kekaha Phase II landfill.
CM/CQA	Required for cell 1.	Required for each expansion cell (assumed every five years).	Unit cost is based on AECOM's CM/CQA services for the recent expansion of the West Hawaii landfill on the Big Island.
Leachate Evaporation Pond	This cost is incurred during initial construction.	The leachate pond initially constructed is used for the entire site life (landfilled waste eventually gets capped, in phases, and stops producing significant leachate).	Unit cost is based on the recent expansion of the existing Kekaha Phase II landfill.
Drainage Improvements	Initial drainage improvements for cell 1 and for managing run-on and runoff, as shown in Figures 4-9 through 4-16.	Drainage improvements will eventually encompass the site.	Planning level cost estimate is based on the site schematics.
Infiltration Basin	Initial infiltration basins will be similar to that present at the existing Kekaha Phase II landfill, scaled upwards to account for site-specific rainfall intensity.	As the landfill becomes larger over the years, additional engineering features will be added to complement the infiltration basin. No additional costs input for now, but this will be further developed during design of the chosen site.	Unit cost is based on the recent expansion of the existing Kekaha Phase II landfill.
Office Building	To be constructed as part of the initial construction.	-	Unit cost is based on a local construction cost estimating database.
Shop	To be constructed as part of the initial construction.	-	Unit cost is based on a local construction cost estimating database.
Scale and Scalehouse	To be constructed as part of the initial construction.	-	Unit cost is based on a recent local purchase and installation by a private party on Oahu, with a slight escalation for the Island of Kauai.
Dropoff Facility	To be constructed as part of the initial construction.	-	Unit cost is based on the recent expansion of the existing Kekaha Phase II landfill.
Site Work	To be constructed as part of the initial construction.	-	Unit cost is based on a local construction cost estimating database.
Access Road	To be constructed as part of the initial construction.	-	Unit cost is based on a local construction cost estimating database.
Utilities	To be constructed as part of the initial construction.	-	Unit cost is based on a local construction cost estimating database.
Visual Impact Mitigation	To be constructed as part of the initial construction; phased implementation for some of the larger sites.	Full, phased implementation to be completed prior to closure.	Cost reflects the in-progress recent cost estimate being developed for the existing Kekaha Phase II landfill by a local landscape architect.
Traffic Flow	To be constructed as part of the initial construction.	-	Unit cost is based on a local construction cost estimating database.
Noise	To be constructed as part of the initial construction.	-	Unit cost is based on a local construction cost estimating database.
Heavy Equipment Purchase	To be purchased as part of the initial construction.	-	Contingency cost allocation.

Table 5-3: Landfill Development Initial Cost Estimates

Item	Unit	Unit Cost ($/unit)	Kalepa		Kekaha Mauka		Kipu		Koloa		Kumukumu		Ma'alo		Pu'u O Pa'pai		Umi	
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Clearing and Grubbing	AC (total)	2,500	40	99,589	70	175,294	49	122,344	60	151,183	66	165,414	58	144,297	47	116,698	54	135,283
Excavation	1,000 C.Y.	6,000.00	194	1,161,600	97	580,800	194	1,161,600	194	1,161,600	194	1,161,600	194	1,161,600	194	1,161,600	194	1,161,600
Temporary Erosion Control, Dust Control, & BMP Maintenance	L.S./Cell	120,000	1	120,000	1	120,000	1	120,000	1	120,000	1	120,000	1	120,000	1	120,000	1	120,000
Subgrade Prep, Install Liner, LFG, Leachate Systems	AC (LOW)	1,000,000	12	12,000,000	12	12,000,000	12	12,000,000	12	12,000,000	12	12,000,000	12	12,000,000	12	12,000,000	12	12,000,000
CM/CQA	AC (LOW)	30,000	12	360,000	12	360,000	12	360,000	12	360,000	12	360,000	12	360,000	12	360,000	12	360,000
Leachate Evaporation Pond	L.S.	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000
Drainage Improvements	L.F.	50	8,600	430,000	8,400	420,000	11,600	580,000	10,100	505,000	13,400	670,000	15,800	790,000	10,200	510,000	11,900	595,000
Infiltration Basin	AC	100,000	3.3	330,000	2.0	200,000	2.9	290,000	2.9	290,000	3.7	370,000	3.2	320,000	2.1	210,000	2.2	220,000
Office Building	S.F.	350	2,000	700,000	2,000	700,000	2,000	700,000	2,000	700,000	2,000	700,000	2,000	700,000	2,000	700,000	2,000	700,000
Shop	S.F.	250	3,200	800,000	3,200	800,000	3,200	800,000	3,200	800,000	3,200	800,000	3,200	800,000	3,200	800,000	3,200	800,000
Scale and Scalehouse	L.S.	200,000	1	200,000	0	0	1	200,000	1	200,000	1	200,000	1	200,000	1	200,000	1	200,000
Public Dropoff Facility	L.S.	300,000	1	300,000	0	0	1	300,000	1	300,000	1	300,000	1	300,000	1	300,000	1	300,000
Site Work	S.F.	25	31,000	775,000	38,000	950,000	34,000	850,000	37,000	925,000	40,000	1,000,000	43,000	1,075,000	41,000	1,025,000	42,000	1,050,000
Access Road																		
Paved	L.F.	110	9,223	1,014,530	3,100	341,000	2,840	312,400	5,978	657,580	1,940	213,400	8,666	953,260	3,220	354,200	5,258	578,380
Unpaved	L.F.	60	6,590	395,400	9,150	549,000	9,000	540,000	7,600	456,000	8,950	537,000	8,240	494,400	8,450	507,000	8,495	509,700
Utilities																		
Water Supply Line	L.F.	100	9,223	922,300	3,100	310,000	2,840	284,000	1,800	180,000	1,940	194,000	-	-	2,925	292,500	2,885	288,500
Irrigation System	L.S.	4,850,000	-	-	-	-	-	-	-	-	-	-	1	4,850,000	-	-	-	-
Water Treatment and Pump Station	L.S.	350,000	-	-	-	-	-	-	1	350,000	-	-	-	-	1	350,000	-	-
Electric	L.F.	200	9,223	1,844,600	3,100	620,000	2,840	568,000	1,800	360,000	1,940	388,000	8,666	1,733,200	3,220	644,000	2,885	577,000
Septic System	L.S.	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000
Visual Impact Mitigation	L.F.	75	5,285	396,338	7,150	536,250	7,358	551,850	4,547	341,006	13,211	990,844	9,373	702,975	10,030	752,213	11,703	877,744
Traffic Flow																		
Signalization	L.S.	500,000	1	500,000	-	-	1	500,000	-	-	-	-	1	500,000	1	500,000	1	500,000
Acceleration/Deceleration Lanes	L.S.	500,000	2	1,000,000	1	500,000	1	500,000	-	-	2	1,000,000	2	1,000,000	1	500,000	1	500,000
Noise	L.F.	100	1,369	136,900	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heavy Equipment Purchase (Compaction, etc.)	L.S.	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000
Subtotal				25,086,257		20,762,344		22,340,194		21,457,369		22,770,258		29,804,732		23,003,210		23,073,206
Kauai General Excise Tax (4.166%)				1,045,093		864,959		930,692		893,914		948,609		1,241,665		958,314		961,230
Contingency (10%)				2,508,626		2,076,234		2,234,019		2,145,737		2,277,026		2,980,473		2,300,321		2,307,321
Subtotal				28,639,976		23,703,538		25,504,906		24,497,020		25,995,893		34,026,871		26,261,845		26,341,757
Design and Permitting (12%)				3,436,797		2,844,425		3,060,589		2,939,642		3,119,507		4,083,224		3,151,421		3,161,011
Initial Development Cost ($MM)				32.1		26.5		28.6		27.4		29.1		38.1		29.4		29.5
Site Acquisition ($MM)				0.2		0.0		0.2		0.1		1.8		0.0		0.2		0.6
Total Initial Cost ($MM)				**32.3**		**26.5**		**28.7**		**27.6**		**30.9**		**38.1**		**29.6**		**30.1**

Table 5-4: Landfill Development Final Cost Estimates

		Unit Cost	Kalepa		Kekaha Mauka		Kipu		Koloa		Kumukumu		Ma'alo		Pu'u O Pa'pai		Umi	
Item	**Unit**	**($/unit)**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**
Clearing and Grubbing	AC (total)	2,500	78	195,000	176	440,000	146	365,000	125	312,500	173	432,500	270	675,000	146	365,000	127	317,500
Excavation	1,000 C.Y.	6,000.00	710	4,259,200	686	4,114,000	1,178	7,066,400	1,226	7,356,800	1,646	9,873,600	3,130	18,779,200	1,549	9,292,800	1,162	6,969,600
Temporary Erosion Control, Dust Control, & BMP Maintenance	L.S./Cell	120,000	6	720,000	12	1,440,000	12	1,440,000	14	1,680,000	21	2,520,000	53	6,360,000	19	2,280,000	11	1,320,000
Subgrade Prep, Install Liner, LFG, Leachate Systems	AC (LOW)	1,000,000	44	44,000,000	85	85,000,000	73	73,000,000	76	76,000,000	102	102,000,000	194	194,000,000	96	96,000,000	72	72,000,000
CM/CQA	AC (LOW)	30,000	44	1,320,000	85	2,550,000	73	2,190,000	76	2,280,000	102	3,060,000	194	5,820,000	96	2,880,000	72	2,160,000
Leachate Evaporation Pond	L.S.	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000	1	1,500,000
Drainage Improvements	L.F.	50	8,600	430,000	8,400	420,000	11,600	580,000	10,100	505,000	13,400	670,000	15,800	790,000	10,200	510,000	11,900	595,000
Infiltration Basin	AC	100,000	3.3	330,000	2.0	200,000	2.9	290,000	2.9	290,000	3.7	370,000	3.2	320,000	2.1	210,000	2.2	220,000
Office Building	S.F.	350	2,000	700,000	2,000	700,000	2,000	700,000	2,000	700,000	2,000	700,000	2,000	700,000	2,000	700,000	2,000	700,000
Shop	S.F.	250	3,200	800,000	3,200	800,000	3,200	800,000	3,200	800,000	3,200	800,000	3,200	800,000	3,200	800,000	3,200	800,000
Scale and Scalehouse	L.S.	200,000	1	200,000	0	0	1	200,000	1	200,000	1	200,000	1	200,000	1	200,000	1	200,000
Public Dropoff Facility	L.S.	300,000	1	300,000	0	0	1	300,000	1	300,000	1	300,000	1	300,000	1	300,000	1	300,000
Site Work	S.F.	25	31,000	775,000	38,000	950,000	34,000	850,000	37,000	925,000	40,000	1,000,000	43,000	1,075,000	41,000	1,025,000	42,000	1,050,000
Access Road																		
Paved	L.F.	110	9,223	1,014,530	3,100	341,000	2,840	312,400	5,978	657,580	1,940	213,400	8,666	953,260	3,220	354,200	5,258	578,380
Unpaved	L.F.	60	6,590	395,400	9,150	549,000	9,000	540,000	7,600	456,000	8,950	537,000	8,240	494,400	8,450	507,000	8,495	509,700
Utilities																		
Water Supply Line	L.F.	100	9,223	922,300	3,100	310,000	2,840	284,000	1,800	180,000	1,940	194,000	-	-	2,925	292,500	2,885	288,500
Irrigation System	L.S.	4,850,000	-	-	-	-	-	-	-	-	-	-	1	4,850,000	-	-	-	-
Water Treatment and Pump Station	L.S.	350,000	-	-	-	-	-	-	1	350,000	-	-	-	-	1	350,000	-	-
Electric	L.F.	200	9,223	1,844,600	3,100	620,000	2,840	568,000	1,800	360,000	1,940	388,000	8,666	1,733,200	3,220	644,000	2,885	577,000
Septic System	L.S.	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000
Visual Impact Mitigation	L.F.	75	5,285	396,338	7,150	536,250	7,358	551,850	4,547	341,006	13,211	990,844	9,373	702,975	10,030	752,213	11,703	877,744
Traffic Flow																		
Signalization	L.S.	500,000	1	500,000	-	-	1	500,000	-	-	-	-	1	500,000	1	500,000	1	500,000
Acceleration/Deceleration Lanes	L.S.	500,000	2	1,000,000	1	500,000	1	500,000	-	-	2	1,000,000	2	1,000,000	1	500,000	1	500,000
Noise	L.F.	100	1,369	136,900	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heavy Equipment Purchase (Compaction, etc.)	L.S.	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000	1	50,000
Subtotal				61,839,268		101,070,250		92,637,650		95,293,886		126,849,344		241,653,035		120,062,713		92,063,424
Kauai General Excise Tax (4.166%)				2,576,224		4,210,587		3,859,284		3,969,943		5,284,544		10,067,265		5,001,813		3,835,362
Contingency (10%)				6,183,927		10,107,025		9,263,765		9,529,389		12,684,934		24,165,304		12,006,271		9,206,342
Subtotal				70,599,418		115,387,862		105,760,699		108,793,218		144,818,822		275,885,604		137,070,796		105,105,128
Design and Permitting (12%)				8,471,930		13,846,543		12,691,284		13,055,186		17,378,259		33,106,272		16,448,496		12,612,615
Total Cost ($ MM)				79		129		118		122		162		309		154		118
Cost Per Year of Site Life ($MM/yr)				**3.04**		**2.15**		**2.12**		**1.77**		**1.56**		**1.17**		**1.62**		**2.22**

5.3 SITE OPERATION COST ESTIMATES

Based on the site conceptual schematics presented in the PREE (Section 4.0), and our experience at the existing Kekaha Phase II landfill and other landfill sites in the state, estimates of the site operational costs have been produced. A brief description of the basis for each cost item follows.

- Basic Landfill Operation Costs – Waste Management currently operates the existing Kekaha Phase II landfill. While their costs per month vary according to amount of waste accepted and other factors, the cost shown represents the best estimate, developed in consultation with the DPW. Other items included in this cost include equipment maintenance, equipment rental, utility costs, infrastructure operation, maintenance and repairs, tools, supplies, and office supplies. The cost is based on current operating costs provided by the DPW, and is expected to be similar for each site.
- Onsite Labor Costs – County employees comprise most of the staff that operate the landfill, which results in labor costs, including fringe benefits and overtime. Similar costs are incurred by administrative support personnel. The cost is based on current operating costs provided by the DPW, and is expected to be similar for each site.
- Wet Weather Operations – Sites with higher annual rainfall and more intense storms will require additional costs for wet weather operations, such as maintaining gravel access roads. We have estimated that the wettest site (Kumukumu) may require $60,000/year of wet weather costs, and s caled the other site's wet weather costs downwards, based on historical rainfall data.
- Semi-annual Groundwater Monitoring and Reporting – It is assumed that each site will require a s emi-annual groundwater detection monitoring program for compliance with applicable regulations. The cost is based on similar programs in the state.
- Regulatory Compliance - National Pollutant Discharge Elimination System (NPDES) – Each site will require an annual NPDES compliance program for compliance with applicable regulations. The cost is based on similar programs on the island and in the state.
- Regulatory Compliance - Surface Water & Spill Prevention – Each site will require an annual surface water & spill prevention compliance program for compliance with applicable regulations. The cost is based on similar programs on the island and in the state.
- Daily/Alternate Cover – The DPW has provided data for the amount of cover soil used during the last year at the existing Kekaha facility. It is assumed that the soil initially excavated from the site (as quantified in the PREE, Section 4.0) will be available for use as daily cover, at a constant rate per year of site life, and that the County will have to procure the remainder of the soil from offsite locations. During the next task of this project (engineering design), these quantity estimates will be refined, using among other things, the results of the geotechnical investigations at the selected site.
- It is quite possible, especially for the larger sites, that different sources of cover material will be required over time. We have assumed that the DPW will identify sources of cover material that need not be purchased, and that the County will have to pay for handling and transportation, as is currently done at the existing Kekaha Phase II landfill. Therefore, for planning purposes, we have calculated the shipping and handling costs based on am ount required, and distance of the site from Lihue, the most active portion of the island, where material may most likely be found. Shipping unit costs are based on a local construction cost estimating database.
- Operations Plan and Solid Waste Permit Update (5-yr cycle) – These items are assumed to be updated every five years, with costs spread out accordingly. The cost is based on similar programs on the island and in the state.

- LFG System Operation; Probe Measurements – It is assumed that each site will require LFG system operation and probe monitoring program. The cost is based on similar programs on the island and in the state.

Table 5-5 summarizes the estimated annual site operation costs for each site. A uniform contingency (10%) has been allotted. The estimated annual operation costs for each site do not vary greatly, with the least expensive sites (Kipu and Kalepa) only 5% less expensive than the most expensive site (Kekaha-Mauka).

Table 5-5: Landfill Operations Costs

			Kalepa		Kekaha Mauka		Kipu		Koloa		Kumukumu		Ma‘alo		Pu‘u O Pa‘pai		Umi	
Item	**Unit**	**Unit Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**
Basic Landfill Operation Costs	L.S.	2,450,000	1	2,450,000	1	2,450,000	1	2,450,000	1	2,450,000	1	2,450,000	1	2,450,000	1	2,450,000	1	2,450,000
Onsite Labor Cost	L.S.	1,815,000	1	1,815,000	1	1,815,000	1	1,815,000	1	1,815,000	1	1,815,000	1	1,815,000	1	1,815,000	1	1,815,000
Wet Weather Operations	S.I.[a]	60,000	0.89	53,603	0.54	32,632	0.79	47,126	0.79	47,530	1.00	60,000	0.87	52,146	0.57	34,494	0.60	35,789
Semi-annual Groundwater Monitoring and Reporting	L.S.	80,000	1	80,000	1	80,000	1	80,000	1	80,000	1	80,000	1	80,000	1	80,000	1	80,000
Regulatory Compliance - NPDES	L.S.	60,000	1	60,000	1	60,000	1	60,000	1	60,000	1	60,000	1	60,000	1	60,000	1	60,000
Regulatory Compliance - Surface Water & Spill Prevention	L.S.	25,000	1	25,000	1	25,000	1	25,000	1	25,000	1	25,000	1	25,000	1	25,000	1	25,000
Daily/Alternate Cover	1000 CY*MI	233	22	5,043	612	142,736	42	9,792	177	41,388	201	46,962	72	16,715	375	87,473	164	38,184
Operations Plan and Solid Waste Permit Update (5-yr cycle)	L.S.	10,000	1	10,000	1	10,000	1	10,000	1	10,000	1	10,000	1	10,000	1	10,000	1	10,000
Landfill Gas System Operation; Probe Measurements	L.S.	150,000	1	150,000	1	150,000	1	150,000	1	150,000	1	150,000	1	150,000	1	150,000	1	150,000
Subtotal				4,648,647		4,765,367		4,646,917		4,678,918		4,696,962		4,658,860		4,711,966		4,663,974
Kauai GET (4.166%)				193,663		198,525		193,591		194,924		195,675		194,088		196,301		194,301
Contingency (10%)				464,865		476,537		464,692		467,892		469,696		465,886		471,197		466,397
Total Annual Operations Cost ($MM/yr)				**5.31**		**5.44**		**5.31**		**5.34**		**5.36**		**5.32**		**5.38**		**5.33**

[a] S.I. = storm intensity (based on in/hr for the 25-year storm, see CCE Criterion # 16), as a fraction of the "wettest" site (Kumukumu).

5.4 PLANNING LEVEL COST ESTIMATE SUMMARY

Based on the foregoing data, Table 5-6 summarizes and compares the cost estimates for each site. The first four rows of data present the overall costs, normalized per year of site life, which are the values used in the CCE; the last row shows the estimated cost of initial construction for each site. The largest sites are expected to be significantly less expensive over time for the County and all of its residents. The three least expensive sites per year of operation, in order, are Ma‘alo, Kumukumu, and Pu‘u O Papai. In fact, this effect is understated as it does not include, for the smaller sites, the additional cycles of landfill siting, EIS, site investigation, design, and permitting required each time a site is closed and a new site must be identified and analyzed. Therefore, in reality, the larger sites are expected to be even less expensive over their entire life (relative to the smaller sites) than these numbers suggest.

Table 5-6: Summary of Cost Estimates

Cost Per Year of Site Life	Kalepa	Kekaha-Mauka	Kipu	Koloa	Kumukumu	Ma‘alo	Pu‘u O Papai	Umi
Site Acquisition ($MM/yr)	0.006	0.000	0.003	0.002	0.014	0.000	0.001	0.009
Site Development ($MM/yr)	3.04	2.15	2.12	1.77	1.56	1.17	1.62	2.22
Site Operations ($MM/yr)	5.31	5.44	5.31	5.34	5.36	5.32	5.38	5.33
Total Effective Annual Cost ($MM/yr)	**8.36**	**7.59**	**7.42**	**7.11**	**6.94**	**6.49**	**7.00**	**7.56**
Overall Annual Cost Rank (1 Lowest Cost; 8 Highest Cost)	8	7	5	4	2	1	3	6
Initial Site Development Cost ($MM)	32.3	26.5	28.7	27.6	30.9	38.1	29.6	30.1

Note: 2012 dollars

The annual cost estimates for acquisition, development, and oper ation were input to the CCE (Section 6.0) to update CCE criteria #5, 20, and 21, respectively. Also, we note that these costs also include items ranked separately in CCE as criteria #7, 19, 22, and 24 (which were intended to reflect development costs that varied due to site location). Because seven of the twenty-six criteria identified by the MACLS are related to cost, we can infer that cost was a very important factor to the MACLS. This cost estimate represents an overall value (in contrast to the seven partial cost measures contained in the MACLS criterion), and therefore may be considered a more comprehensive basis of comparison of costs between the sites than the various criteria related to cost in the CCE.

6.0 COMMUNITY CRITERIA EVALUATION

This CCE updates the community-based landfill site evaluation last summarized in the *Report of the Mayor's Advisory Committee on Landfill Site Selection*, April 2009 (RMTC 2009). It ranks the potential landfill sites according to overall scores based on e valuation of the 26 s iting criteria originally identified by the 2009 MACLS study. This 2012 update was a project team effort. Individual site criterion data sheets were prepared by AECOM Technical Services, Inc., RMTC, SMS Research, and Pacific Waste Consulting Group.

6.1 ORIGINAL SCORING, 2009

The original MACLS Landfill Site Selection Criteria system consisted of 26 criteria scores defined by the consultant team and approved by the MACLS. The MACLS established a set of criteria weights intended to reflect the community's valuation of the relative importance of the criteria. The scoring system used in the 2009 MACLS study included a range of different scale and weight values across each of the various criteria, as shown in Table 6-1. Once the MACLS determined the weight of each criterion, each site was assigned its overall site score using the following steps:

- Each criterion at each site was evaluated and given "points" according to the allowable 2009 Point Values, shown below in Table 6-1. For example, for Criterion #1, Population Density, a site with a population density of "less than 25 people per square mile living within one-half mile of the site" was awarded a value of 4 points as its criterion score (as lower populations near the landfill are favorable). Sites with higher population densities were awarded 0 or 2 points, depending on the population density.
- The weighted criterion score for each site was calculated as the product of its criterion point value and the associated weight. For instance, Criterion #1 has a weight of 9. If the criterion score for a particular site was 4, then the weighted criterion score for the site was 36 (i.e., 4 × 9).
- The weighted criterion scores for each site were then summed to get the MACLS total site score.

Table 6-1: 26 MACLS Community-Based Criteria and Scoring Values

No.	MACLS Community Based Criterion	2009 Point Values	Weight
1.	Population density near the site	0-2-4	9
2.	Distance to nearest residence, school, hospital, or business	1-2-3	8
3.	Displacement of residences and/or businesses	1-3	7
4.	Archaeological and/or historical significance	1-2-3	7
5.	Cost of site acquisition	1-2-3	7
6.	Ceded or Hawaiian Homestead Land	0-2-4	3
7.	Site distance from major highway	1-2-3	4
8.	Schools or hospitals along access road	1-2-3	4
9.	Residential units or developments along access road	1-2-3	2
10.	Consistency of the designation of the site for a landfill with the Kaua'i General Plan land use designation (later changed to: Quality of Agricultural Lands)	0-2-4	8
11.	Consistency of the site with the existing County land use zoning designation	0-2-4	1
12.	Consistency of the site with the existing State Land Use District designation	0-2-4	2
13.	Location of site relative to the Underground Injection Control (UIC) Line	1-2-3	10
14.	Proximity to surface water	0-2-4	7
15.	Flora and fauna habitat	0-2-4	5
16.	Annual precipitation	1-2-3	5
17.	Wind direction relative to populated areas	1-3	1

No.	MACLS Community Based Criterion	2009 Point Values	Weight
18.	Haul distance from major municipal solid waste generation areas	1-2-3	9
19.	Adequacy of drainage	1-2-3	2
20.	Cost of development	1-2-3	9
21.	Cost of operations	1-2-3	7
22.	Availability of utilities (water)	1-2-3	2
23.	Access to fire protection	1-2-3	1
24.	Availability of existing access roadway from major highway	1-2-3	2
25.	Proximity to parks and recreational facilities	1-2-3	3
26.	Landfill capacity or site life	1-3	8

Source: RMTC (2009)

6.2 ISSUES WITH THE 2009 STUDY

During 2010 public meetings on the island of Kaua'i, several suggestions were made to improve the precision of the scores or make them more understandable to the community. The public suggestions included:

1. ***Updating the data:*** Some observers felt that using the 2000 Census data may result in an inaccurate evaluation of sites due to the age of the data. Accordingly, the 2010 Census results, which became available in 2011, would therefore provide for more accurate estimates. It was agreed to expand this suggestion and to review all criterion data to reflect the most recent data available.
2. ***Eliminating zeros from the scoring ranges****:* Some observers felt that multiplying a non-zero weight by a zero score caused problems in comparability, especially for sites that had no zeros for any particular criterion. Although this procedure may be statistically acceptable, it was agreed that eliminating zeros from the scoring ranges would help clarify the community's understanding of the scoring methodology.
3. ***Adopting comparable if not equal scoring ranges:*** Some observers felt that the use of different ranges (1-2-3 vs. 0-2-4) to establish scoring for any particular criterion across each of the sites could also compromise comparability in scoring. Indeed, this had a practical effect similar to changing the criterion weights.
4. ***Enhancing the differentiation of scores:*** It was also mentioned that the scoring system produced final scores that differed by only one or two points, which made it difficult to justify decisions. If the top two sites differed by only one point, for example, some observers felt that the scoring system would be insufficient for making important site selection decisions. It was suggested that the differences in scores be adjusted to be more pronounced, thus enhancing the decision-making process.
5. ***Adjusting the content of some criteria:*** Certain criterion measurements were thought to be less than precise measures of the intent of the MACLS. For instance, observers felt that agricultural land was not treated effectively in Criterion #10 ("Consistency of the designation of the site for landfill with the Kaua'i General Plan land use designation"). It was agreed to review definitions of all criteria and adjust them if necessary.

6.2.1.1 CHANGES TO CRITERION 10

As a result of feedback from the MACLS, Criterion 10 in the MACLS report, "Consistency of the designation of the site for landfill with the Kaua'i General Plan land use designation," was revised to reflect the agricultural importance of each potential landfill site. Criterion 10 in the 2012 CCE is therefore the "Quality of Agricultural Lands."

Two sources were used to qualify the quality of agricultural lands comprising each proposed landfill location: the Agricultural Lands of Importance to the State of Hawai‘i (ALISH) and Important Agricultural Land (IAL). A site received the lowest scaled score in the CCE if the site was either classified as “mostly prime agricultural land” by ALISH or was situated on IAL. The ALISH and IAL land classification systems are summarized in the following.

Agricultural Lands of Importance to the State of Hawai‘i

ALISH is an agr icultural land rating system developed by the Hawai‘i Department of Agriculture (DOA), United States Department of Agriculture (USDA), Soil Conservation Service (SCS), and others, and was adopted by the Board of Agriculture on January 28, 1977. The ALISH system was initiated in Hawai‘i as part of a national effort by the USDA to inventory important farmlands across the U.S. and is based on the use of national criteria applied and adapted for use in Hawai‘i by the USDA; University of Hawai‘i, College of Tropical Agriculture and Human Resources (CTAHR); and the DOA. The ALISH system is recognized as a primary land rating systems that classifies agricultural land in Hawai‘i, and is used in the evaluation and identification of agricultural lands in community and development plans.

The ALISH system considers a broad range of factors influencing agricultural viability including soils, climate, availability of irrigation supply, inputs necessary to sustain agricultural productivity, and other general production related factors such as the effort required for harvesting. The three classes of ALISH lands include: prime agricultural land, unique agricultural land, and other important agricultural land. A fourth class, other unclassified land, was used in the CCE to recognize land not in any ALISH class.

Important Agricultural Lands

The State Land Use Commission (LUC) designates five land use districts: important agricultural, agricultural, urban, rural, and conservation. As defined in Article XI, Section 3, of the State of Hawai‘i Constitution, IAL are lands that cannot be reclassified or rezoned “without meeting the standards and criteria established by the legislature and approved by a two-thirds vote of the body (LUC) responsible for the reclassification or rezoning action.” Eight criteria are considered by the LUC in granting the IAL designation:

1. Land currently used for agricultural production;
2. Land with soil qualities and growing conditions that support agricultural production of food, fiber, or fuel- and energy-producing crops;
3. Land identified under agricultural productivity rating systems, such as the ALISH system adopted by the board of agriculture on January 28, 1977;
4. Land types associated with traditional native Hawaiian agricultural uses, such as taro cultivation, or unique agricultural crops and uses, such as coffee, vineyards, aquaculture, and energy production;
5. Land with sufficient quantities of water to support viable agricultural production;
6. Land whose designation as important agricultural lands is consistent with general, development, and community plans of the county;
7. Land that contributes to maintaining a critical land mass important to agricultural operating productivity; and
8. Land with or near support infrastructure conducive to agricultural productivity, such as transportation to markets, water, or power.

Attachment B summarizes Criterion 10, Quality of Agricultural Lands, for each of the eight potential landfill sites.

6.3 CCE OBJECTIVES

The objectives of the current CCE are to update the underlying data and to address the issues identified above by developing a revised set of criterion scores and scoring procedures for the 2012 CCE. The new system therefore:

- Makes use of the most recent data available for all scores.
- Provides objective engineering data, where appropriate.
- Eliminates zeros from the scoring criteria.
- Standardizes all scoring criteria to a single range.
- Makes appropriate adjustments to content, as needed.
- Retains the MACLS criterion weighting system.

6.4 PROCEDURES

6.4.1 Raw Data

U.S. Census data were used to update data elements that relied on 2000 Census data in the CCE. All other raw data were updated using the most recent data available, including results of the PREE for criteria # 5, 7, 19, 20, 21, 22, 24, and 26. Raw data for each criterion at each site is summarized in the worksheets contained in Attachment B.

6.4.2 Scaled Score Ranges

The original MACLS criterion weighting was bolstered in the CCE by implementing uniform scaled score ranges of 1-to-10 points for all criteria, in place of the variable range of point values used in the previous study. Table 6-2 shows the 2009 point value ranges and the 2012 CCE scaled score ranges for each criterion; the latter are further described below and in the worksheets in Attachment B. The scaled score ranges are now consistent for all criteria, giving greater effect to the MACLS weights. By eliminating zero values and evaluating all criteria on the same scale, the CCE scaled score approach yields a more mathematically robust scoring system, and bolsters the community criteria weighting established in the MACLS study.

Table 6-2: MACLS Point Value Ranges and CCE Scoring Ranges

No.	2012 Community Based Criterion	2009 Point Values	2012 CCE Scaled Score Ranges
1.	Population near the site	0, 2, 4	1-10
2.	Number of residences, schools, hospitals, or businesses along the access roadway	1, 2, 3	1-10
3.	Displacement of residences and/or businesses, including agricultural businesses	1, 3	1, 10
4.	Proximity to sites of archaeological and/or historical significance	1, 2, 3	1, 6, 10
5.	Cost of site acquisition	1, 2, 3	1-10
6.	Ceded or Hawaiian Homestead Land	0, 2, 4	1, 10
7.	Distance from principal highway	1, 2, 3	1-10
8.	Schools or hospitals along access road	1, 2, 3	1-10
9.	Residential units or developments along access road	1, 2, 3	1-10
10.	Consistency of the designation of the site for a landfill with the Kaua'i General Plan land use designation (later changed to: Quality of Agricultural Lands)	0, 2, 4	1, 4, 7, 10
11.	Consistency of the site with the existing County land use zoning designation	0, 2, 4	1, 6, 10

No.	2012 Community Based Criterion	2009 Point Values	2012 CCE Scaled Score Ranges
12.	Consistency of the site with the existing State Land Use District designation	0, 2, 4	1, 6, 10
13.	Location of site relative to the Underground Injection Control (UIC) Line	1, 2, 3	1, 6, 10
14.	Proximity to surface water	0, 2, 4	1-10
15.	Distance to the nearest flora and fauna habitat	0, 2, 4	1-10
16.	Rainfall intensity	1, 2, 3	1-10
17.	Prevailing wind direction relative to populated areas	1, 3	1, 10
18.	Haul distance from major municipal solid waste generation areas	1, 2, 3	1-10
19.	Adequacy of site drainage	1, 2, 3	1, 4, 7, 10
20.	Cost of development	1, 2, 3	1-10
21.	Cost of operations	1, 2, 3	1-10
22.	Availability of utilities (water)	1, 2, 3	1-10
23.	Access to fire protection	1, 2, 3	1-10
24.	Availability of existing access roadway from highway or collector street/road	1, 2, 3	1-10
25.	Proximity to parks and recreational facilities	1, 2, 3	1-10
26.	Landfill capacity or site life	1, 3	1-10

Note: Commas indicate lists of possible values, while minus signs indicated ranges of possible values

The following sections describe how the scaled score ranges were established for those criteria with a continuous range of possible raw scores, and for those criteria with discrete values of possible raw scores.

6.4.2.1 Criteria With a Continuous Range of Possible Raw Scores

Criteria that have a continuous range of possible raw scores were scaled such that the least desirable value was assigned a value of 1 (e.g., the highest cost among the sites, or the shortest site life), the most desirable value was assigned a value of 10 (e.g., the lowest costs among the sites, or the longest site life), and all other scores were scaled proportionally according to their raw data value. Computed scaled scores were rounded to integers ranging from 1 to 10.

Expressed mathematically, for those Criteria for which large scores are desirable (e.g., site life), each scaled score was computed using the following equation, and rounding off the result:

$$\text{scaled score} = 1 + \left(\frac{\text{raw score - minimum}}{\text{maximum - minimum}}\right) \times 9$$

For those Criteria for which small raw scores are desirable (e.g., costs), each scaled score was computed using the following equation, and rounding off the result:

$$\text{scaled score} = 1 + \left(\frac{\text{maximum - raw score}}{\text{maximum - minimum}}\right) \times 9$$

These equations result in a minimum score of 1, a maximum score of 10, and intermediate scores scaled proportionally. The data sheets in Attachment B show the raw score ranges and corresponding scaled scores for each criterion, as calculated using these formulas.

For example, Criterion 26 is the anticipated site life, for which the minimum is 26 years, and the maximum is 264 years. Because higher raw scores (more years of site life) are desirable, the scaled score for each site was calculated using the first equation above:

- The Kalepa site is expected to have the minimum site life, 26 years:

$$\text{Kalepa scaled score} = 1 + \left(\frac{26-26}{264-26}\right) \times 9 = 1$$

- The Ma'alo site is expected to have the maximum site life, 264 years:

$$\text{Ma'alo scaled score} = 1 + \left(\frac{264-26}{264-26}\right) \times 9 = 10$$

- The Kumukumu site is expected to have a site life of 106 years:

$$\text{Kumukumu scaled score} = 1 + \left(\frac{106-26}{264-26}\right) \times 9 = 4.03$$

Which was rounded off to 4.

6.4.2.2 Criteria With Discrete Values of Possible Raw Scores

Some of the criteria have raw scores that cannot be represented as a continuous range of numbers (e.g., criterion number 6, Ceded or Hawaiian Homestead Land, only has two possible values: yes or no). The CCE raw scores for discrete variables were scaled in a similar manner to that described above for continuous variables:

The least desired raw score was assigned a scaled score of 1, the most desired raw score was assigned a value of 10, and intermediate raw scores were scaled according to the range of possible raw scores.

For example, Criterion 19 is the adequacy of site drainage, and the scores were assigned as follows:

- The least desirable classification was "poorly drained" which was assigned a scaled score of 1
- The second least desirable classification was "moderately well drained" which was assigned a scaled score of 4
- The second most desirable classification was "well drained" which was assigned a scaled score of 7
- The most desirable classification was "excessively drained" which was assigned a scaled score of 10

6.4.3 Weights

The data weights for the criterion scores were not changed for the current evaluation. The CCE retains the set of weights and relative values previously established by the MACLS, thus preserving the community's relative valuation of criteria.

6.4.4 Weighted Scores

For each criterion applied to each site, the weighted score is the weight established by the MACLS multiplied by the scaled score, which was obtained using objective data to the maximum extent possible. Therefore, for each criterion, a site could receive a weighted score ranging from 1 to 10 times the weight. This results in higher weighted scores being reported in the CCE evaluation (up to 100) than were obtained in the 2009 MACLS (up to 40).

6.4.5 CCE Total Site Scores

The CCE method for combining the 26 criterion scores to arrive at the master site score is identical to the method used in the MACLS scoring system. Weighted scores were summed across the 26 criteria to produce the CCE total site score. With the new scaled score ranges, and the existing

MACLS criterion weighting, the CCE total site scores have a minimum possible value of 133 (i.e., if each of the 26 scaled scores for a hypothetical site was 1), and a m aximum possible value of 1,330 (if each of the 26 scaled scores for a hypothetical site was 10). This range of total site scores is much larger than the range in the previous MACLS study.

6.5 RESULTS

The results of the adjustments to the Kaua'i Landfill Site Selection scoring system are as follows:

- Table 6-3 presents a t abular summary of the site scores for each of the eight alternative landfill sites for all 26 community-based criteria, as well as the CCE total site scores, and the site CCE rankings.
- The individual data sheets for the 26 criteria for each of the eight alternative landfill sites are presented in Attachment B of this report. The data sheets explain for each site the methodologies employed and the databases and other sources utilized, as well as a summary of the raw and scaled scores for each criterion.

The new scoring system has the following desired characteristics:

- All raw scores are based on the most recent data available.
- Raw scores are based on objective data to the extent practicable.
- No scaled scoring ranges include zeros.
- All criteria have scaled scoring ranges from 1 to 10, with 1 indicating the least desirable site and 10 indicating the most desirable site, with reference to that criterion.
- Some data ranges have been revised as suggested by the community.

The new scoring system produces CCE total site scores that are higher than the original system and that generally exhibit greater numerical differences between sites. The original MACLS (2009) and CCE (2012) total site scores and rankings are compared in Table 6-4, and summary statistics of the CCE scores are presented in Table 6-5.

The current site list includes an additional site that was not analyzed in the MACLS study, Kumukumu; therefore, site rankings are not exactly comparable. Nevertheless, the recommended adjustments to the scoring system resulted in clear rankings between the sites.

In general, the changes in rankings were the result of three factors. First, new data were available in 2011–2012 that were not available in 2008–2009 when the first assessment was completed. The new data reflected expected changes (e.g., population growth, new data from the census) and also more precise and more accurate data for the sites (e.g., data obtained from the PREE).

Second, the choice of a single 1-to-10 scaled scale for all criteria made the MACLS criteria weighting more meaningful, and made the overall scoring more mathematically robust. For example, under the previous system:

- Criterion 1 had a weight of 9 and allowable point values of 0, 2, or 4. Therefore, the highest possible score for Criterion 1 was 36 (9×4).
- Criterion 13 had a weight of 10 and allowable point values of 1, 2, or 3. Therefore, the highest possible score Criterion 13 was 30 (3×10).

Therefore, Criterion 1 could have a higher maximum possible score than Criterion 13 (36 vs. 30, respectively), despite Criterion 1 being weighted lower than Criterion 13 (9 vs. 10, respectively).

Under the new uniform scaled score ranges (1 to 10, for all criteria), the maximum value for Criterion 1 is now 90 (9×10), which is less than the maximum value for Criterion 13, which is now 100 (10×10). Thus, the community value judgments inherent in the MACLS criteria weighting is preserved and bolstered under the new system.

Third, the ten-point scales generate higher scores overall, and they increase the scores uniformly. As demonstrated in the example above, the previous range of scores for Criterion 1 was 0 to 36, but is now 1 to 90. This effect generally increases the distance between adjacent scores. Conversely, it also makes the overall scores more sensitive to the scaled scores given, as the weights are multiplied by up to 10 (where the old system multiplied the weights by no more than 4). Overall site rankings were therefore sensitive to relatively small changes in raw data scores. On average, the new scores are 1.4 times the old scores (which is to be expected, with the old maximum scaled score of 4 or less, and the new maximum scaled score of 10). The average distance between adjacently-ranked site scores was 14 points in 2009 and 42 points in 2012. The minimum distance between two total site scores was 4 points in 2009 and 11 points in 2012. The largest difference between two total site scores was 31 in 2009 and 80 in 2012.

Finally, we note that while the scoring system changes are fairly simple, they interact in ways that can be very complicated. The system changes came together to significantly change the overall ranking of the Koloa and Ma‘alo sites, for example. The site scoring changes were due to a combination of several factors, including conducting a conceptual detailed analysis, more accurate quantifications of land uses, and other factors.

Table 6-3: CCE Scores and Site Rankings for 26 Criteria

			Kalepa		Kekaha-Mauka		Kipu		Koloa		Kumukumu		Ma'alo		Pu'u O Papai		Umi	
		CCE Rank	8		3		5		7		6		1		2		4	
		CCE Total Site Score	585		835		769		665		707		877		848		780	
	Criterion	Weight	Scaled Score	Weighted Score	Scaled Score	Weighted Score	Scaled Score	Weighted Score	Scaled Score	Weighted Score	Scaled Score	Weighted Score	Scaled Score	Weighted Score	Scaled Score	Weighted Score	Scaled Score	Weighted Score
1	Population near the site	9	1	9	10	90	10	90	6	54	8	72	10	90	10	90	5	45
2	Number of residences, schools, hospitals or businesses along the access roadway	8	10	80	10	80	10	80	1	8	10	80	10	80	10	80	10	80
3	Displacement of residences and/or businesses, including agricultural businesses	7	1	7	1	7	1	7	1	7	1	7	1	7	1	7	1	7
4	Proximity to sites of archaeological and historical significance	7	1	7	5	35	1	7	5	35	1	7	5	35	10	70	5	35
5	Cost of site acquisition	7	6	42	10	70	8	56	9	63	1	7	10	70	9	63	4	28
6	Ceded or Hawaiian homestead land	3	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
7	Distance from principal highway	4	7	28	10	40	9	36	1	4	10	40	4	16	9	36	7	28
8	Schools and hospitals along access route	4	10	40	10	40	10	40	10	40	10	40	10	40	10	40	10	40
9	Residential units or developments along access road	2	10	20	10	20	10	20	1	2	10	20	10	20	10	20	10	20
10	Quality of agricultural lands	8	1	8	7	56	1	8	7	56	1	8	1	8	1	8	1	8
11	Consistency of site with existing County land use zoning designation	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
12	Consistency of site with existing State land use district designation	2	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10
13	Location of site relative to the Underground Injection Control (UIC) line	10	1	10	10	100	1	10	1	10	1	10	1	10	1	10	10	100
14	Proximity to surface water	7	4	28	6	42	3	21	5	35	1	7	10	70	4	28	4	28
15	Distance to nearest flora and fauna habitat	5	6	30	1	5	3	15	1	5	8	40	4	20	10	50	4	20
16	Rainfall intensity	5	3	15	10	50	6	30	4	20	1	5	3	15	9	45	8	40
17	Wind direction relative to populated areas	1	1	1	10	10	10	10	1	1	1	1	10	10	1	1	1	1
18	Haul distance from major municipal solid waste generation areas	9	10	90	1	9	10	90	7	63	10	90	9	81	5	45	7	63
19	Adequacy of site drainage	2	7	14	10	20	7	14	7	14	7	14	7	14	7	14	7	14
20	Cost of development	9	1	9	5	45	5	45	7	63	8	72	10	90	8	72	5	45
21	Cost of operations	7	10	70	1	7	10	70	8	56	7	49	9	63	5	35	9	63
22	Availability of utilities (water)	2	3	6	9	18	9	18	8	16	10	20	1	2	6	12	9	18
23	Access to fire protection	1	6	6	1	1	6	6	6	6	6	6	6	6	1	1	10	10
24	Availability of existing access roadway from highway or collector street/road	2	3	6	10	20	10	20	10	20	10	20	1	2	7	14	10	20
25	Proximity to parks and recreational facilities	3	2	6	3	9	5	15	6	18	5	15	1	3	10	30	2	6
26	Landfill capacity or site life	8	1	8	2	16	2	16	3	24	4	32	10	80	4	32	2	16

Table 6-4: Comparison of Community Criteria Total Site Scores, 2009 and 2012

Site	Old Rank	New Rank	Old Score	New Score
Kalepa	7	8	248	585
Kekaha Mauka	2	3	326	835
Kipu	4	5	288	769
Koloa	3	7	295	665
Kumukumu	–	6	–	707
Ma‘alo	6	1	265	877
Pu‘u O Papai	5	2	269	848
Umi	1	4	334	780

– The Kumukumu site was previously eliminated from evaluation due to prior land use entitlements that had been secured for development of a subdivision. The site has now been re-included for further evaluation.

Table 6-5: Summary Statistics for 2012 CCE Total Site Scores

Site	Score	Rank	Difference [a]	% Difference [b]
Ma‘alo	877	1	29	3.3%
Pu‘u O Papai	848	2	13	1.5%
Kekaha-Mauka	835	3	55	6.6%
Umi	780	4	11	1.4%
Kipu	769	5	62	8.1%
Kumukumu	707	6	42	5.9%
Koloa	665	7	80	12.0%
Kalepa	585	8	-	-

[a] Point difference from next ranked site
[b] Percentage difference from next ranked site

7.0 OTHER IMPORTANT DECISION FACTORS

During the various attempts to site the new landfill over the last twelve years, several of the eight sites analyzed in this report were at one time or another considered the proposed site for the new County landfill, including Kekaha-Mauka, Kalepa, and Umi. Ultimately, however, in each case negotiations with the landowner broke down. Based on this previous experience, several factors have proven to be critical, including landowner willingness and a site's value as agricultural land. These factors are inter-related, and are discussed in the following sections. An additional important decision factor, not captured in the previous studies or other elements of this report, is the proximity of the site to Kaua'i's waste generation centroid, which will significantly impact costs and sustainability due to waste shipment requirements. Finally, the County is investigating the development of a RRP to maximize diversion of waste from the new landfill and to promote sustainability. The location of the new landfill site and the co-located RRP will influence the cost effectiveness of the RRP and may promote or discourage its use. A location proximate to Kaua'i's waste generation centroid could both lengthen the expected lifetime of the new landfill, potentially resulting in significant savings to the County of Kaua'i, and increase sustainability improvements.

7.1 LANDOWNER WILLINGNESS

During past negotiations with landowners, the project was repeatedly derailed as the landowners ultimately opposed using the sites as landfills. Therefore, landowner willingness has been identified as a critical decision factor to allow this project to go forward in a timely fashion. Of the eight sites, two are government (State) owned, Kekaha-Mauka and Ma'alo, and the rest are privately owned. While the County does have the option of condemning private land to create a landfill (which it prefers not to exercise), the County greatly prefers to identify a willing landowner. If a willing landowner can be identified, the County could potentially save significant legal and related compensatory expenses (the value of which cannot currently be quantified), and would be able to avoid an undesirable situation.

To document the attempt to locate a willing landowner, and to assess whether any of the landowners have reconsidered their past positions, the County (through its consultants) prepared landowner willingness questionnaires for each landowner, delivered via certified mail. The questionnaires included a figure of the potential landfill site and a potential co-located RRP site, and asked the landowners whether they might consider negotiating the use of the site (for either purpose) with the County. Each site has room outside of the exclusionary zones to accommodate an approximately 80-acre co-located RRP. A second and third questionnaire was sent to those landowners who did not respond to previous requests. All landowners eventually responded, and only the Ma'alo landowners responded affirmatively:

- The owner of the Kalepa site stated that they are not willing to negotiate the use of the site, stating: "Absolutely Not. This land is currently in agriculture production."
- The owner of the Kekaha-Mauka site stated that they are not willing to negotiate the use of the site, noting that the site is currently in agricultural use.
- The owner of the Kipu site stated that they are not willing to negotiate the use of the site, stating: "Absolutely Not. This land is currently in agriculture production."
- The owner of the Koloa site stated that they are not willing to negotiate the use of the site, stating: "Absolutely Not. This land is currently in agriculture production."
- The owner of the Kumukumu site responded, simply: "No."
- The owner of the Ma'alo site stated that they are willing to consider use of the site. Additionally, the owner of a nearby parcel has indicated that they may be willing to lease a site for (an essentially co-located) RRP. The County is currently discussing landowner terms and requirements that may be required to use the Ma'alo landfill and RRP sites.

- The owner of the Pu‘u O Papai site stated that they are not willing to negotiate the use of the site, because the “area is being leased long-term to important land tenant, whose operations would be significantly affected.”
- The owner of the Umi site provided a detailed response indicating that they were strongly opposed to having their site considered due to “actively cultivated, highly productive coffee fields” and the property’s designation as “Important Agricultural Lands.”

Because the existing Kekaha Landfill will reach capacity in the coming years, and will need to be permanently closed, the island must identify a new landfill, in the very near future – there is no more time available to delay the siting of the new landfill. No matter how successful any reuse, recycling, and other waste diversion activities become, a landfill will always be required to dispose of the island’s wastes in the most environmentally safe manner possible, i.e., a modern “RCRA-D” landfill. Events such as Hurricane Iniki, with the attendant huge spike in waste generation, illustrate the long-term importance of a landfill to the people of Kaua‘i. The waste generated from Hurricane Iniki prematurely brought the Kekaha Phase I Landfill to capacity, and it was closed well before its expected lifetime had transpired. Identifying a willing landowner may save the County significant time in establishing a new landfill. Finding a willing landowner for the new landfill may save the County significant time and expense, and may be imperative in helping the County fulfill its mandate to properly manage the island’s waste stream in the safest way possible.

7.2 HIGH VALUE AGRICULTURAL SITES

All of the eight identified sites currently have various degrees of agricultural or similar uses (e.g., livestock grazing). Most of the sites are predominantly or significantly classified as “prime” or “unique” agricultural land by the State under the “Agricultural Lands of Importance to the State of Hawai‘i” (ALISH) system. (Kekaha-Mauka is the parcel with the least portion classified as prime or unique.) However, within this broad categorization, qualitatively different uses are currently being pursued. For example, looking at the privately held sites, on one end of the spectrum is Kumukumu, which appears to be partially used for grazing only, which could be considered minimally burdensome to relocate. On the other end of the spectrum, the Umi site has well-established coffee growing operations, and is the only site designated as an IAL. Coffee plants are high value crops that take significant time to establish and therefore could be considered more burdensome to relocate. Both the State and the County are undergoing significant efforts to promote high value agricultural sites in Hawai‘i.

7.3 SUSTAINABILITY AND PROXIMITY TO KAUA‘I’S WASTE GENERATION CENTROID

An additional decision factor, not captured in the previous studies or other elements of this report, is the proximity of the site to Kaua‘i’s waste generation centroid. The distance between a landfill and RRP site and Kaua‘i’s waste generation centroid provides a measure of the amount of shipping of waste and recyclable and reusable materials that will be required. According to the data in the County’s ISWMP, the island’s waste generation centroid is estimated to lie between the Lihue/Kapa‘a and Koloa/Poipu areas (R. W. Beck 2009). Generally speaking, the closer the landfill and RRP are to the centroid, the shorter will be the average distance of material shipment (and re-shipment). Siting the landfill and RRP closer to the island’s waste generation centroid will have positive impacts on:

- Fuel consumption
- Carbon footprint
- Waste transportation-related costs
- Waste transportation-related traffic

If the new landfill is located close to the centroid, it is also conceivable that the County could realize further cost savings at the Kapa‘a or Lihue transfer stations, through reduced use due to the nearby landfill (this effect is not quantified in this report).

While a full analysis of the relative sustainability of the sites is beyond the scope of the current analysis, one important consideration is the waste transportation cost and associated resource use (fuels, carbon footprint, costs, etc.). Generally, sites that minimize waste shipment are more sustainable and less expensive. Table 7-1 compares the amount and distance of waste transported from the County's four transfer stations to the eight potential landfill sites, based on the data contained in the ISWMP. Results are presented in terms of the total amount and distance of waste shipped (ton-miles per year), as well as an estimate of the associated cost; sites are ordered from the site requiring the least transportation to the site requiring the most transportation. The last row of Table 7-1 further summarizes the data, showing that each of the top four sites (Kalepa, Kumukumu, Kipu, and Ma‘alo) perform nearly as well as each other on this sustainability metric (within 9% of each other), while Kekaha-Mauka is the site requiring the most transportation of waste (more than twice as much as the top four sites).

Additionally, in qualitative terms, it is noted that co-locating an RRP at any of the four top-ranked sustainability sites would have similar beneficial sustainability effects, in terms of making reuse and recycling efforts at the RRP more economical, more convenient, and thus more likely to be successful. They are also the closest sites to Nawiliwili, and are thus preferable for potential off-island shipment of recovered material.

7.4 RESOURCE RECOVERY PARK

Based on the SLCE, it appears feasible for the County to develop an RRP at or near any of the eight new landfill sites. Each site has room to develop an approximately 80-acre RRP, outside of the mapped exclusion zones.

The sustainability benefits associated with a new landfill located near the waste generation centroid (Section 7.3) may be even more pronounced if the County develops a RRP co-located with the new landfill. Use of a RRP may require materials to be shipped more than once; this would be most cost effective (and therefore more likely to be fully utilized) if located closest to the centroid. If the RRP is developed, it is expected to be co-located with the new landfill, which could also argue for locating the landfill/RRP relatively close to the port at Nawiliwili, where some recovered recyclable materials may be shipped off-island.

A Feasibility Study to quantitatively analyze potential RRP technologies and options is planned to be conducted in the next task of the current project (engineering design), once a proposed site is selected. The Feasibility Study will provide more details regarding the costs and benefits of the location of the RRP, which will be reflected in the EIS.

Table 7-1: Alternative Landfill Site Waste Shipment Comparison

Description	Unit	Kumukumu	Kalepa	Kipu	Ma‘alo	Umi	Koloa	Pu‘u O Papai	Kekaha Mauka
Hanalei Transfer Station	Daily Waste (TPD)	21	21	21	21	21	21	21	21
	Annual Waste (TPY)	7,392	7,392	7,392	7,392	7,392	7,392	7,392	7,392
	Distance (mi)	15.5	27.8	30.5	29.1	40.5	38.2	46.8	54.7
	Ton-Miles/year	114,576	205,498	225,456	215,107	299,376	282,374	345,946	404,342
Hanapepe Transfer Station	Daily Waste (TPD)	24	24	24	24	24	24	24	24
	Annual Waste (TPY)	8,448	8,448	8,448	8,448	8,448	8,448	8,448	8,448
	Distance (mi)	28.5	20.7	15.1	22.0	6.5	15.4	3.4	11.2
	Ton-Miles/year	240,768	174,874	127,565	185,856	54,912	130,099	28,723	94,618
Kapaa Transfer Station	Daily Waste (TPD)	31	31	31	31	31	31	31	31
	Annual Waste (TPY)	10,912	10,912	10,912	10,912	10,912	10,912	10,912	10,912
	Distance (mi)	3.7	10.5	13.1	11.7	23.1	20.9	29.5	37.3
	Ton-Miles/year	40,374	114,576	142,947	127,670	252,067	228,061	321,904	407,018
Lihue Transfer Station	Daily Waste (TPD)	34	34	34	34	34	34	34	34
	Annual Waste (TPY)	11,968	11,968	11,968	11,968	11,968	11,968	11,968	11,968
	Distance (mi)	12.9	5.0	6.2	6.3	16.2	14.0	22.6	30.5
	Ton-Miles/year	154,387	59,840	74,202	75,398	193,882	167,552	270,477	365,024
Total	Ton-miles/year	550,106	554,787	570,170	604,032	800,237	808,086	967,050	1,271,002
Unit Cost	($/TON-mile)	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Total Hauling Cost	Cost ($/yr)	385,074	388,351	399,119	422,822	560,166	565,660	676,935	889,701
% Exceeding Minimum Site		-	0.9%	3.6%	9.8%	45.5%	46.9%	75.8%	131.0%

Note: Tons per year for each transfer station is the daily rate times 352 days/year.
mi mile
TPD ton per day
TPY ton per year

8.0 OVERALL SITE COMPARISON AND RECOMMENDATION

As suggested in the foregoing sections of this report, there are several bases upon which the County could rationally select a proposed site for the new landfill. The following sections highlight some of the most relevant features of the sites, and provide potential alternative bases upon which to select the proposed new landfill site.

8.1 SITE SUMMARY

Table 8-1 compares some of the major considerations for the eight sites. The order of the decision factors is not intended to imply any relative importance. Any site, if chosen, would require further analysis (likely including but not limited to land surveys, flora and fauna surveys, archaeological surveys, geotechnical analysis, wetlands delineation, traffic studies, EJ evaluation, engineering design and cost analysis, etc.) during the design and EIS phases of this project. By first identifying one proposed site, the County can limit these detailed studies to less than eight sites, thus saving the County significant time and expense.

It should also be noted that any identified real or perceived deficiency in a particular site can potentially be mitigated, and the EIS process will investigate these possibilities. Also, as the existing Kekaha Phase II Landfill approaches capacity and closure, the No Action alternative (not siting a new landfill), while requiring consideration in the EIS process, is simply not a practicable option for the County of Kaua‘i.

8.2 RECOMMENDATION

All eight sites are technically and legally feasible sites for the County’s new landfill, although no site is perfect. If any given site were chosen, the EIS process to follow should identify any shortcomings for the site, which can then potentially be mitigated.

The County could rationally decide which site to pursue based on several different criteria, or combinations of considerations. The recommendation which follows was arrived at by weighing the pros and cons of all the various rankings, important decision criteria, and other measures presented in this report.

8.2.1 Ma‘alo

The Ma‘alo site is the longest-term solution for the County’s waste disposal problem. The estimated site life of 264 years can potentially be extended even further with the operation of a RRP, making this a near-permanent potential solution to the County’s needs. As the last twelve years of trying to site a landfill show, the value of this near-permanent potential solution cannot be overstressed.

The Ma‘alo site is also the only site identified that currently has a potentially willing landowner. As this factor has derailed previous efforts, it could reasonably be the overriding decision-making factor.

Although it has a relatively high initial cost, the Ma‘alo site is the most economical site over the life of the landfill, due to factors including economy of scale and potential cost amortization over its long site life. The economic benefits of Ma‘alo discussed in this report are if anything understated, as they do not quantify the additional cycles of siting new future landfills that all the other sites would require. The overall site development costs and impacts need not be incurred at once, as the County can build successive cells as they become necessary. Similarly, displacement of current land users can be phased in over hundreds of years, lessening the impacts. On the other hand, initial development costs for Ma‘alo are relatively high.

The Ma‘alo site ranks the highest in the CCE system, followed by Pu‘u O Papa‘i and Kekaha-Mauka, the other State-owned site. The difference between the three sites is only 42 points.

Other factors that argue for the Ma‘alo site include its central location (which will save costs and fuels, decrease waste-related traffic, and have positive sustainability effects); the relatively ease with which current land uses (grazing) can be displaced to nearby locations, over the projected 264-year life of the landfill; and the local topography that shields the site from creating adverse visual impacts.

Standing water was observed in and around the Ma‘alo site, so a wetland survey and jurisdictional determination may be required if the site is to be considered further. Wetlands, if present, may require mitigation measures, the cost of which cannot currently be quantified.

Table 8-1: Overall Comparison of Site Attributes and Rankings

Site	Willing Landowner?	Estimated Site Life in Years (and Rank)	2011 Community Criteria Evaluation Score (and Rank)	Estimated Total Cost per Year of Site Life (and Rank)	Estimated Initial Cost (and Rank)	Agricultural Value	Central Location / Sustainability	Major Pros	Major Cons
KALEPA	No	26 (8)	585 (8)	$ 8.36 MM (8)	$ 32.3 MM (7)	✓	✓	• Near island's waste centroid, providing cost savings and positive sustainability effects.	• Unwilling private landowner. • Shortest site life of all sites under consideration. • Ranks last on the CCE. • Most expensive annual and initial costs. • Active agricultural land use.
KEKAHA MAUKA	No	60 (5)	835 (3)	$ 7.59 MM (7)	$ 26.5 MM (1)	✓		• Ranks third on the CCE. • Lowest initial cost • Located near existing Kekaha Landfill which has some in-place infrastructure. • Relatively low nuisance factor due to distance from population. • Located below the UIC line. • Low rainfall. • Located near existing roadway.	• Unwilling landowner (State of Hawaii). • County cannot condemn State-owned property; requires willing landowner. • Distant from island's waste centroid. • Second most expensive annual cost. • Active agricultural land use. • Local community has already hosted the existing Kekaha Landfill.
KIPU	No	56 (6)	769 (5)	$ 7.42 MM (5)	$ 28.7 MM (3)	✓	✓	• Near island's waste centroid, providing cost savings and positive sustainability effects. • Located near existing roadway. • Low initial cost.	• Unwilling private landowner. • Third shortest site life.
KOLOA	No	69 (4)	665 (7)	$ 7.11 MM (4)	$ 27.6 MM (2)	✓		• Located near existing roadway. • Low initial cost.	• Unwilling private landowner. • Groundwater utility: the DOW has stated that groundwater supply wells in the area are productive, and that they may want to advance additional wells in the future.
KUMUKUMU	No	104 (2)	707 (6)	$ 6.94 MM (2)	$ 30.9 MM (6)	✓	✓	• Second longest site life. • Second least annual cost. • Near island's waste centroid, providing cost savings and positive sustainability effects. • Disruption of current site activities relatively minor compared to other sites. • Located near existing roadway.	• Unwilling private landowner. • Possible wetlands features may require mitigation. • Ranked somewhat low on the CCE.
MA'ALO	Yes	264 (1)	877 (1)	$ 6.49 MM (1)	$ 38.1 MM (8)	✓	✓	• The only willing landowner. • Longest site life. • Overall least annual cost. • Ranks best on the CCE. • Near island's waste centroid, providing cost savings and positive sustainability effects. • Landowner willing to site adjacent Resources Recovery Park. • Low nuisance factor due to local topography.	• Highest initial cost • Possible wetlands features may require mitigation.
PU'U O PAPAI	No	95 (3)	848 (2)	$ 7.00 MM (3)	$ 29.6 MM (4)	✓		• Ranks second on the CCE. • Third longest site life. • Third least annual cost. • Low rainfall.	• Unwilling private landowner. • Active agricultural land use. • Distant from island's waste centroid.
UMI	No	53 (7)	835 (4)	$ 7.56 MM (6)	$ 30.1 MM (5)	✓		• Located below the UIC line. • Low rainfall. • Located near existing roadway.	• Unwilling private landowner. • Second shortest site life. • High annual and initial cost • Disruption of current agricultural uses relatively significant compared to other sites. • Designated as Important Agricultural Land • Distant from island's waste centroid.

9.0 REFERENCES

AECOM Technical Services, Inc. 2011. *State Landfill Criteria Evaluation*. Prepared for County of Kaua‘i, Department of Public Works. Honolulu.

Earth Tech, Inc. 2001. *Kaua‘i Municipal Solid Waste Landfill Siting Study, Kaua‘i, Hawai‘i*. Prepared for County of Kaua‘i, Department of Public Works. Honolulu. March.

Earth Tech, Inc. 2002. *New Kaua‘i Municipal Solid Waste Landfill Kalepa Site Evaluation, Kaua‘i, Hawai‘i*. Prepared for County of Kaua‘i, Department of Public Works. Honolulu. June.

Eddy, W. 2011. E-mail correspondence from William Eddy, County of Kaua‘i Department of Water, to Donald Fujimoto, County of Kaua‘i Environmental Services Officer, re: Hawaii Source Water Assessment Program. November 29.

R. M. Towill Corporation. 2009. *Mayor's Advisory Committee on Landfill Site Selection: Vol. 1: Report (May), Vol. 2: Site Data Sheets (March)*. Prepared for County of Kaua‘i, Department of Public Works, Refuse Division. Honolulu.

R. M. Towill Corporation. 2011. *Community Criteria Evaluation*. Prepared for County of Kaua‘i, Department of Public Works. Honolulu.

R. W. Beck. 2009. *Integrated Solid Waste Management Plan*. Prepared for County of Kaua‘i, Department of Public Works – Solid Waste Division. September.

State of Hawaii Office of Planning. 2011. *Hawaii Statewide Planning and Geographic Information System Program*, Downloadable Layers web page: http://hawaii.gov/dbedt/gis/download.htm.

United States Department of Agriculture, Natural Resources Conservation Service (NRCS). 2011. *Soil survey database the island of Kaua‘i, Hawaii*. NRCS Soil Data Mart web page: (URL: http://soildatamart.nrcs.usda.gov).

United States Fish & Wildlife Service (USFWS). 2011. *National Wetlands Inventory*, Data Download web page: http://www.fws.gov/wetlands/Data/DataDownload.html.

University of Hawai‘i, School of Ocean and Earth Science and Technology (SOEST), Coastal Geology Group. 2011. *Digital Elevation Model (DEM) Imagery for Kauai* web page: http://www.soest.hawaii.edu/coasts/data/kauai/dem.html.

United States Department of Agriculture, Natural Resources Conservation Service (USDA NRCS). 2011. *Soil Survey Database* (URL: http://soildatamart.nrcs.usda.gov).