GROUP 70
INTERNATIONAL

May 25, 2016

State of Hawai'i
Department of Health
P.O. Box 3378
Honolulu, HI 96801-3378

Attn: Ms. Sina Pruder, Chief, Wastewater Branch

Subject: **Hawai'i Dairy Farms**
Waste Management Plan – Updates for Review
Māhā'ulepū, Kaua'i, Hawai'i
TMK: (4) 2-9-003: 001 por and 006 por & (4) 2-9-001: 001 por

Dear Ms. Pruder:

As you have been aware, in late 2013, Ulupono Initiative made the investment to fund Hawai'i Dairy Farms, the first pasture-based rotational-grazing dairy in the state. Hawai'i Dairy Farms, LLC (HDF) was formed as a positive step toward the island state's food security, economic diversity, and sustainability. At steady-state production with 699 milking cows, the farm will produce roughly 1.2 million gallons annually at market price.

The farm will be based on the most successful island dairy models in the world, and will utilize a sustainable, pasture-based rotational-grazing system and 21st century technology. The farm will be very different from conventional feedlot dairy farms found elsewhere in the state.

HDF is committed to establishing a herd of up to 699 mature dairy cows, and demonstrating the pasture-based system as an economically and environmentally sustainable model for Hawai'i. With proven success at a herd size of 699, HDF will contemplate the possibility of expanding the herd in the future to up to 2,000 productive milking cows. Permit process compliance would be followed at such time HDF may decide to pursue an expanded operation.

The State of Hawai'i, Department of Health (DOH), Wastewater Branch has previously reviewed HDF's submitted Waste Management Plan (WMP) for an operation of 699 mature dairy cows, as required by the "Guidelines for Livestock Waste Management". In the WMP, HDF detailed the operations and management of the effluent ponds, which will be used to store effluent and manure for re-use as a primary nutrient source for growing Kikuyu grass, the cows' main food source. With the final review of the WMP by DOH in October 2014, HDF obtained their required building permit and approval to construct the dairy facility.

In the course of this effort, opponents to the dairy filed a lawsuit against HDF, claiming that an Environmental Impact Statement (EIS) was required prior to use of the agricultural land that HDF is situated upon. While HDF strongly disagrees with that requirement, HDF has *voluntarily* agreed to prepare and submit an EIS

pursuant to HRS Chapter 343. The purpose of the EIS is to evaluate potential environmental impacts of a pasture-based, rotational-grazing dairy system at 699 mature dairy cows and up to 2,000 mature dairy cows in Māha'ulepū Valley, Kaua'i.

While the EIS process was progressing, on-going technical studies and field trials were continued for various dairy components, including and not limited to groundwater and surface water quality assessments, historical and archeological studies, nutrient management calculations, and forage trials. Refinements to the dairy operation, including and not limited to adjustments to the total available pasture area, physical setbacks, inclusion of calves in the nutrient model, and current forage data, improved the nutrient mass balance analysis within the WMP previously submitted to DOH. The following attachment consists of an executive summary and description of those changes.

HDF would like to emphasize that the pasture-based, rotational-grazing dairy system, including the design of the effluent ponds, is fundamentally the same and has not changed. At 699 mature dairy cows, the updates to the mass balance analysis have minimal effect on the effluent ponds as the farm's infrastructure had been sized for up to 2,000 mature dairy cows. The expected percentage of the nutrient demand for healthy pasture productivity which will be provided by the animals is 30.5% for nitrogen and 35.8% for phosphorus, both of which show that the nutrients applied from the animals (at the 699 mature dairy cow herd size) are only about one-third of what the grass crop requires.

Please feel free to let me know if you have any questions or comments regarding these changes or the information presented herein or in the attachment. Please also let me know if any additional information or copies are required. Thank you for your consideration and review.

Sincerely,

Paul T. Matsuda, PE
Principal/Director of Civil Engineering
Group 70 International

Attachment(s): Update to Waste Management Plan, Hawai'i Dairy Farms

Copy: Kyle Datta, Hawai'i Dairy Farms
Jim Garmatz, Hawai'i Dairy Farms
Jenna Dunn, NRCS District Conservationist, Pacific Island Area, Lihue Service Center
Adam Reed, NRCS State Agronomist, Pacific Island Area, State Office

ATTACHMENT

UPDATES TO WASTE MANAGEMENT PLAN HAWAI'I DAIRY FARMS

MĀHĀ'ULEPŪ, KAUA'I, HAWAI'I

Prepared By:

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Dated:

May 25, 2016

EXECUTIVE SUMMARY

The Waste Management Plan (WMP) for Hawai'i Dairy Farms, focusing on a pasture-based, rotational-grazing dairy system with 699 mature dairy cows located in Māhā'ulepū, Kaua'i, was submitted to DOH on July 23, 2014. Subsequently, the WMP was reviewed by the State of Hawai'i, Department of Health (DOH), Wastewater Branch (WWB).

On October 24, 2014, the DOH-WWB indicated that HDF has addressed all of DOH-WWB comments from their review of the WMP and that there were no further comments on the WMP. DOH-WWB indicated there would be no further action on the WMP at that time, signaling that HDF had met the requirements of the "Guidelines for Livestock Waste Management" for effluent pond systems in the State of Hawai'i.

However, before construction was able to commence, HDF voluntarily agreed to prepare and submit an Environmental Impact Statement (EIS) pursuant to HRS Chapter 343. Based upon current environmental regulations and confirmed by the State of Hawaii Department of Health, the preparation of an EIS was not required, but was requested by neighboring developments and a select group of the public. Nevertheless, HDF agreed to conduct the environmental assessment with the State of Hawaii, Department of Health agreeing to be the accepting authority.

While the EIS process was progressing, previously on-going technical studies and field trials continued and discussions with other regulatory agencies were held. Forage productivity sampling was conducted to provide current data for nutrient management consideration. This updated information, specific to the project site, requires refinements to the WMP previously reviewed by DOH-WWB.

HDF would like to emphasize that the pasture-based, rotational-grazing dairy system, including the design and sizing of the effluent ponds, is fundamentally the same and has not changed. Simply put, field-tested and proven data, based on ground-level trials and studies, can improve the basis of the WMP.

#	Current WMP	Proposed Change	Justification
1	174 calves on site	150 calves on site	No more than 150 calves will be kept on site at any time, based on size and age.
2	Nutrient Mass Balance Table is populated by the Dairy New Zealand Model.	Nutrient Mass Balance Table is updated with the Cornell Model.	The Cornell Net Carbohydrate Protein System Model is a United States industry-recognized nutrient and milk production model. While HDF recognizes the success of the Dairy New Zealand model for evaluation of nutrients, HDF ultimately believes that the United States standard is best suited for operation on Kaua'i.
3	Project Boundary	Reduced Project Boundary	The boundary has slightly adjusted along the perimeter of the farm.
4	Receiving Water Body State Water Quality = Class A Marine Waters / Class 1 Critical Habitat	Receiving Water Body State Water Quality = Class A Marine Waters	The State of Hawai'i has recently updated its water quality classifications for this region.
5	Water Wells = 14	Water Wells = 14 original, 3 remaining.	Most of Well Battery 14 was abandoned, with only 3 wells remaining.
6	Total Lease Area = 577.9 acs	Total Lease area = 556.8 acs	Field conditions and negotiations with Mahaulepu Farm (landowner) have resulted in a defined and measureable lease area.
7	Grazing Area = 517.3 acs	Grazing Area = 469.9 acs	Area has been set aside for project buffers, setbacks, raceways, and other areas not available for pasture grazing.
8	Land Use Summary Table	Revised Land Use Summary Table	With revisions to the project boundary, the total farm acreage has changed, including the pasture acreage, facility acreage, and open space acreage.
9	Total Paddocks = 118	Total Paddocks = 119	With the revision to the farm area, paddock layouts were slight altered, resulting in 1 new paddock formed. Though the farm area decreased, several paddocks were divided to create additional paddocks near the calf sheds for housing the calves.
10	Area Percentages	Revised Area Percentages	Percent areas for the dairy facility, effluent ponds, etc. compared to the total farm area have changed due to the change in leased area.

11	Access Road and Tanker Truck Turnaround	New Location for Access Road and Tanker Truck Turnaround moved to east side of facility	The new location makes access to the facility both safer and cost effective, as the steep downhill grade on the west side of the facility is avoided.
12	**Drip Irrigation in areas outside of the pivot extent**	**Gun Irrigation in areas outside of the pivot extent**	**Drip irrigation tubing and infrastructure would likely be destroyed often by grazing cows and require significant repair.**
13	Irrigated Area Percentages	Revised Irrigated Area Percentages	Percent areas for irrigated farm areas versus non-irrigated farm areas, etc. compared to the total farm area have changed due to the change in leased area.
14	**Irrigation Demand Summary**	**Revised Irrigation Demand Summary**	**Revised amounts of irrigated areas and non-irrigated areas results in changes in demand.**
15	Section 6.1 – Irrigation Schedule	Renumbered Section 6.1 to Section 6.6	Duplicate section heading number to be renumbered for clarity and to avoid confusion.
16	**Wastewater Treatment Section**	**Wastewater Management Section**	**Public comments on the original WMP correctly indicated that the ponds are not treatment systems, as the original WMP did not indicate any wastewater treatment systems for the effluent. Wastewater is stored and not treated in the effluent ponds.**
17	Cow Weight = 1,210 lbs	Cow Weight = 1,200 lbs	Same cow but parameter has changed, with switch to Cornell Model
18	**Manure Production = 143 lbs per day**	**Manure Production = 90.8 lbs per day**	**Manure production is affected by the nutrient content and chemical composition of the forage. With updated forage testing incorporated into the Cornell Model, manure production values have been updated and are consistent with the USDA/NRCS Agricultural Waste Management Field Handbook (March 2008), which utilizes established American Society of Agricultural Engineers (ASAE) values for manure production per cow per day.**
19	Effluent / Manure Volume	Revised Effluent / Manure Volume for Calves	Added in generation of manure from calves and updated based on total manure produced. Increased daily generation effluent due to increase in wash water projections at 699 cows.
20	**Minimum Effluent Storage = 23 days**	**Minimum Effluent Storage = 25 days**	**Incorporated 2 days of storage before forecasted rain event. No effect as total storage provided is still 30 days.**
21	Effluent Totals within Storage Pond Volume	Revised Effluent Totals within Storage Pond Volume	**NOTE: The sizes of the ponds have <u>not</u> changed.** Because of the increase in daily wastewater generation, more volume is required in storage

			pond at 699 cows. However, since the pond is designed for up to 2,000 cows, the increase has no impact.
22	Grass Yield Goal = 20 tons DM per acre per year	Grass Yield Goal remains the same. However, calculations are based upon ongoing grass trials = 16.3 tons DM per acre per year	HDF has committed to studying the operation of the farm at current grass trial levels. While HDF expects the yield goal to realize, existing trial data guarantees that 16.3 tons DM per acre per year can be produced by the current field and system.
23	Nutrient Mass Balance Tables	Revised Nutrient Mass Balance Tables	Balance based upon revised manure numbers, revised pasture acreage, & revised grass yields.
24	Soil Sampling Frequency = Every Three Years	Soil Sampling Frequency = Every Year	Allows for better and more efficient farm management. Sampling the soil for nutrient content and fertility recommendations more often ensures that nutrients are 1) not over applied but 2) not wasted.

DESCRIPTION OF CHANGES

A description of the changes above is detailed by item number below, with the corresponding section reference to the original WMP in **bold**.

1) **Letter to DOH from Group 70 International, "Hawaii Dairy Farm, Waste management Plan – Review Comments", Dated June 23, 2014:** The number of calves on-site has been evaluated to consist of, at most, 150 calves on site, instead of 174 calves as shown in the original WMP. Calves will be managed to be moved off-site after 90 days or after they reach 150 lbs. At 699 calves, this equates to 150 calves.
2) **Section 1.0 – Project Overview:** The Cornell Net Carbohydrate Protein System (CNCPS) model is being used for the basis of estimating nutrient content of the manure, based upon grass inputs. The nutritional content of the grass has also been analyzed within field trials and actual grass grown on the Māhā'ulepū site has been input into the CNCPS model to determine the nutritional value to the animals, and ultimately the nutrient content of their manure. While the original WMP previously utilized the Dairy New Zealand model, HDF believes each model is comparable and ultimately will be used to provide the same information, but the CNCPS model is recognized in the United States. It allows for easier comparison of farm-specific data with other farms in the State of Hawaii and throughout the country. Just as significant, the inputs into the model are now based upon field trials.
3) **Figure 2 – Project Location Map**: The project boundary has been slightly altered. The taro farm within the center of the project will occupy more area than anticipated in the original WMP. Additionally, the perimeter boundary has been updated based upon a topographic survey performed for the project by Red Barn Consulting.

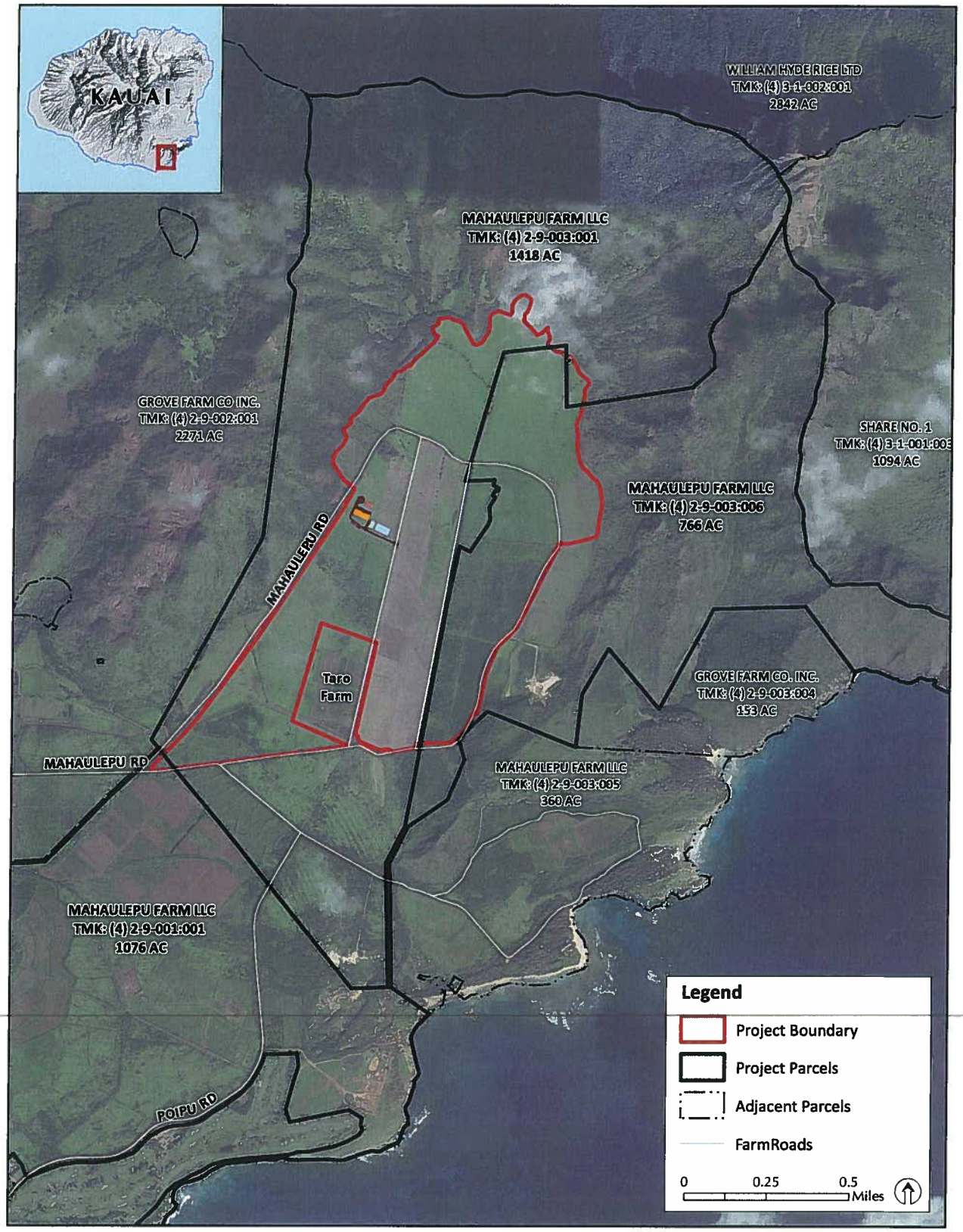


Figure 2 – Project Location Map

4) **Section 2.2.1 – Receiving Water Body State Water Quality:** The Water Quality Maps available from the State of Hawai'i Department of Health are no longer applicable to the project site, and State Water Body Quality is now available only within HAR §11-54. The WMP will now state that this stretch of open coastal waters is classified as Class A for water quality standards in HAR §11-54.

5) **Section 2.2.3 – Water Wells:** The existing private water wells on-site were described. Further field study has indicated that of the original 14 wells in the Māhā'ulepū 14 Well Battery, only 3 remain. These wells will be used for potable water use, a backup source, and for groundwater monitoring.

6) **Section 3.0 - Land Use Summary**: As the project boundaries have changed, the total lease area agreed upon between HDF and Mahaulepu Farms (Owner) has reduced from 577.9 acres to 556.8 acres. As mentioned, more area was reserved for the taro farm and area was removed based upon the topographic survey of the site, which identified perimeter roads and the tree line.

7) **Section 3.0 – Land Use Summary:** At 699 mature dairy cows, the original WMP included setbacks and project buffers, raceways, etc., but did not specify its total area within the pasture area calculations. The total area of the setbacks and buffers is now calculated, and the available grazing and pasture area is now 469.9 acres. Setbacks and buffers include:

   - 35-foot setback (fencing) from water resources on the farm
   - 1,000-foot setback (fencing) from the County of Kaua'i Kōloa F Well.
   - 16-foot to 20-foot wide raceways

   The addition of the 1,000-foot setback from the County of Kaua'i Kōloa F Well was requested by the County of Kauai Department of Water following submission and review of the original WMP. HDF has agreed to provide this setback and the WMP must be updated to reflect the change in available pasture areas.

8) **Section 3.0 – Land Use Summary:** Changes in the land use table are required as the project boundary, pasture acreage, and other farm features have been incorporated into the WMP.

Land Use	Acres
Farm	
Paddocks / Pasture	469.9
Cow Races, Farm Roads, Drainage Ways & Setbacks / Vegetated Buffers	77.2
Subtotal	**547.1**
Headquarters / Dairy Facility	
Milking Parlor, Yards, Sheds, Road, Ponds	9.7
Subtotal	**9.7**
TOTAL	**556.8**

9) **Section 3.0 – Land use Summary:** The net total amount of paddocks has been revised. With reconfiguration to the project area and boundaries, the paddocks and cow raceway layouts were updated. Several paddocks were created in the mauka sections of the farm, while several paddocks were removed to maintain a 1,000 foot setback from the Kōloa F County Well, which was agreed to by the County of Kauai and HDF. Several paddocks near the calf sheds were divided into smaller paddocks to allow better management of the grazing calves. The net number of paddocks, therefore, increased by one (1).

Field	Acres	Field	Acres	Field	Acres	Field	Acres
P 101	3.62	P 133	4.26	P 202	3.60	P 234	4.64
P 102	1.12	P 134	4.73	P 203	3.99	P 235	4.62
P 103	4.47	P 135	4.74	P 204	3.40	P 236	4.67
P 104	4.54	P 136	4.78	P 205	6.01	P 237	5.04
P 105	3.08	P 137	4.81	P 206	6.04	P 238	6.14
P 106	2.94	P 138	5.06	P 207	4.17	P 239	7.63
P 107	3.02	P 139	5.53	P 208	4.41	P 301	3.29
P 108	2.91	P 140	6.57	P 209	0.55	P 302	3.94
P 109	1.69	P 141	4.76	P 210	0.59	P 303	3.65
P 110	2.83	P 142	4.93	P 211	0.63	P 304	3.97
P 111	3.04	P 143	4.32	P 212	0.52	P 305	4.01
P 112	4.19	P 144	3.94	P 213	0.51	P 306	4.16
P 113	4.12	P 145	3.87	P 214	0.48	P 307	4.11
P 114	3.80	P 146	3.43	P 215	4.24	P 308	4.02
P 115	4.51	P 147	3.89	P 216	4.54	P 309	4.55
P 116	4.29	P 148	3.88	P 217	4.64		
P 117	3.29	P 149	4.11	P 218	4.20		
P 118	4.54	P 150	4.17	P 219	4.41		
P 119	3.06	P 151	4.23	P 220	4.32	P 313	3.00
P 120	3.49	P 152	3.44	P 221	4.30	P 314	3.01
P 121	3.17	P 153	4.03	P 222	4.29	P 315	3.01
P 122	4.25	P 154	4.46	P 223	4.35	P 316	3.02
P 123	3.53	P 155	3.94	P 224	4.41	P 317	3.78
P 124	3.90	P 156	4.46	P 225	4.38	P 318	3.64
P 125	3.89	P 157	4.14	P 226	4.42	P 319	4.34
P 126	3.24	P 158	5.24	P 227	4.46	P 320	4.29
P 127	4.59	P 159	4.49	P 228	4.50		
P 128	4.38	P 160	4.56	P 229	4.47		
P 129	4.35	P 161	4.52	P 230	3.69		
P 130	4.10	P 162	3.54	P 231	3.39		
P 131	4.02	P 163	3.43	P 232	4.26		
P 132	3.94	P 201	4.47	P 233	4.55	Total	469.9

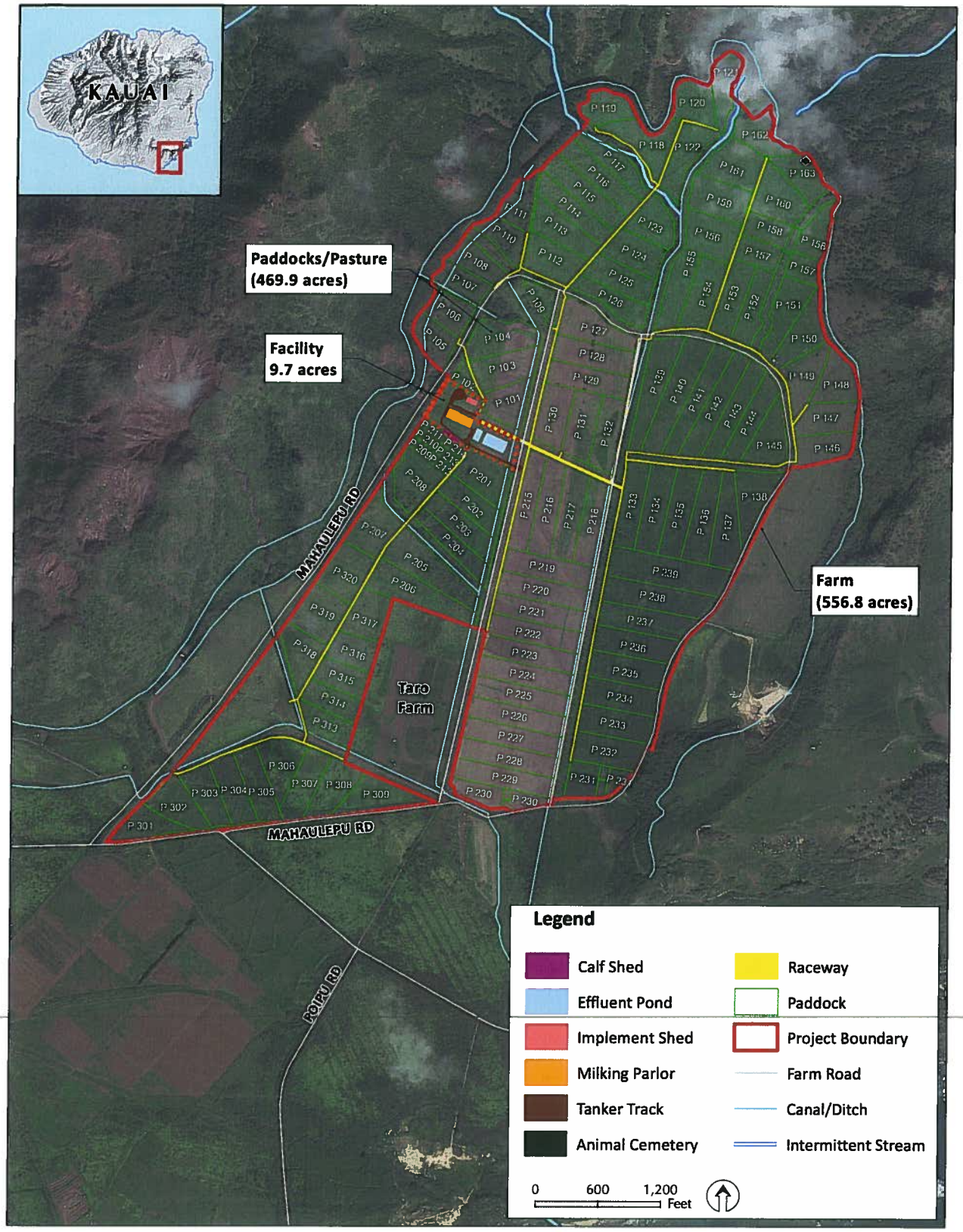


Figure 6 – Paddock Map

10) **Section 4.0 – Farm Description:** The original WMP noted several percentage calculations of areas for specific facilities with respect to the overall farm area. These numbers have been updated as the total farm boundary has been updated and the overall area specified as the "dairy facility" has been slightly altered to 9.7 acres (change in "open space" to paddocks).

    *The majority of the dairy farm area (i.e. ~83%) is dedicated to pasture. Much of the remaining area is dedicated to access roads, cow races, the dairy facility, and waterway setback / buffers. The dairy facility including the parlor, effluent ponds and secondary containment areas is contained within a **9.7-acre** area, which represents about **1.7%** of the entire farm. The corresponding building areas are under **0.1%** of the total farm area.*

11) **Section 4.2.6 – Access Road and Tanker Truck Turnaround:** Access to the dairy facility was provided off of Māhā'ulepū Road on the western side of the facility in the original WMP. Due to steeper terrain and the condition of Māhā'ulepū Road along the western side of the valley, access was relocated to one of the main farm roads in the center of the valley. The existing farm road, which passes by the taro farm and Pivot #2, is flat and is the current, operational access road to the various parts of the farm. Relocation of the access will save on construction costs and improve safety for tanker trucks to the facility. The configuration of the tanker truck turnaround adjacent to the implement shed will remain the same as in the original WMP.

12) **Section 6.2 – Drip Irrigation System:** The original WMP called for drip irrigation features in the makai areas of the farm where the center pivots could not reach. HDF has decided it will install a gun irrigation system instead, to allow for better management of the system and reduce required upkeep, as maintenance of drip irrigation facilities in active pastures where cows are grazing is expected to be more intense. The gun irrigation design will utilize a hard-hose reel gun nozzle on a cart, which attaches to hydrants, but can be moved around the area to provide even irrigation coverage.

13) **Section 6.5 – Irrigation Demand:** With the reconfiguration of the paddock layout on the farm, irrigated area totals have changed from the original WMP. Percentages of the farm that are irrigated versus non-irrigated have been updated.

Irrigated Pasture Areas:

Irrigated Pasture Area	**Acres**
Irrigation Pivot #1 (Full Circle)	164.7
Irrigation Pivot #2 (Partial Circle)	120.4
Subtotal	285.1
Gun Irrigation Area	61.4
Total Irrigated Pasture Area	**346.5**

Non-Irrigated Pasture Areas:

Non-Irrigated Pasture Area	**Acres**
Pasture Area within 50' Pivot Irrigation Setback	13.8
Remaining Non-Irrigated Pasture Area	109.6
Total Non-Irrigated Pasture Area	**123.4**

14) **Section 6.5 – Irrigation Demand:** With changes in the irrigation areas, the overall irrigation demand from the grass crop has changed. A reduction in irrigated area results in less irrigation water demand per day. The upper-end irrigation demand estimate, used for planning purposes, will be 2.26 MGD in lieu of 2.93 MGD as indicated in the original WMP.

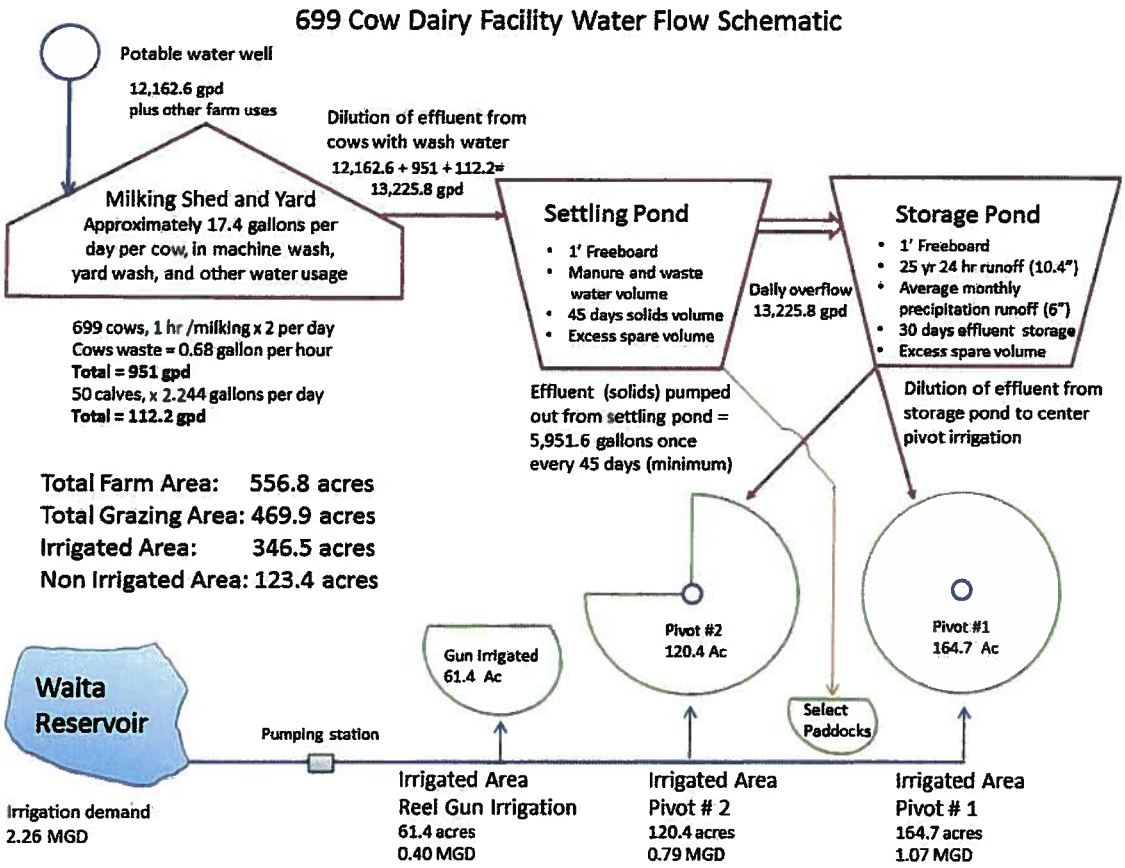
15) **Section 6.1 – Irrigation Schedule** on page 37 of the original WMP should be renumbered to Section 6.6 – Irrigation Schedule for clarity and to avoid confusion.

16) **Section 7.0 – Wastewater Treatment:** Public comments on the original WMP correctly indicated that the ponds are not treatment systems, as the original WMP did not indicate any wastewater treatment systems for the effluent. To avoid confusion and for added clarity, Section 7 – Wastewater Treatment in the original WMP should be renamed to Section 7 – Wastewater Management.

17) **Section 7.1 – Effluent / Manure Volume:** The mature cow's weight has been slightly adjusted from 1,210 lbs to 1,200 lbs.

18) **Section 7.1 – Effluent / Manure Volume:** Manure production per mature dairy cow has reduced from 143 lbs per day to 90.8 lbs per day. The change incorporates actual grass trials and forage testing data from grass grown on the farm. Manure production is affected by the nutrient content and chemical composition of the forage. With the updated forage testing data incorporated into the Cornell Model, manure production values have been updated and are consistent with the USDA/NRCS Agricultural Waste Management Field Handbook (March 2008), which utilizes established American Society of Agricultural Engineers (ASAE) values for manure production per cow per day.

19) **Section 7.1 – Effluent / Manure Volume:** The original WMP did not account for calves in the volume projections for sizing of the effluent ponds. Because the calves produce very little manure per day (19 lbs per day) and only a fraction of the calves are within the sheds which ultimately discharge to the effluent ponds, calves are typically not required to be taken into account for nutrient management purposes. However, HDF has updated the WMP to include manure production for calves, meaning there is a slight increase in the daily wastewater generation collected by the ponds. Additionally, wash water projections were increased at 699 mature dairy cows from 10,667 gpd to 12,162.6 gpd based upon an estimated requirement of 17.4 gpd of wash water per mature dairy cow. See revised waterflow schematic:



20) **Section 7.1 – Effluent / Manure Volume:** The original WMP noted that the required storage period, utilized to size the storage pond, was 23 days, including 17 days for the longest recorded consecutive day rainfall event on record, 4 days between scheduled irrigation of effluent, and 2 days for a forecasted storm event. The total storage period was then set to 30 days to provide additional capacity. 2 additional days are added into the 23 day total for pasture dry time following a significant rain event, bringing the total required minimum storage period to 25 days. However, the 30 day storage period will remain the same and will still provide additional buffer capacity.

21) **Section 7.2 – Effluent Ponds:** Overall storage pond volumes shown in the original WMP have remained the same. However, because of increased storage requirements – due to increased projections in wash water usage (10,667 gpd to 12,162.5 gpd) at 17.4 gpd per mature dairy cow as well as due to the inclusion of calves in the pond sizing calculations, more effluent is shown to be entering into the storage pond at 699 animals. However, since the pond is designed for up to 2,000 cows, there is no impact to the pond sizes.

Design Criteria/Assumption	699 Mature Dairy Cows	2,000 Mature Dairy Cows	Pond
Daily Wastewater Generation	13,225.8 gpd	37,894.7 gpd	
Percentage of Solids	1%	1%	Settling
Volume of Accumulated Solids for 45-day Period Between Application	5,951.6 gal	17,052.6 gal	Settling
Daily Flow to Storage Pond	13,225.8 gpd	37,894.7 gpd	
Minimum Volume of Effluent for 30-day Design Volume Period	396,774 gal	1,136,841 gal	Storage
Depth of 25-Year, 24 Hour Storm	10.4 inches	10.4 inches	Storage
Depth of Normal Precipitation for 30-day Design Volume Period	6 inches	6 inches	Storage

22) **Section 8.2 – Pasture Based Dairy:** Grass yields in the original WMP were projected for 20 tons of dry matter (DM) per acre per year and were the basis for all nutrient application rates and nutrient management planning.

HDF has approximately 18 months of grass trial data, for grass growth on over 70 acres of pasture on the project site. The grass trials simulate an expected grazing and 18-day rest period that a paddock would be subject to on the operational dairy. Current yields (as of 2015) indicate a production of 16.3 tons of DM per acre per year, only after 18 months of trials. Once the pasture is established and has matured, yields of 20 tons of DM per acre per year, or even greater, are anticipated. However, for the purposes of the WMP, HDF has elected to utilize the current grass yield at 16.3 tons of DM per acre per year as the basis of the nutrient management section, as physical trials have proven that the field is at least capable of producing this much forage.

23) **Section 8.4.2 – Nutrient Mass Balance:** With the use of 16.3 tons of DM per acre per year in the nutrient mass balance calculations, the nutrient demand of the grass crop is reduced. In the overall farm ecosystem, less production of grass means that fewer nutrients are required from the crop. However, because the quantity of nutrients supplied by 699 mature dairy cows and 150 calves is minimal on the 469.9 acres of pasture, the nutrient mass balance of the farm is not significantly impacted by the reduction in the grass yield to current data from a yield goal of 20 tons of DM per acre per year. Commercial fertilizer is still required to fulfill the grass nutrient need and maintain high productivity and soil health.

Nutrient Application	Area (acre)	Nitrogen Applied (lbs N/year)	Phosphorous Applied (lbs P_2O_5/year)
Manure As-Excreted	469.9	129,556	26,966
Liquid Effluent	285.1	11,980.8	2,586.7
Slurry Application	42.0	7,987.2	1,724.4
Total		**149,524**	**31,277**
Plant Nutrient Demand		**490,200**	**87,317**
Percentage from Animals		30.5%	35.8%
Required Chemical Fertilizer		340,676	56,040
Percentage Demand from Fertilizer		69.5%	64.2%

Month	N Collected in Pond (lbs-N/mo)	P Collected in Pond (lbs-P/mo)	N Excreted on Pasture (lbs-N/mo)	P Excreted on Pasture (lbs-P/mo)	N Total Deposited on Farm (lbs-N/mo)	P Total Deposited on Farm (lbs-P/mo)	N Total Uptake from Farm (lbs-N/mo)	P Total Uptake from Farm (lbs-P/mo)	N Deficit (lbs-N/mo) (Fertilizer Need)	P Deficit (lbs-P/mo) (Fertilizer Need)
January	1,696	366	11,003	2,290	12,699	2,656	41,633	7,416	28,934	4,760
February	1,532	331	9,939	2,069	11,470	2,399	37,604	6,698	26,134	4,299
March	1,696	366	11,003	2,290	12,699	2,656	41,633	7,416	28,934	4,760
April	1,641	354	10,648	2,216	12,290	2,571	40,290	7,177	28,001	4,606
May	1,696	366	11,003	2,290	12,699	2,656	41,633	7,416	28,934	4,760
June	1,641	354	10,648	2,216	12,290	2,571	40,290	7,177	28,001	4,606
July	1,696	366	11,003	2,290	12,699	2,656	41,633	7,416	28,934	4,760
August	1,696	366	11,003	2,290	12,699	2,656	41,633	7,416	28,934	4,760
September	1,641	354	10,648	2,216	12,290	2,571	40,290	7,177	28,001	4,606
October	1,696	366	11,003	2,290	12,699	2,656	41,633	7,416	28,934	4,760
November	1,641	354	10,648	2,216	12,290	2,571	40,290	7,177	28,001	4,606
December	1,696	366	11,003	2,290	12,699	2,656	41,633	7,416	28,934	4,760
Annual Total	19,968	4,311	129,556	26,966	149,524	31,277	490,200	87,317	340,676	56,040

24) **Section 8.8.1 – Soil Testing Frequency:** In the original WMP, soil sampling was expected every three years. However, based upon the public's input as well as additional soils testing by Dr. Russell Yost, with the University of Hawai'i, soil sampling and testing for nutrient content and fertility recommendations will be conducted yearly. Increased testing will ensure that nutrients are not over-applied past the grass nutrient demand, and HDF will benefit from more frequent testing to ensure that nutrients are not wasted.

SUMMARY

HDF believes that the changes made above improve the original Waste Management Plan, submitted to DOH on July 23, 2014, which was subsequently reviewed. These changes not only address public concern over the proposed dairy (with the addition of calves, reduction in available pasture area, etc.), but also are grounded in scientific reality with the additional incorporation of field-tested and site-specific, proven data (grass yields and soils analysis) and technical studies conducted within the last year.

HDF would like to emphasize that the pasture-based, rotational-grazing dairy system, including the design and sizing of the effluent ponds, is fundamentally the same and has not changed. Simply put, better and more current data, based on ground-level trials and studies, can improve the basis of the WMP.