

TRANSMITTAL and OFFER LETTER RFP WSAG17

Name of Organization: Hōkū Nui Maui, LLC

Point of Contact: Andrea Dean

Phone: 808-960-3727

Email: andrea@hokunui.com

Water Security Advisory Group  
Department of Land and Natural Resources, Commission on Water Resource Management  
Punchbowl Street, Room 227  
Honolulu, Hawaii 96813

The undersigned has carefully read and understands the terms and conditions specified in RFP WSAG17, the Special Provisions attached hereto, and hereby submits the following offer to perform the work specified herein, all in accordance with the true intent and meaning thereof. The undersigned further understands and agrees that by submitting this offer, 1) he/she is declaring his/her offer is not in violation of Chapter 84, Hawaii Revised Statutes, concerning prohibited State contracts, and 2) he/she is certifying that the price submitted was independently arrived at without collusion.

A list of secured and required permits necessary to implement the project are hereto attached.

WSAG17: Water Security for Agriculture—Capturing and Utilizing On-Farm Surface Water  
**Proposal Title:** \_\_\_\_\_

**Total Amount of Proposal:** \$ \$310,225 (\$100,000 request, \$200,000 cash match, \$10,225 in-kind)

If awarded, the contract with the State would be made with the following entity (please use the **exact legal name** as registered with the Dept. of Commerce and Consumer Affairs):

Hoku Nui Maui, LLC

Legal name

P.O. Box 1347, Makawao, HI 96768

Address (Contract and Billing Address must be the same)



State Tax ID No. (GE)

Federal Tax ID No.

4/19/17

Offeror Signature

Date

Gregory Raab

CEO/CFO

Print Name

Title



OFFER FORM OF-1
2017 IMPLEMENTATION OF WATER SECURITY PROJECTS AND PROGRAMS
STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES
RFP-WSAG17

Procurement Officer
Department of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii 96813

Dear Procurement Officer:

The undersigned has carefully read and understands the terms and conditions specified in the Specifications and Special Provisions; and hereby submits the following offer to perform the work specified herein, all in accordance with the true intent and meaning thereof. The undersigned further understands and agrees that by submitting this offer, 1) he/she is declaring his/her offer is not in violation of Chapter 84, Hawaii Revised Statutes, concerning prohibited State contracts, and 2) he/she is certifying that the price(s) submitted was (were) independently arrived at without collusion.

Offeror is: [ ] Sole Proprietor [ ] Partnership [ ] \*Corporation [ ] Joint Venture
[ ] Other Limited Liability Company

\*State of incorporation: \_\_\_\_\_

Hawaii General Excise Tax License I.D. No. \_\_\_\_\_

Federal I.D. No. \_\_\_\_\_

Payment address (other than street address below): P.O. Box 1347
City, State, Zip Code: Makawao, HI 96768

Business address (street address): 186 Pi'iholo Road
City, State, Zip Code: Makawao, HI 96768

Respectfully submitted:
Date: 4/19/17

(x) [Signature]
Authorized (Original) Signature

Telephone No.: 914-319-6708

Gregory Raab, CEO/CFO
Name and Title (Please Type or Print)

Fax No.: N/A

E-mail Address:
greg@hokunui.com

\*\* Hoku Nui Maui, LLC
Exact Legal Name of Company (Offeror)

\*\*If Offeror is a "dba" or a "division" of a corporation, furnish the exact legal name of the corporation under which the awarded contract will be executed.




OFFER FORM OF-2

Total contract cost for accomplishing the development and delivery of the services.

\$ 100,000 \_\_\_\_\_

**Note: Pricing shall include labor, materials, supplies, all applicable taxes, and any other costs incurred to provide the specified services.**

I, Gregory Raab for Hoku Nui Maui, LLC (Offeror), certify that at time of award the 1:1 matching fund requirement will be met for Water Security for Agriculture—Capturing and Utilizing On-Farm Surplus (project). The total amount of matching funds will be \$ \$200,000 cash and \$10,225 in-kind

	<u>4/19/17</u>
Offeror Signature	Date
<u>Gregory Raab</u>	<u>CEO/CFO</u>
Print Name	Title

## **WSAG17: WATER SECURITY FOR AGRICULTURE— CAPTURING AND UTILIZING ON-FARM SURFACE WATER**

**Uē ka lani, ola ka honua  
When the sky weeps, the earth lives. <sup>i</sup>**

### **I. SCOPE OF WORK: NARRATIVE**

*Describe each proposed activity under the relevant scope of work item. Include information on: Budget; Description of proposed activities and justification of need; List of deliverables.*

#### **About Hōkū Nui Maui, LLC**

Hōkū Nui Maui is an innovative farm, forest and housing community being developed on 258-acres of former pineapple and sugar cane plantation land. Hōkū Nui Maui calls itself a *Regenerative Farming Community*, as the project integrates a small community of sustainable residential homes on a minimal land footprint while devoting about 200 acres to regenerative agriculture and forestry, the philosophy being to continually improve the soil and water. The farm currently encompasses a poultry operation (meat and eggs), livestock (sheep and cattle), apiculture (honey, candles and queen breeding), native forest habitat restoration and traditional agroforestry. Enhancing the carbon sequestered in the soil is targeted through a non-selective rotational grazing system. The property is also the future site of Keali'i Reichel's award-winning Hālau Ke'alaokamaile's Cultural Center and Hula Platform.

Hōkū Nui Maui operates entirely on solar power and has its own water resources. The project strives to demonstrate that a residential community and agricultural operation can be energy and water self-sufficient.

Hōkū Nui Maui strives to be a model in Hawai'i—demonstrating how to enhance environmental, social and cultural qualities while operating a financially viable and sustainable business model. Hōkū Nui Maui's desire is to influence positive economic change and set an example for other landowners and land developers in Hawai'i—by testing, documenting and sharing results.

#### **Regenerative Design Philosophy**

Hōkū Nui Maui has taken advantage of the best international, national and local consultants while developing a plan for the management of the 258-acres with an emphasis on the sustainable management of water resources. Our plan for the capture, use and re-use of water has been developed by qualified team of professionals: Stacy Otomo, Otomo Engineering, Inc. of Wailuku, Maui; Lauren Roth Venu, Roth Ecological Design International, LLC of Honolulu, Hawai'i; Darren J. Doherty, Regrarians Ltd. from Australia; USDA NRCS (Natural Resources Conservation Service) on Maui.



The overall design philosophy was informed by Darren Doherty and his Regrarians platform, which derives heavily from the work of P.A. Yeomans who, in the 1950's in Australia, developed what is called Keyline Design.

*"[Keyline Design] A comprehensive design strategy for agricultural and urban development based on fundamental, repeating land shapes that have been created by water." -Abe Collins<sup>ii</sup>*

In Keyline Design water capture begins at the "keypoint," the natural point of water collection on the land. "Keylines," the other concept in Keyline Design, are contour lines cut by a Yeomans Plow (loosens, without turning over soil) that are parallel to the keypoint and help distribute water to the naturally dryer parts of the landscape.

Ground water recharge is estimated at 2.0 – 6.3 inches per hour (Makawao Soil Series)<sup>iii</sup>, and is enhanced through keyline design.

According to the California Ag Water Stewardship Initiative:

*"Keyline systems capture significant quantities of water that would otherwise run off, and store it in the soil. Keyline systems also build soil fertility, which further improves moisture-holding capacity. Ultimately, while no research has quantified the reductions in applied water associated with this system, it is clear that the benefits are substantial. For instance, we know that for each 1% increase in soil organic matter, which can increase water storage by 16,000 gallons per acre-foot of applied water.*

*Keyline plans typically employs water storages (usually ponds) as a component of the overall plan. Small ponds of surplus runoff water can be placed at the natural intersection of a ridge and a valley, or convex and concave slopes, known as a key point. This stored water can provide gravity-fed irrigation later in the season for pastureland or crops. The spillway or primary outlet channel from ponds is managed in a way to maximize the distribution of water to irrigate the land below."<sup>iv</sup>*

## **Need**

According to *Energy for Water and Water for Energy on Maui Island, Hawai'i* by Emily A. Grubert and Michael E. Webber:

*"Maui's particular characteristics mean that it is unusually dependent on energy to access its significant freshwater resources. While Maui has an estimated 760 million gallons per day (mgd) of available freshwater resources, both as surface (330 mgd, [29]) and groundwater (430 mgd, [31]), it is highly dependent on pumping groundwater both long horizontal distances from wet areas to more populated drier areas and long vertical distances from the freshwater lenses resting above seawater in Maui's volcanic rock up to users at high elevations on the flanks of its two volcanoes.*

*A result of this dependence on pumping is that Maui's water delivery systems are relatively energy-intensive, which means that Maui potentially faces economic water scarcity due to energy limitations despite its large water resources. **Since most of Maui's fresh surface water is allocated to environmental and agricultural uses, further freshwater supplies must come either from displacing agriculture or by spending more energy to pump, treat, and reclaim water.**"<sup>v</sup>*

Until recently, HC & S has been Maui's biggest agricultural water user, using 60% of the island's freshwater supply for sugar cane irrigation.<sup>vi</sup> With the closure of the sugar plantation, HC & S is no longer irrigating cane, but has stated a need to retain the right to most of that water resource (115 million gallons of water per day) for its plans to convert to diversified agriculture.<sup>vii</sup> Much of that water is provided by East Maui Irrigation, and is from two-dozen diverted East Maui streams. The stream diversions have been legally, socially and culturally contentious.

Furthermore, the County of Maui relies upon the surface water from East Maui Irrigation to provide water to 35,000 Upcountry customers.<sup>viii</sup>

According to the Maui County Soil and Water Conservation District website: *"Currently, Upcountry Maui farmers use domestic drinking water for irrigating their crops. They pay one of the nation's highest rate for agricultural water (\$1.19 per thousand gallons). More importantly, during times of drought – which seems to be happening more often – farmers are required to reduce their water usage. This decrease in water availability has resulted in lower yields and crop loss."*<sup>ix</sup>

At current levels, the livestock, forestry and irrigation water needs at Hōkū Nui Maui are estimated at 3,361,630 gallons per year: 1,336,630 gallons per year for cattle, sheep and chickens and 2,025,000 gallons per year for forestry and landscape irrigation. (Forestry and landscaping plants are all optimized for the environment, and water is only anticipated during an 18-month establishment period.) It is estimated the current 2 million gallon detention basin is adequate to meet about half of these needs. Construction of Detention Basin #1 is needed to meet the rest of these water needs in a sustainable fashion.

Clearly, there is a need for housing developers, ranchers and agricultural operations to more efficiently capture surface water on their own lands in order to offset the practice of diverting natural stream flows and relying upon scarce municipal water supplies. Taking advantage of land shaped by plantation agriculture and natural land features, Hōkū Nui Maui can demonstrate how to use regenerative principles to construct a water capture system that makes efficient use of surface water for agriculture, forestry and landscaping.

### **Agricultural and Residential Water Management Practices**

Most housing developments are designed to direct water *away* from the property—into storm drains, streams and the ocean. Hōkū Nui Maui is designed so that surface water is captured and retained on the property for agricultural use. The project is harvesting



rainwater, instead of using diverted stream water and municipal or private potable water sources for agricultural operations.

The entire 258-acres at Hōkū Nui Maui has been designed using the above-mentioned regenerative principles. Pertinent to fresh water management:

- The pastures at Hōkū Nui Maui have been mapped with keylines, along which the Yeomans Plow, as described above, is used to divert and re-distribute water to the drier parts of the pastures.
- Hōkū Nui Maui will use no municipal water. The project has it's own 205 gpm well and pump to supply potable water to the 42 residences. A newly installed 91 kW photovoltaic system will pump water to a holding tank at the top of the property, where it will then be gravity fed down to the houses. Because Hōkū Nui Maui has its own well, best management practices that encourage groundwater recharge are employed.
- So as to utilize potable well water only for human drinking water, the project design calls for the construction of seven detention basins at keypoints in order to collect and store runoff for agricultural use. One reservoir, "Detention Basin #6" has already been constructed.
- A 30-acre Native Forest Corridor is planned within the same natural drainage area as the seven drainage basins, which makes use of the water for establishing native reforestation and agroforestry. In turn, the native plants and trees return the favor through their wise use of water, as opposed to water thirsty invasive species, which sap the water resources of an area.

### **Proposed Project and Impact**

This project constructs a road so that it, and grassed swales, (a total of 12 acres) can be used as a catchment surface, to divert runoff into a 1.5 million gallon detention basin (Detention Basin #1), which is then used for:

- Agriculture:
  - Drinking and other water for cattle, sheep and chicken operations.
  - A place to grow specific wetland plant species for chicken feed.
- Establishment of a native forest restoration and traditional agroforestry project.
- Landscaping irrigation for farm and subdivision roads.

### **Impact**

- Through innovative design that captures and uses rainwater, this project create a new water resource that mitigates the use of approximately 3,361,630 gallons per year of potable water for agriculture and landscaping.
- Prior to the installation of Detention Basin #6, the following was true:  
*"Onsite runoff of 1,055 cfs from approximately 148 acres of the project area presently sheet flows across the project site and into Maliko Gulch. Runoff of 784 cfs from the*

*remaining 110 acres presently sheet flows onto Pi'iholo Road or onto the adjacent downstream properties.*

*After the development of the proposed project, there will be a net decrease in the volume of runoff sheet flowing from the project site into Maliko Gulch and onto the adjacent makai properties and Piiholo Road.”<sup>x</sup>*

Runoff will now be efficiently captured and utilized. Overflow discharge will be filtered through the Native Forest Corridor, more closely mimicking a natural cycle of clean water flowing into the gulches.

Demonstration value: This project demonstrates full water security for an active agricultural operation and residential community, as well as energy and food security, which are closely connected to the water resources and enhance climate resilience.

### **Deliverables**

- Construction of:
  - 1,300 feet of farm road as a catchment surface.
  - 1.5 million-gallon Detention Basin.
- Design of:
  - Maintenance Plan: A maintenance plan will be developed for the permanent stormwater Best Management Practices (BMP's) for the Road and Detention Basin. The plan will include the requirements for removal of the accumulated debris and sediment, maintaining vegetation, and performing inspections to insure that the BMPs are functioning properly.
  - Filtration and Distribution System: to treat and transport the water to end-users.
- Design and Installation:
  - Floating Wetlands to clean the water and grow plants for chicken feed.
- Documentation of Results
  - Set up monitoring equipment to track rainfall and water capture over the course of the project period. Specifically, volume of water captured, volume of potable or municipal source water conserved.
- Educational Outreach to Promote Adoption of Method
  - Write-up and photo documentation of process and results (including water captured and saved, cost and technical information) for dissemination through website, and promoted through print and online media that target ranchers, large agricultural operations and large land owners/developers.
  - Production and dissemination of 2-minute video explaining the design philosophy, water security objectives and results.



## **Project Sustainability**

Hōkū Nui Maui LLC is philosophically and legally committed to the long-term operation and maintenance of the water, energy, agricultural and housing resources of the project.

Detention Basin #1 is the uppermost reservoir on the property and therefore a key strategic component in the agricultural water system of the property. Detention Basin #1 is directly adjacent to the finish pasture for cattle, a major line of planned agroforest along Pi'iholo Road and is directly uphill from the Native Forest Corridor.

Plans call for the construction of five more detention basins, for a total of seven on the property, which represents over 2,039,426 cf of available water storage capacity.

Hōkū Nui Maui LLC currently has 20 full-time staff members and multiple contractors that manage and execute infrastructure, agriculture, housing, water, maintenance and energy projects. In the short-term, Detention Basin #1 will be maintained by existing farm staff. In the long-term (outside of project time frame), a Water Resource Specialist position will be created and filled in order to ensure the daily maintenance and operation of the seven detention basins, filtration and distribution of water.

## **II. EXPERIENCE AND CAPABILITIES**

*Previous experience, capability and proficiency in implementing proposed project or program.*

### **Conservation Design and Construction**

Hōkū Nui Maui, LLC and its partners Otomo Engineering Inc., Alpha Inc. (General Contractor) and USDA NRCS (conversation plan partners) have already successfully built one of the detention basins (Detention Basin #6), a similar 2 million gallon pond and runoff capture system. Detention Basin #1 is very similar in design and execution to Detention Basin #6, and the same team will be used for construction.

#### **Otomo Engineering, Inc.**

Stacy A. Otomo is the lead engineer on the Hōkū Nui Maui, LLC project, including: roadways, detention basins, drainage, water, sewers and utilities.

Stacy A. Otomo is a civil engineer, and has been in business in Hawai'i for over 20 years. Otomo Engineering Inc. has provided engineering services for numerous county, state, federal and private projects. Past projects have included: South Kihei Road Drainage Improvements, Kihei Drainage Master Plan, Waikapu Affordable Housing Project, Ohana Kai Village, Ka'ono'ulu Estates, Olowalu Country Town, Waikapu Country Town and Wailuku/Kahului Force Main Replacement.

## USDA NRCS

Hōkū Nui Maui, LLC has utilized the services of the USDA NRCS for the conservation design and necessary permit. Ryan Woolbright, PE is the Civil Engineer for NRCS on Maui and has been in that position for over five years. He was previously an Agricultural Engineer with USDA-NRCS.

## Alpha, Inc.

Alpha, Inc. acts as the general contractor, executing the construction of the road and detention basin according to design specifications.

Alpha, Inc. is a general contractor on Maui that specializes in large-scale infrastructure projects. They have state-of-the-art equipment and provide engineering services, as well as: Soil Stabilization; Retention ponds; Water well drilling, pump installation; Subdivision development; Earthmoving, grading and excavation; Complete pad prep; Demolition; Rock breaking; Water, sewer and power line installation; Underground utilities; Soil stabilization; Septic systems.

Their recent clients include: U.S. Army Corp of Engineers; State of Hawai'i; U.S. Marine Corp; U.S. Naval Facilities; Department of Land & Natural Resources; RMT Wind Farms; County of Maui; Ocean Vodka.

Alpha, Inc. is well qualified to successfully execute the construction aspects of this project as described in this proposal.

## **Measuring Water Security Benefits**

### Roth Ecological Design International, Inc. (REDI)

Lauren Roth Venu, Founding Principal & Project Director of Roth Ecological Design International, Inc. (REDI) has been retained as a consultant for Hōkū Nui Maui LLC since the project inception. Lauren has provided consultation on efficient water use and wastewater design for the residential and agricultural aspects of the project.

Lauren will design the water monitoring protocol, train staff in use and help interpret data. She will also design the floating wetlands.

As the Founding Principal of Roth Ecological Design Int. LLC, Lauren strives to bridge her background in ecological design, the water sciences and policy to elevate site design by maximizing onsite water conservation, reuse and stormwater recharge practices that meet the triple bottom line. Her educational background includes B.A. in Environmental Science with a specialty in Water from the University of Colorado at Boulder; a Master of Science in Oceanography from the University of Hawai'i at Manoa; a graduate of the Proper.net Leadership Program from the United Nations University / East-West Center; and is a fellow of the 2015 Water Leadership Institute (Water Environment Federation).



Lauren is a frequent lecturer and published author on ecological design and green (water) infrastructure. She also has served in variety of public service roles, including: an advisory role for the State of Hawai'i Water Conservation Plan Committee (2011-2013); member of the City and County of Honolulu Sustainable Building Task Force of which she chaired the Water and Wastewater Sub-Committee (2010-2011); the State of Hawai'i Department of Health Water Reuse Guidelines Advisory Committee (2013-2016); and as Chair of the Hawai'i Chapter United States Green Building Council Advocacy Committee she leads the (green) plumbing codes investigation for the Green Codes Investigative Committee for the Hawai'i State Building Code Council (2013-present). She has also volunteered her time as a (Co)-Project Manager for the Hawai'i Engineers Without Borders Chapter. In addition she serves as President of the Board of Directors for the Water Institute for Sustainability Education (WISE) and as well as a Board of Directors member for 'Ahahui Malama I Ka Lokahi. Some of Lauren's accolades include: a Region 9 Environmental Protection Agency awarded project (2005); being named one of the "Top Forty Under Forty Business Leaders" by Pacific Business News (2014); and named by Pacific Edge Magazine (2015) as an "Emerging Leader in Design."

### **Project Management and Project Outreach**

**Joshua Chavez** is the *Chief Operating Officer of Construction and Development* at Hōkū Nui Maui, LLC and will be primarily responsible for the direct management of this project, including ground level management of all contractors, construction, timeline and budgets. Joshua was responsible for the successful completion of Detention Basis #6, and has excellent working relationships with Otomo Engineering, Alpha, Inc., NRCS and Roth Ecological Design International, Inc.

Joshua was born and raised on Maui and has twenty years of experience in real estate sales, construction and development. Before joining the team at Hōkū Nui Maui four years ago, Josh developed two residential subdivisions, built and sold five new homes and completed nine remodels.

**Gregory Raab** is the *Chief Executive Officer/Chief Financial Officer* at Hōkū Nui Maui, LLC. Greg will be responsible for the overall fiscal management of the project, working with bookkeeper Sandra Morikawa. Greg will track expenses according to the project budget and prepare semi-annual and final financial reports as required. As the CEO/CFO of the company, he will also provide general oversight of the project, ensuring all project deliverables, legal and financial requirements are met.

Before becoming the CEO/CFO at Hōkū Nui Maui, Greg worked for Financial Services companies in New York City and London and specialized in real estate and financial risk analytics. He was the Senior Managing Director—RMBS at Assured Guaranty Ltd, Chief Risk Officer and Senior Managing Director at Ambac Assurance Corporation, Portfolio Manager/Senior Managing Director at General Electric/GE Equity and Chief Executive Officer and Chief Risk Officer at Axon Financial Services.

**Andrea Dean** is the *Strategic and Community Partnerships Manager* at Hōkū Nui Maui, LLC. She will be responsible for the write up of the process and results for sharing with the target community of ranchers, large agricultural operations and large land owners/developers.

Prior to working at Hōkū Nui Maui, Andrea spearheaded numerous local food and farming projects, and worked as a consultant to local non-profits and businesses. Andrea’s writing about sustainability issues has been featured in many Hawai‘i-based magazines, including: Honolulu Weekly, Ke Ola Magazine, Big Island Traveler and Innov8.

**Rina Chavez** is a consultant to Hōkū Nui Maui in the area of Graphic Design and Marketing. Rina will be responsible for the graphic layout of communications collateral, contracting and supervision of the video and dissemination of outreach materials to the target audience and general public.

Rina is a graphic designer, photographer and artist. Born in Japan and raised on the island of Maui, Rina graduated from the Joshibi College of Art and Design in Tokyo, Japan in 2010, with a degree in Communication Media Design. Upon returning to Hawai‘i, she has worked with various clients on Maui, Japan, and the Mainland. Areas of focus include portrait, wedding, and event photography, graphic design, branding, and marketing.

### III. STRATEGY, TIMELINE, PLAN, AND PRICING

<b>Milestone</b>	<b>Timeline</b>
Contract Start Date	9/1/17
Notify NRCS, Alpha Inc. and REDI	9/1/17
Review and approve any revisions to engineering plans	9/15/17
Contract with Alpha, Inc. and REDI	9/30/17
Contract with video production company	9/30/17
Order materials and equipment	10/15/17
Implement construction BMP’s	10/30/17
Commence runoff monitoring and floating wetlands design	10/30/17
Commence video production	11/7/17
Commence road work	11/13/17
Commence detention basin work	12/15/17
Commence floating wetlands construction	12/15/17
Semi-annual report due	3/1/18
Road and detention basin complete	3/3/18
Commence erosion control grass/plants	3/3/18
Commence installation of runoff monitoring equipment and protocol	3/8/18
Commence installation of floating wetlands	4/8/18
Water treatment, water plants and erosion control complete	5/28/18
Project outreach materials complete	6/1/18
Video production complete	6/1/18



Commence outreach to target audience	6/2/18
Project Complete and Final Report Submitted	8/31/18

The total project budget is \$310,225: \$100,000 grant request, \$200,000 in cash matching and \$10,225 in-kind. (See attached budget).

**Strategy 1—Road and Detention Basin for Water Capture:** Use innovative design to build a farm road to be used as a catchment surface, along with grassed swales, to divert runoff into a 2 million gallon detention basin to be used for agriculture and landscaping.

### Permit

Hōkū Nui Maui has utilized Conservation Technical Assistance (CTA) from the USDA NRCS to develop a Conservation Plan that covers Hōkū Nui Maui LLC’s plans for seven Detention Basins and all roads within the property. Therefore, plans which meet NRCS standards and specifications mitigate the need for the required County of Maui Grading and Grubbing Permit (Chapter 20.08 MCC Soil Erosion and Sedimentation Control). See attached letter from NRCS.

As described above, Alpha Inc. will conduct all construction work under the supervision of Joshua Chavez.

### Road Construction Plan:

- Grub greenways
- Cut the grade of the road including drainage swales
- Compact surface in preparation for gravel
- Lay gravel
- Drench and roll gravel

### Drainage Basin #1 Plan:

- Grub green waste
- Excavate basin
- Cut and fill excavated dirt to build embankment
- Compact embankment
- Install drain pipe and sediment filter
- Apply bentonite liner
- Cover liner with one foot of soil
- Compact
- Amour water entry spillway

### Excerpted from Otomo Engineering:

- The project requires both excavation and embankment for the construction of the roadways, building pads, infrastructure installation and drainage improvements. In

general, the drainage design criteria are to minimize any alteration to the existing drainage patterns and volumes.

- In accordance with Chapter 4, *Rules for the Design of Storm Drainage Facilities in the County of Maui*, the Rational Method is used to design the onsite drainage systems and detention basins with drainage areas less than 100 acres. For these onsite drainage systems, the 50-year, 1-hour storm frequency will be used. In accordance with said rules, the design of the drainage systems with retention basins is based on the following design conditions:

*“In areas where the existing drainage systems are inadequate, the existing system shall be upgraded to handle runoff from the new project area or a new system shall be provided to connect to an adequate outlet. When there is no existing drainage system or adequate outlet to connect to, the additional runoff generated by the development may be retained on-site in a temporary retention basin with the following design conditions:*

*A. Storage volume of an infiltration basin, infiltration trench piping, or retention basin shall equal at least the total additional runoff volume for the appropriate storm intensity.*

*B. Soil percolation shall not be used in satisfying required storage volumes.*

*C. Fifty percent (50%) of voids within the rock envelope for subsurface drains may be used in satisfying required storage volume provided that filter fabric is installed around the pipe and at the interface of the rock envelope and soil.*

*D. Sumps, detention and retention facilities will remain private.*

*E. Detention or retention ponds with embankment heights equal to or in excess of 50 acre-feet shall conform to all state and federal requirements relative to dams”.*

- Based on the above drainage design criteria, the drainage plan for the project include grassed swales along the roadways which will transport the runoff into seven (7) onsite detention basins.
- The seven proposed onsite detention basins have a total storage volume of approximately 2,039,426 cubic feet (46.8 acre-feet). Runoff from the developed areas within the seven drainage basins will require approximately 265,343 cubic feet of storage volume. The available storage volume provided far exceeds the storage volume required to accommodate the flow from the development for a 50-year, 1-hour storm.
- In accordance with the County’s “Rules for the Design of Storm Water Treatment Best Management Practices”, the design of the stormwater system will include water quality treatment to reduce the discharge of pollutants to the maximum extent practicable. Some examples of stormwater best management practices (BMP) are:

- Grassed Swales will be implemented within the landscaped areas where practical. Grass and groundcover provides natural filtration and allows for percolation into the underlying soils.
  - Open Space will be maintained with grass or other landscape materials, thereby reducing the amount of impervious surfaces and promotes infiltration.
  - Stormwater Detention serves to collect and store stormwater allowing some of the suspended solids to settle out. The stored runoff will be used as the primary source of irrigation for the project.
- Temporary erosion control measures will be incorporated during the construction period to minimize dust and soil erosion. Additional controls will be implemented to protect Maliko Gulch. Temporary BMPs include the construction of diversion berms and swales, dust fences, silt fences, stabilized construction entrances, truck wash down areas, inlet protection, temporary grassing of graded areas, and slope protection. Water trucks and temporary sprinkler systems will be used to minimize dust generated from the graded areas.
  - The drainage design minimizes any alterations to the drainage pattern of the existing onsite surface runoff. No additional runoff will be allowed to sheet flow from the project site into Maliko Gulch, the adjacent makai properties or onto Pi'iholo Road.

**Strategy 2—Use Water for Agriculture, Forestry and Landscaping:** Design filtration and distribution system to treat and transport water for irrigation and animal agriculture.

#### Filtration Consultation and Design

Roth Ecological Design International, Inc. (REDI) will provide:

- Consultation on water filtration for agricultural use.
- Design of Floating Wetlands in order to provide primary treatment of the water in preparation for agricultural use.
- Floating Wetlands will also be piloted for use in growing plants to supplement feed for poultry.

#### Water Distribution System

Hōkū Nui Maui staff will:

- Design and budget of water distribution system that transports the water from Detention Basin #1 to the end users: forestry, livestock and landscaping.

*Note: Water filtration and distribution pipelines will be implemented, but it is outside the one-year time frame and financial scope of this project. Hōkū Nui Maui is happy to continue to track results and usage to share with the community beyond the scope of this project.*

**Strategy 3—Documenting and Sharing Results to Scale Methodology:** Document design and construction process and metrics, monitor water capture results and design educational materials to share with target audience.

Monitoring Results

Roth Ecological Design International, Inc. (REDI) is tasked with designing and implementing the water monitoring protocol, specifically:

- Design water-monitoring protocol, to include monitoring quantity of rainwater capture into the detention basin and potable/municipal water saved.
- Oversee installation of monitoring equipment and training of staff to perform basic monitoring functions.
- Provide interpretation of results.

Hōkū Nui Maui staff will:

- Collect data on a daily basis and track in a database or spreadsheet.

Outreach

Hōkū Nui Maui staff (Andrea Dean and Rina Chavez) will:

- Collate data and create explanatory graphics.
- Photo document the process from start to finish.
- Create an easy to understand and graphically pleasing report on project philosophy, design methodology, cost and results.
- Write script and oversee production of two-minute video.
- Post report and video at [www.hokunui.com](http://www.hokunui.com), post video on YouTube, and promote through print and online media that target ranchers, large agricultural operations and large land owners/developers.

**Possible Shortfalls**

<b>Potential Risk</b>	<b>How to Mitigate</b>
1. Construction delays due to rainy weather, equipment failure, scheduling conflicts of contractors or other factors.	Construction is scheduled to be complete by March 2018, that leaves six additional months in the project schedule to account for construction delays. Previous detention basin construction was completed in under one year.
2. Cost overruns due to environmental conditions, shipping of materials and equipment, contractor overtime, etc.	Hōkū Nui Maui is committed to completing all of the deliverables outlined in this proposal. Cost overruns will be covered by Hōkū Nui Maui, LLC.
3. Inaccuracy in measuring water capture results.	REDI will make every effort to design a system that provides accurate measurement and to train staff in

	monitoring. Hōkū Nui staff will be tracked my management to ensure data capture is consistent and accurate.
4. Slow to Scale/Adopt Methodology	Hōkū Nui Maui will offer site visits and provide consultation to interested parties beyond the timeframe of this one-year project.

#### IV. PROPOSAL BUDGET FORM

- Budget Form (see Attachment E)

#### V. EXCEPTIONS

- Not applicable.

<sup>i</sup> Mary Kawena Pukui, 'Ōlelo No'eau: Hawaiian Proverbs and Poetical Sayings.

<sup>ii</sup> KEYLINE DESIGN Mark IV 'Soil, Water & Carbon for Every Farm' Building Soils,

<sup>ii</sup> KEYLINE DESIGN Mark IV 'Soil, Water & Carbon for Every Farm' Building Soils, Harvesting Rainwater, Storing Carbon Abe Collins & Darren J. Doherty

<sup>iii</sup> Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai; State of Hawaii. United States Department of Agriculture Soil Conservation Service in cooperation with The University of Hawaii Agricultural Experiment Station, August 1972, Page 162, Sheet 114.

<sup>iv</sup> California Ag Water Stewardship Initiative:

[http://agwaterstewards.org/practices/keyline\\_design/](http://agwaterstewards.org/practices/keyline_design/)

<sup>v</sup> Energy for water and water for energy on Maui Island, Hawai'i. Emily A Grubert<sup>1</sup> and Michael E Webber<sup>2</sup>. Published 9 June 2015 • © 2015 IOP Publishing Ltd Environmental Research Letters, Volume 10, Number 6.

<http://iopscience.iop.org/article/10.1088/1748-9326/10/6/064009>

<sup>vi</sup> Energy for water and water for energy on Maui Island, Hawai'i. Emily A Grubert<sup>1</sup> and Michael E Webber<sup>2</sup>. Published 9 June 2015 • © 2015 IOP Publishing Ltd Environmental Research Letters, Volume 10, Number 6.

<http://iopscience.iop.org/article/10.1088/1748-9326/10/6/064009>

<sup>vii</sup> HC&S' need for E. Maui stream water weighed, Maui News, February 11, 2017.

<http://www.mauinews.com/news/local-news/2017/02/hcs-need-for-e-maui-stream-water-weighed/>

<sup>viii</sup> County Slowly Attacking Water Meter List. <http://www.mauinews.com/news/local-news/2015/10/county-slowly-attacking-water-meter-list/>

<sup>ix</sup> <http://www.mauicountysoilandwater.org/upcountry-maui-waterline-project/>

<sup>x</sup> *Preliminary Engineering Report For Hōkū Nui Sustainable Community*. Otomo Engineering, Inc., Consulting Engineers



## Attachment E

## WSAG17- Proposal Budget

GRAND TOTAL (including match) \$ 310,225Subtotal for labor \$ 10,225Subtotal for materials \$ 55,000Subtotal for other actions \$ 245,000

Please round amounts to the nearest dollar.

Budget Category	Proposed Grant Budget	Matching Cash	Matching In-kind	Total Budget
Salary and wages			10,225	10,225
Materials and supplies	55,000			55,000
Travel				
Training				
Contracts	45,000	200,000		245,000
Rentals				
Other				
<b>Total Cost</b>	100,000	200,000	10,225	310,225

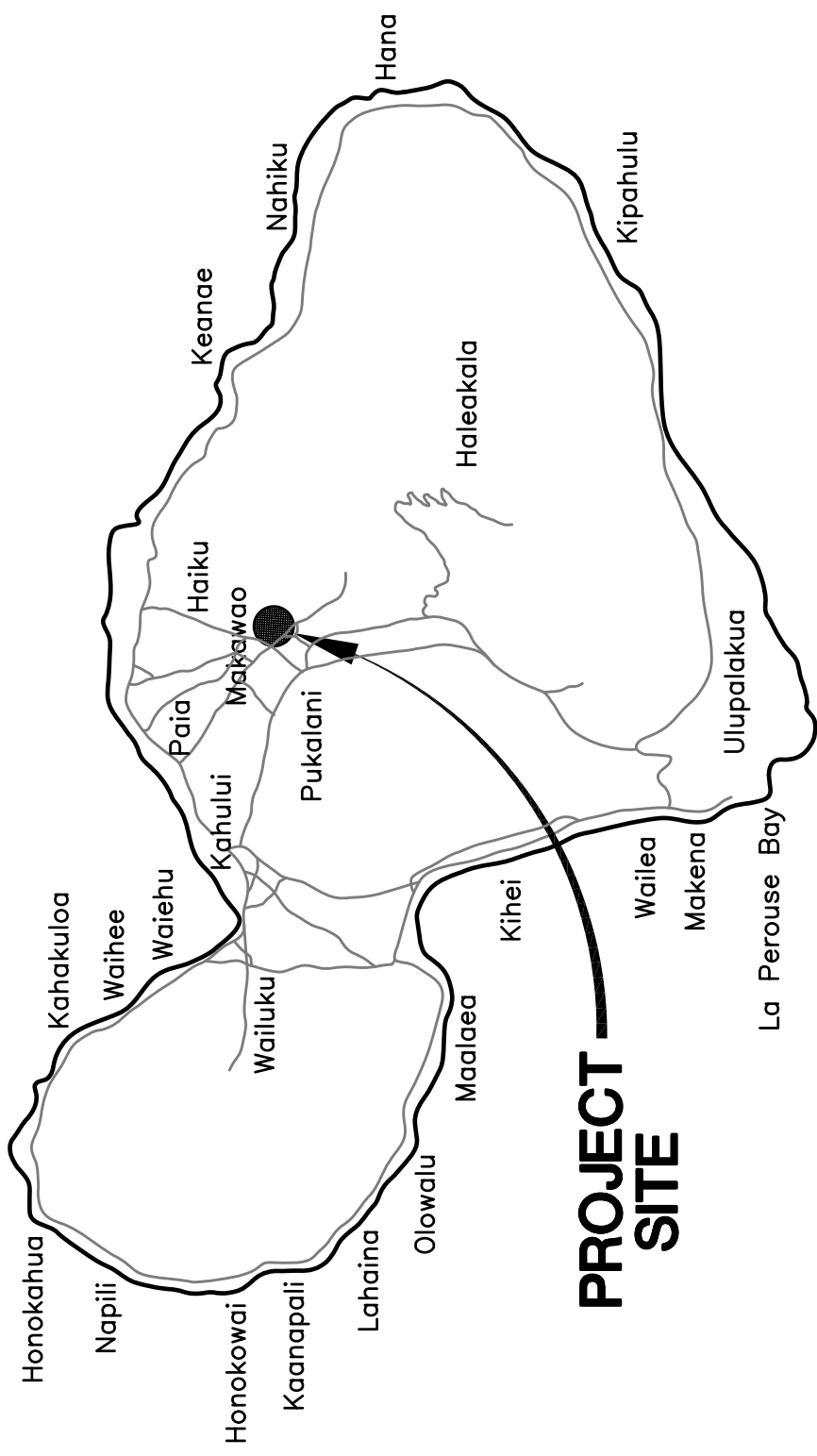
The targeted percentage for indirect costs should not exceed 10% of total costs requested. If there are different indirect costs for different budget categories, please create different spreadsheets for each indirect cost rate.

## Compensation and Payment Schedule

#	Deliverable/Task/Activity	Grant Amount (\$)	Matching Cash (\$)	Matching In-kind (\$)	Total Amount (\$)
1	Contract with Alpha, Inc and REDI	26,000	0	0	26,000
2	Order materials and supplies	55,000	0	0	55,000
3	Road Construction 50% complete	0	45,000		45,000
4	Road Construction 100% complete	0	45,000		45,000
5	Detention Basin 50% complete	0	45,000		45,000
6	Detention Basin 100% complete	0	65,000		65,000
7	Monitoring design 100% complete	8,500	0	0	8,500
8	Floating wetlands design 100% complete	8,500	0	0	8,500
9	Filtration and Irrigation Design complete			800	800
10	Floating wetlands pilot 100% constructed			800	800
11	Video production commences	1,000			1,000
12	Monitoring complete			7,200	7,200
13	Video production 100% complete	1,000			1,000
14	Outreach materials complete			375	375
15	Outreach dissemination complete			1,050	1,050

# **ATTACHMENTS**

Hōkū Nui Maui, LLC  
WSAG107: WATER SECURITY FOR AGRICULTURE—CAPTURING AND UTILIZING  
ON-FARM SURFACE WATER



**PROJECT  
SITE**



**ISLAND OF MAUI**  
NOT TO SCALE

TRUE NORTH  
NOT TO SCALE

PROJECT  
SITE

PIIHOLO ROAD

OLINDA ROAD

ROAD

KAILILI

KOKOMO RD.

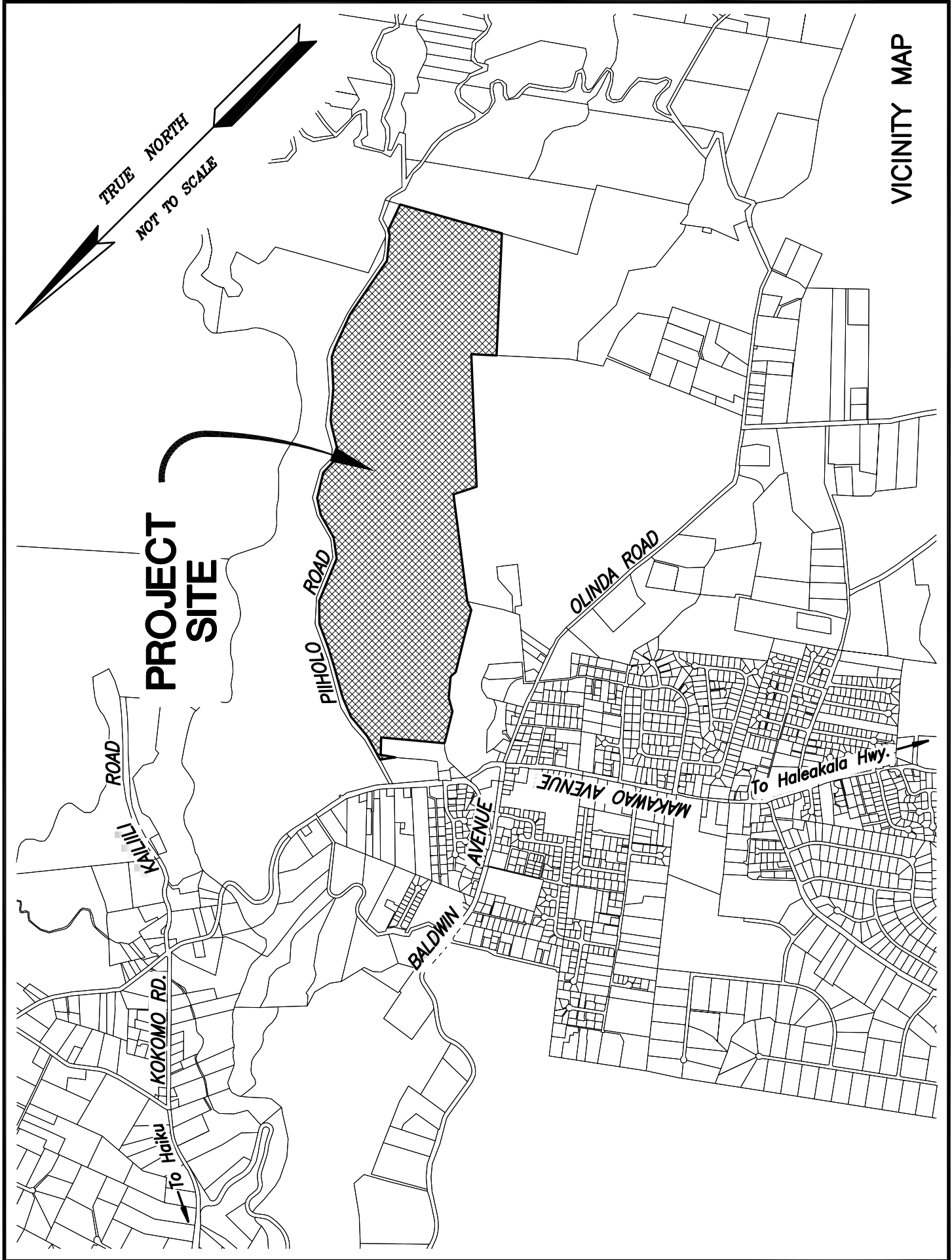
To Hailu

BALDWIN AVENUE

MAKAWAO AVENUE

To Haleakala Hwy.

VICINITY MAP



## ABOUT HÖKŪ NUI

Hökū Nui Maui (HNM) is a land management group developing an innovative regenerative project on a 258-acre property purchased by the Frost Family in 2012. The property was a former sugar cane and pineapple plantation for over 100 years.

We strive to optimize environmental, social and cultural impacts while operating a financially viable business model, which will sustain itself and expand over time. We refer to this as the Regenerative Quadruple Bottom Line (QBL®).



HÖKŪ NUI  
MAUI

Regenerative  
Farming  
Community

## REGENERATIVE AGRICULTURE

To design and manage ecosystem restoration activities, Hōkū Nui employs the Regrarians System of regenerative agriculture. Integrative farm practices build soil health, or regenerate unhealthy soil; without the use of chemical fertilizers and pesticides. This promotes the biosphere's ecosystem processes.

Our primary tools are rotational grazing with cows, sheep, and chickens, yeomans plow, and Indigenous Micro-Organisms (IMO).

## CULTURE

We strive to marry the traditional Hawaiian practices with our modern day regenerative methods. As a team, we represent a broad spectrum of cultures with the desire to inspire a symbiotic relationship between our natural resources and community.

## HULA HALAU

Keali'i Reichel and his hula hālau, Ke'alaokamaile, will be building their hula and cultural center at Hōkū Nui.

## HOUSING

Housing will be clustered into 21 acres, and the remaining 237 acres will be maintained as a permanent farm operation. There will be 22 affordable homes, and 20 market homes on 1-acre lots.

## NATIVE HABITAT

Hawaiian cultural practices and farming methods were fully self-sustaining and are synonymous with regenerative farming. It is our intention to design and plant a native species corridor curving through the middle length of HNM with the hope of restoring a sense of how the landscape used to be, and entice native birds back down to this elevation.

## WATER & ENERGY

HNM has an "Off-Grid" Water and Energy Master Plan. Potable water is sourced from an onsite well. Water for agricultural use will be sourced from an integrated system of contoured roadways and rooftops that will supply water to seven ponds. These roads support alternative forms of transportation, such as biking, walking, electric farm vehicles, and horseback riding paths.

Our energy systems are powered by photo voltaic, battery storage, and back-up generators. Other forms of renewable energy continue to be explored.





## OUR VISION

To have a thriving and regenerative relationship between community and agriculture.

## OUR MISSION

To re-establish a diverse native and endemic Hawaiian habitat and foster a productive agricultural operation, integrating a small community of sustainable residential homes.

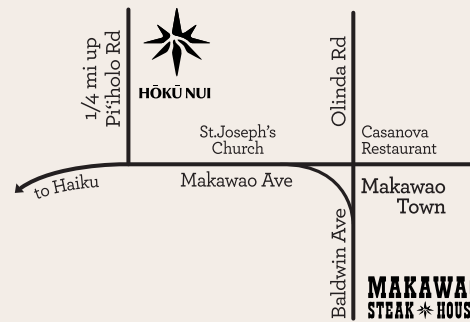


## FARM STAND

The Hōkū Nui Farm Stand is our next step in offering our farm-raised products to the Maui community. We take great pride in the care we give our animals and the land upon which they are raised. We never use chemicals, herbicides, pesticides or hormones.

To sign up for our mailing list and to stay up to date regarding our current offerings, visit: [www.hokunui.com/economy/farm-stand/](http://www.hokunui.com/economy/farm-stand/).

Our farm stand at Hōkū Nui is open Monday through Friday 8am-5pm, come check it out!



Located behind St. Joseph's Church in Makawao on Pi'iholo Road.

### Follow us Online!

 hokunui  hokunuimaui  hokunuimaui

### HŌKŪ NUI MAUI

#### Regenerative Farming Community

Mailing Address: P.O. Box 1347 Makawao, HI 96768

Location: 186 Pi'iholo Rd. Makawao, HI 96768

[info@hokunui.com](mailto:info@hokunui.com) | [www.hokunui.com](http://www.hokunui.com)



### Regenerative Farming Community

186 Pi'iholo Rd. Makawao, HI 96768

[www.hokunui.com](http://www.hokunui.com)



# Conservation Plan Map


Date: 7/7/2015

Customer(s): HOKU NUI MAUI LLC  
District: CENTRAL MAUI SOIL & WATER CONSERVATION DISTRICT  
Approximate Acres: 154.7  
Legal Description: FN: 1482 TN:1634

Field Office: KAHULUI SERVICE CENTER  
Agency: HACD  
Assisted By: Kylie Wong  
State and County: HI, Maui County, Hawaii  
Land Units:




## Legend

 Pond *Pond, Pond Sealing or Lining Flexible Membrane*

**Practice name**

 Access Road

 KA\_HokuNui\_CTA2015

 Prescribed Grazing

 Brush Management





KAHULUI SERVICE CENTER  
 77 HOOKELE ST. SUITE 202  
 KAHULUI, HI 96732  
 8088715500 ext. 3

RANAE GANSKE-CERIZO  
 DISTRICT CONSERVATIONIST

## Conservation Plan

HOKU NUI MAUI LLC  
 PO BOX 1347  
 MAKAWAO, HI 96768

### OBJECTIVE(S)

To establish a sustainable grazing practice while conserving soil and water resources

### Pasture

Tract: 1634

#### Access Road

Build a designated route or constructed travelway to be used by vehicles necessary for management of the operation.

Field	Planned Amount	Month	Year	Applied Amount	Date
2	3545.8 ft	12	2015		
3	1324.3 ft	12	2015		
4	1567.6 ft	12	2015		
14	1014.6 ft	12	2017		
15	2216.2 ft	12	2017		
17	3742.7 ft	12	2016		
20	6927.2 ft	12	2016		
20	1595.2 ft	12	2016		
Total:	21933.6 ft				

#### Brush Management

Remove, reduce or manipulate brush species to achieve the desired plant community.

Field	Planned Amount	Month	Year	Applied Amount	Date
2	9.1 ac	12	2015		
3	2.2 ac	12	2015		
5	6.7 ac	12	2015		
19	4.3 ac	12	2015		
Total:	22.1 ac				

**Pond**

Construct a water impoundment to provide water.

Field	Planned Amount	Month	Year	Applied Amount	Date
16	1 no	8	2015		
20	1 no	1	2015		
20	1 no	1	2016		
20	1 no	7	2016		
20	1 no	7	2017		
20	1 no	1	2017		
Total:	6 no				

**Pond Sealing or Lining, Flexible Membrane**

Install bentoliner (geotextile and bentonite clay) to reduce seepage to an acceptable level

Field	Planned Amount	Month	Year	Applied Amount	Date
16	1 no	9	2015		
20	1 no	2	2015		
20	1 no	2	2016		
20	1 no	8	2016		
20	1 no	8	2017		
20	1 no	2	2017		
Total:	6 no				


**Prescribed Grazing**

Grazing will be managed according to a schedule that meets the needs of the soil, water, air, plant and animal resources and the objectives of the resource manager. A key line Yeoman's plow subsoiler will be used following the cattle.

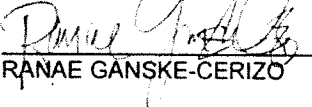
Field	Planned Amount	Month	Year	Applied Amount	Date
1	4 ac	12	2016		
2	9.1 ac	12	2016		
3	2.2 ac	12	2016		
4	7.8 ac	12	2016		
5	6.7 ac	12	2016		
6	11.9 ac	12	2016		
7	4 ac	12	2016		
8	8 ac	12	2016		
9	6.5 ac	12	2016		
10	9.6 ac	12	2016		
11	5.6 ac	12	2016		
12	5.3 ac	12	2016		
13	8.2 ac	12	2016		
14	6.1 ac	12	2016		
15	6.1 ac	12	2016		
16	13.7 ac	12	2016		
17	2.2 ac	12	2016		
18	7.7 ac	12	2016		
19	4.3 ac	12	2016		
20	31 ac	12	2016		
Total:	146.1 ac				




CERTIFICATION OF PARTICIPANTS

  
HOKU NUI MAUI LLC  
PRESIDENT/CEO  
Dec. 8th, 2014  
DATE

CERTIFICATION OF:

DISTRICT CONSERVATIONIST  
  
RANAE GANSKE-CERIZO  
12/9/2014  
DATE

CONSERVATION DISTRICT  
  
CENTRAL MAUI SOIL & WATER  
12/9/14  
DATE

PUBLIC BURDEN STATEMENT

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collections is 0578-0013. The time required to complete this information collection is estimated to average 45/0.75 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection information.

PRIVACY ACT

The above statements are made in accordance with the Privacy Act of 1974 (5 U.S.C 522a). Furnishing this information is voluntary; however failure to furnish correct, complete information will result in the withholding or withdrawal of such technical or financial assistance. The information may be furnished to other USDA agencies, the Internal Revenue Service, the Department of Justice, or other state or federal law enforcement agencies, or in response to orders of a court, magistrate, or administrative tribunal.

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The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers. If you believe you experienced discrimination when obtaining services from USDA, participating in a USDA program, or participating in a program that receives financial assistance from USDA, you may file a complaint with USDA. Information about how to file a discrimination complaint is available from the Office of the Assistant Secretary for Civil Rights. USDA prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex (including gender identity and expression), marital status, familial status, parental status, religion, sexual orientation, political beliefs, genetic information, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) To file a complaint of discrimination, complete, sign, and mail a program discrimination complaint form, available at any USDA office location or online at [www.ascr.usda.gov](http://www.ascr.usda.gov), or write to:

USDA Office of the Assistant Secretary for Civil Rights  
1400 Independence Avenue, SW.  
Washington, DC 20250-9410

Or call toll free at (866) 632-9992 (voice) to obtain additional information, the appropriate office or to request documents. Individuals who are deaf, hard of hearing, or have speech disabilities may contact USDA through the Federal Relay service at (800) 877-8339 or (800) 845-6136 (in Spanish). USDA is an equal opportunity provider, employer, and lender. Persons with disabilities who require alternative means for communication of program information (e.g., Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).



United States Department of Agriculture

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April 17, 2017

Department of Land and Natural Resources  
Commission on Water Resource Management  
1151 Punchbowl Street, Room 227  
Honolulu, HI 96813

Re: Hōkū Nui Maui LLC application for 2017 Implementation Of Water Security Projects And Programs. No. WSAG 17.

At their request, I'm writing to inform you that Hōkū Nui Maui has an active conservation plan which has been approved by the Central Maui Soil and Water Conservation District (SWCD). A Grading and Grubbing Permit is not required for the conservation practices included in the plan under Maui County Code Chapter 20.08.030 Soil Erosion and Sedimentation Control – Exclusions. All conservation practices included on the plan are required to meet Natural Resource Conservation Service (NRCS) Standards and Specifications. To ensure compliance, plans and construction are reviewed and approved by NRCS and SWCD staff.

The planned Detention Basins are covered under the NRCS Pond (PI 378) Standard, and the Roads are covered by the Access Road (PI 560) Standard. Any revisions to the plans between now and the anticipated start date would be reviewed by NRCS and SWCD staff to ensure they are in compliance.

Sincerely,

A handwritten signature in blue ink that reads "Ryan Woolbright, P.E." in a cursive style.

Ryan Woolbright, P.E

Natural Resources Conservation Service  
Pacific Islands Area – Kahului Field Office  
77 Hookele St., Suite 202, Kahului, HI 96732  
Phone: 808-871-5500 ext. 3, Fax: 855-878-2454  
[www.pia.nrcs.usda.gov](http://www.pia.nrcs.usda.gov)

An Equal Opportunity Provide, Employer, & Lender

## Hydrologic Calculations – Detention Basins

Purpose: Determine the runoff and storage volume required for the seven (7) onsite detention basins for a 50-year, 1-hour storm.

A. Determine the Runoff Coefficient (C):

### DRAINAGE AREA CHARACTERISTICS:

#### LANDSCAPE AREAS:

Infiltration (Medium)	=	0.07
Relief (Flat)	=	0.03
Vegetal Cover (Good)	=	0.03
Development Type (Landscape)	=	<u>0.15</u>
C	=	0.28

Note-The drainage areas for detention basins 2, 3, 4 and 6 will be partially developed with homes or other structures. The runoff coefficient for these drainage areas is computed to be 0.30.

B. Determine the 50-year 1-hour rainfall:

$$i_{50} = 3.0 \text{ inches}$$

Adjust for time of concentration to compute Rainfall Intensity (I):

Detention Basin	1	2	3	4	5	6	7
Tc (min)	19	26	20	36	14	35	21
I [in]	5.25	4.59	5.14	3.94	5.88	3.99	5.04

C. Drainage Area (A):

Detention Basin	1	2	3	4	5	6	7
Area (acres)	12.32	16.04	24.43	38.15	5.04	13.36	15.27

D. Compute the 50-year storm runoff (Q) for each detention basin:

$$Q = CIA$$

$$\begin{aligned} Q1 &= (0.28)(5.25)(12.32) \\ &= 18.11 \text{ cfs} \end{aligned}$$

$$\begin{aligned} Q2 &= (0.30)(4.59)(16.04) \\ &= 22.11 \text{ cfs} \end{aligned}$$

$$\begin{aligned} Q3 &= (0.30)(5.14)(24.43) \\ &= 37.68 \text{ cfs} \end{aligned}$$

$$\begin{aligned} Q4 &= (0.30)(3.94)(38.15) \\ &= 45.04 \text{ cfs} \end{aligned}$$

$$\begin{aligned} Q5 &= (0.28)(5.88)(5.04) \\ &= 8.30 \text{ cfs} \end{aligned}$$

$$\begin{aligned} Q6 &= (0.30)(3.99)(13.36) \\ &= 15.99 \text{ cfs} \end{aligned}$$

$$\begin{aligned} Q7 &= (0.28)(5.04)(15.27) \\ &= 21.54 \text{ cfs} \end{aligned}$$

E. 50-year, 1-hour storm Volume (V):

<b>Basin</b>	<b>Drainage Area (ac)</b>	<b>Q 50-Yr (cfs)</b>	<b>Storage Volume Required (cf)</b>
1	12.32	18.1	20,643
2	16.04	22.1	34,487
3	24.43	37.7	45,218
4	38.15	45.0	97,293
5	5.04	8.3	6,472
6	13.36	16.0	33,587
7	15.27	21.5	27,143
<b>TOTAL STORAGE REQUIRED</b>			<b>265,343</b>

F. Calculate the available storage for the proposed detention basins:

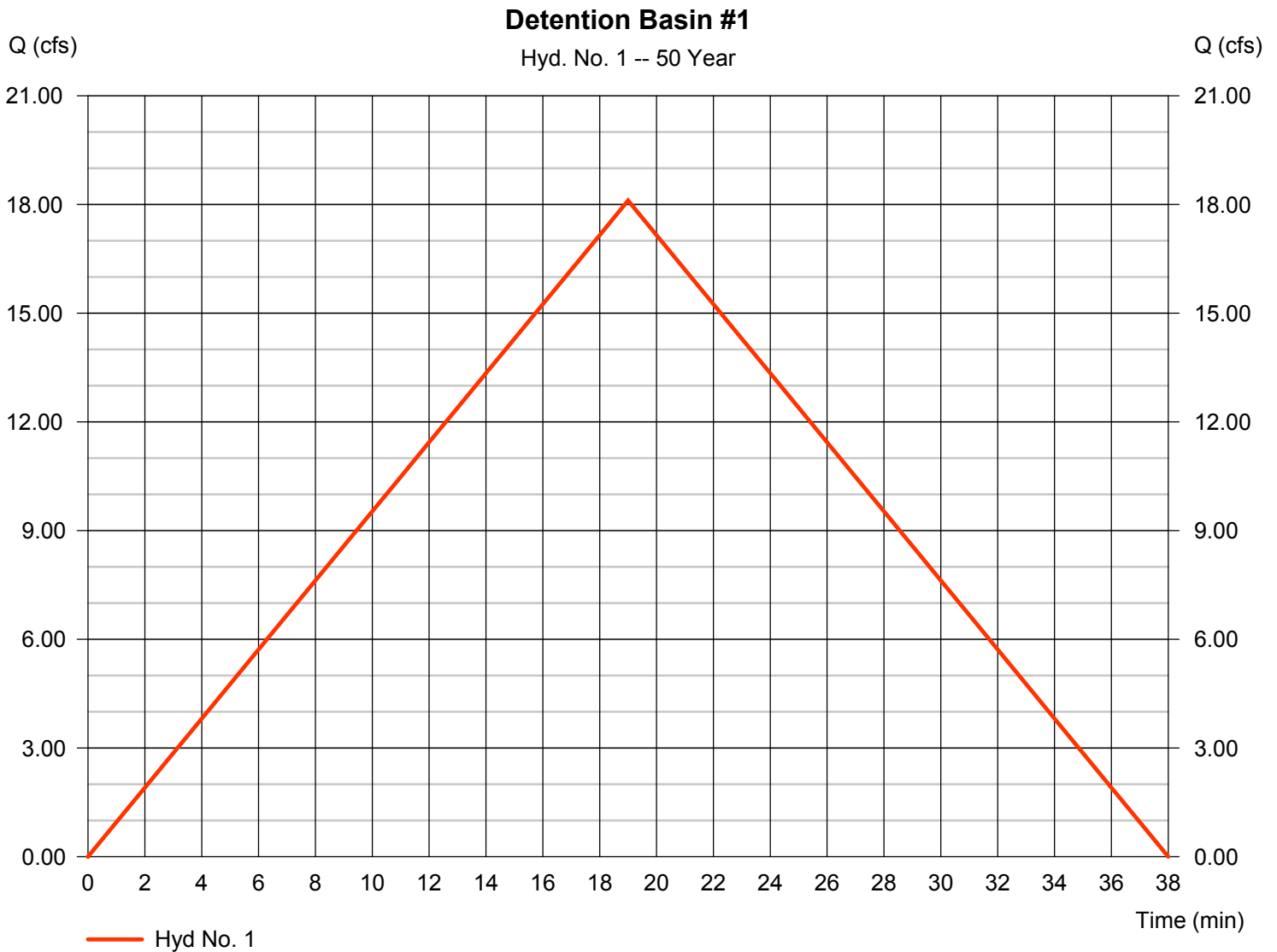
<b>Basin</b>	<b>Top Area (sf)</b>	<b>Bottom Area (sf)</b>	<b>Average Area (sf)</b>	<b>Average Height (ft)</b>	<b>Volume (cf)</b>
1	22,585	2,548	12,567	16	201,072
2	32,999	4,841	18,920	18	340,560
3	34,793	1,225	18,009	26	468,234
4	21,079	3,161	12,120	16	193,920
5	16,019	1	8,010	20	160,200
6	33,526	4,916	19,221	20	384,420
7	27,140	1,962	14,551	20	291,020
<b>TOTAL AVAILABLE STORAGE</b>					<b>2,039,426</b>

# Hydrograph Report

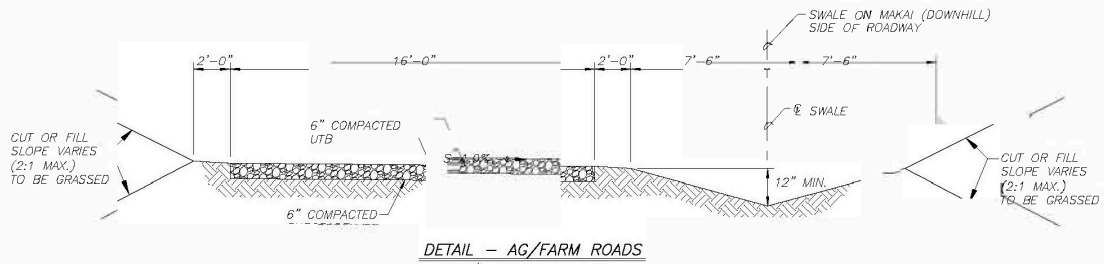
## Hyd. No. 1

### Detention Basin #1

Hydrograph type	= Rational	Peak discharge	= 18.11 cfs
Storm frequency	= 50 yrs	Time to peak	= 19 min
Time interval	= 1 min	Hyd. volume	= 20,643 cuft
Drainage area	= 12.321 ac	Runoff coeff.	= 0.28
Intensity	= 5.249 in/hr	Tc by FAA	= 19.00 min
IDF Curve	= 3-0.IDF	Asc/Rec limb fact	= 1/1

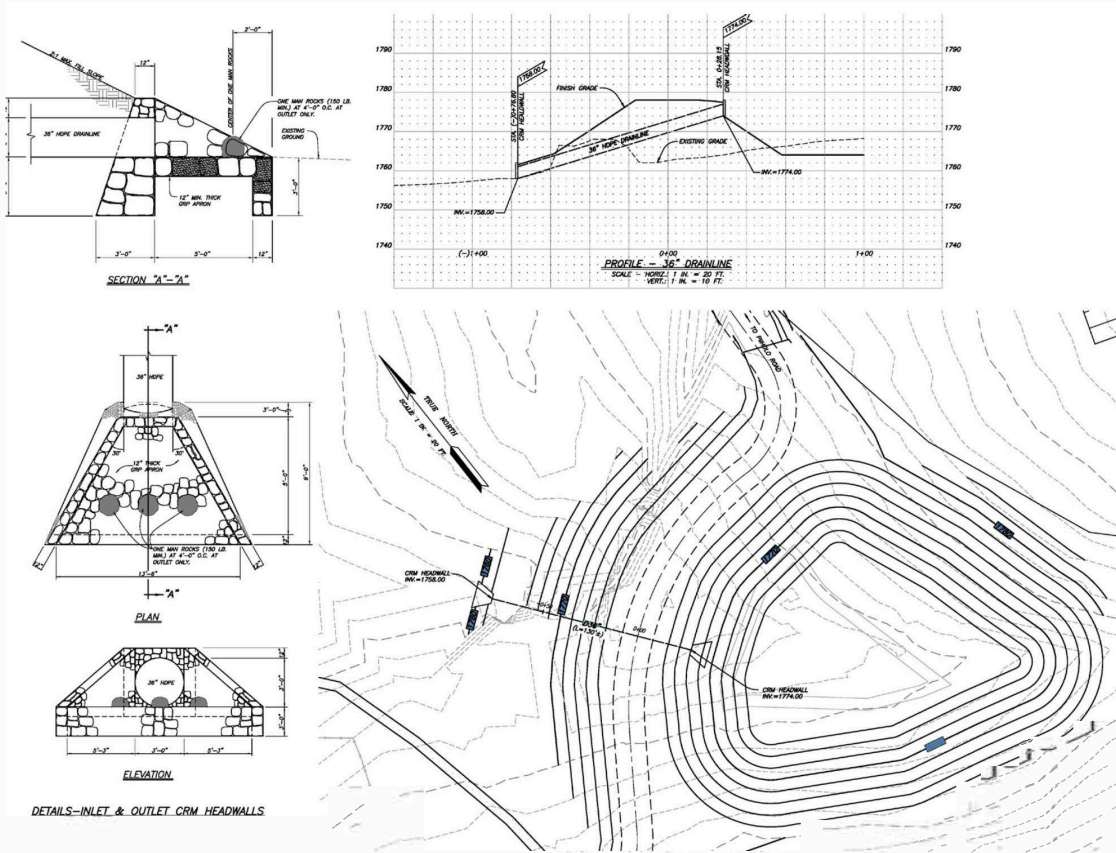






**DETAIL - AG/FARM ROADS**

**PROPOSED ROADWAY SECTIONS**





**HŌKŪ NUI**  
M A U I

**ESTIMATED ANNUAL AGRICULTURAL WATER NEEDS**

**ANIMALS**

<b>Farm Animal</b>	<b># Animals</b>	<b>Average water requirements gpd</b>	<b>Gallons per day</b>	<b>Gallons per year (x365 days)</b>
Chickens (Egg layers- Full grown)	1,500	.07	105	38,325
Chicks (Egg layers – Juvenile)	500	.07	35	12,775
Chickens (Poultry – Full Grown)	200	.09	18	6,570
Chicks (Poultry – Juvenile)	600	.09	54	19,710
Cattle (Beef – Full grown)	150	17	2,550	930,750
Cattle (Beef – Calves)	50	10	500	182,500
Sheep (adult)	120	3	360	131,400
Sheep (weaners)	40	1	40	14,600
<b>Total</b>			<b>3,662</b>	<b>1,336,630</b>

**FORESTRY AND LANDSCAPE**

- Maximum number of acres of agroforest to be irrigated at any given time (maximum acres fed by pond that are less than 18 months old): 10 acres
- Percentage of area to be irrigated (only irrigating rows): 50%
- Rainfall required for non-water stress: 5 inches/month (60 inches/year)
- Longest expected drought period: 3 months
- Number of gallons in an acre-inch of rainfall: 27,000

= Amount of irrigation water consumed to eliminate water stress over longest drought => 3 months X 5 inches X 10 acres X 50% X 27,000 gal/acre = 2,025,000 gallons



**HŌKŪ NUI**  
M A U I

**In-Kind Contribution**

<b>Task</b>	<b>Staff</b>	<b>Man Hours</b>	<b>Hourly Rate</b>	<b>Total</b>
Daily Rainfall and Runoff Monitoring	Nick Sickles	360	\$20	\$7,200
Write up of project results	Andrea Dean	15	\$25	\$375
Dissemination of project results	Rina Chavez	30	\$35	\$1,050
Construction of floating wetland	Nick Sickles	40	\$20	\$800
Design of filtration and irrigation	Ryan Anderson	40	\$20	\$800
<b>Total In-Kind</b>				<b>\$10,225</b>