expressed by the phrase, "Healthy lands healthy people." With this in mind, the priority will be to nurture the land, soil, vegetation and people; crop choices, agrarian methodologies, vegetation deployment will ensure that management actions are planned and implemented accordingly. The land must be cleared, the soil remediated, native forest restored, and a vegetation continuum implemented, with a focus on growing traditional food, medicine, and utilitarian items supported by other crops, methods, and practices.

THE VEGETATION CONTINUUM

The Vegetation Continuum was a guiding vision throughout the planning process to describe the application of Hoʻoulu ʻĀina. The Continuum utilizes an approach that considers the full-spectrum of vegetation planting strategies. These strategies will address the many needs of the environment while providing options for agricultural production and a variety of programmatic uses. One of the benefits of this holistic approach is that it allows a myriad of conservation and programmatic functions to be integrated into an agricultural model. This integration increases the potential output value of the overall project based on the form and function of the vegetative development of the property and promotes learning opportunities.

The following narrative has been provided by the Working Group to describe what is envisioned for the site: "By creating a diverse ecosystem at Kūkaniloko, the watershed will be restored through the reforestation of native trees, which in turn feeds the understory below and ultimately feeds our lāhui."

The Working Group has recommended a list of species and crops outlined in the Vegetation Continuum section. The full list of plant species was provided by Rick Barboza of Hui Kū Maoli Ola, and can be found in Appendix M.

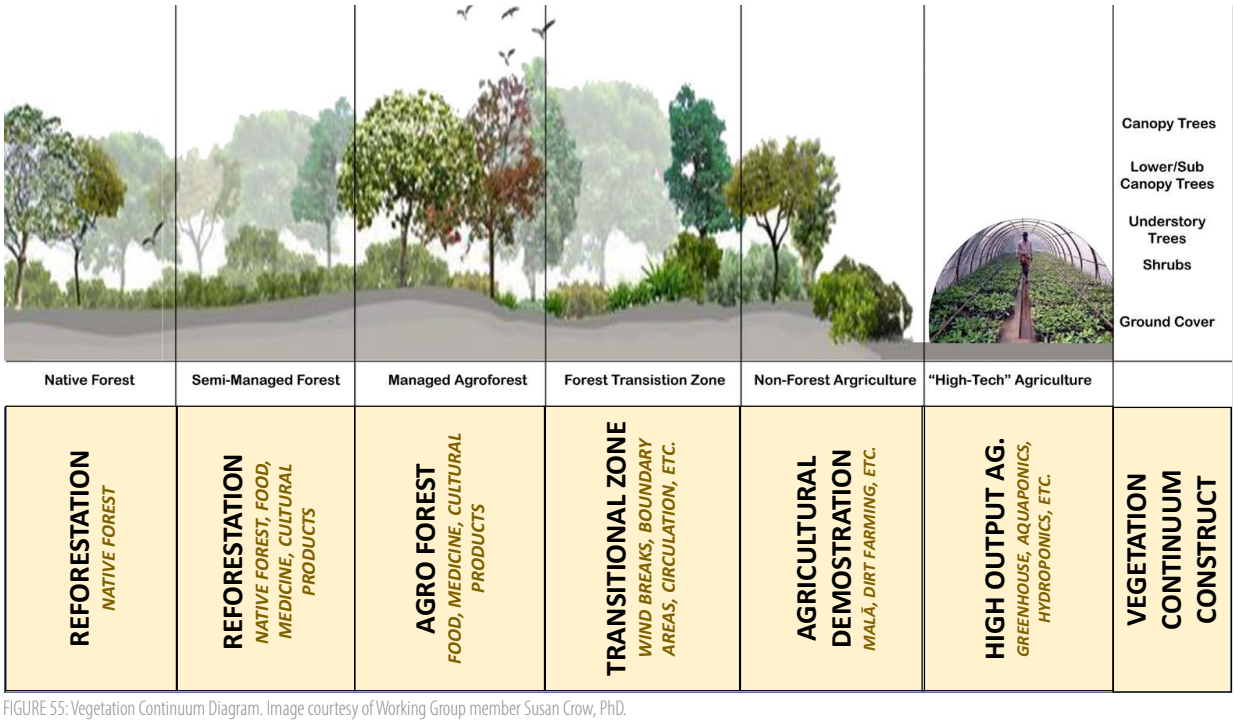

FIGURE 55: Vegetation Continuum Diagram. Image courtesy of Working Group member Susan Crow, PhD.

NATIVE REFORESTATION

» *Purpose:* It is recommended that native trees be planted early to re-create a forest so that the holistic process of restoring the ecosystem, watershed, and soil health can commence. This portion of the Vegetation Continuum addresses ecological impact mitigation stemming from over a century of human-driven change. It also creates an environment that will: help to bring a true sense of place to the property; serve as a marker for significant locations within the property; allow for diversified programmatic and cultural uses; and indicate buffered areas around the Birthing Stones and other areas as specified on the property. This portion contributes to ecological regeneration and creates overarching vegetated points of interest that will initially be unique to Wahiawā.

» *Timing*: It is understood that significant time will be required to shift the environmental state from an overgrown grassland back into a forest (a feat that would take decades to naturally occur). Thus, it is recommended that efforts involving the growth of trees for reforestation or agriculture begin as soon as possible based on an overall planting plan and the availability of water.

» *Crop-Mix*: While there was discussion about a variety of tree species, ʻiliahi was commonly suggested to be used for the dense and primary canopy as it is known to be the primary canopy species of the area in historic times. Other native plants will be identified in a planting plan that may include: koa; ʻōhiʻa lehua; lama; ʻohe; and other species that are determined to be appropriate for the site.

» *Management Needs*: Once established, it is envisioned that these sections of vegetation will require lower maintenance and remain in a state akin to "the wild." Further, the seed bank provided by this native forest could be used to help repopulate other portions of this property and other areas across the island. The OHA should anticipate moderate development, maintenance, and management requirements in the establishment of the native reforestation portions of the Vegetation Continuum.

NATIVE-FOOD FOREST

» *Purpose:* This portion of the Continuum is described as a semi-managed forest that incorporates native forest with native foods, medicine and cultural products for traditional and cultural practices, use, market and other aligned uses. As people walk through the Vegetation Continuum, they will start to recognize the food crops with medicinal plants dispersed throughout.

» An example of this type of forestry can be seen at Puʻu O Hoku Ranch on Molokaʻi which is home to a family-owned biodynamic and organic ranch and farm. The farm produces certified biodynamic and organic dried bananas, fresh frozen Hawaiian ʻawa root, honey, and a wide variety of other fresh fruits and vegetables.

» *Timing:* This section of the Continuum should also occur as early as possible in the planting process to help establish the canopy trees in association with an overall planting plan, the availability of water, and the capacity to build-out, manage and maintain any required elements.

» *Crop-Mix*: ʻUlu is a species that was highly recommended as a potential canopy tree that can start

The following recommendation came from Working Group to find a culturally appropriation way to handle soil remediation and how to manage the maintenance and continuum.

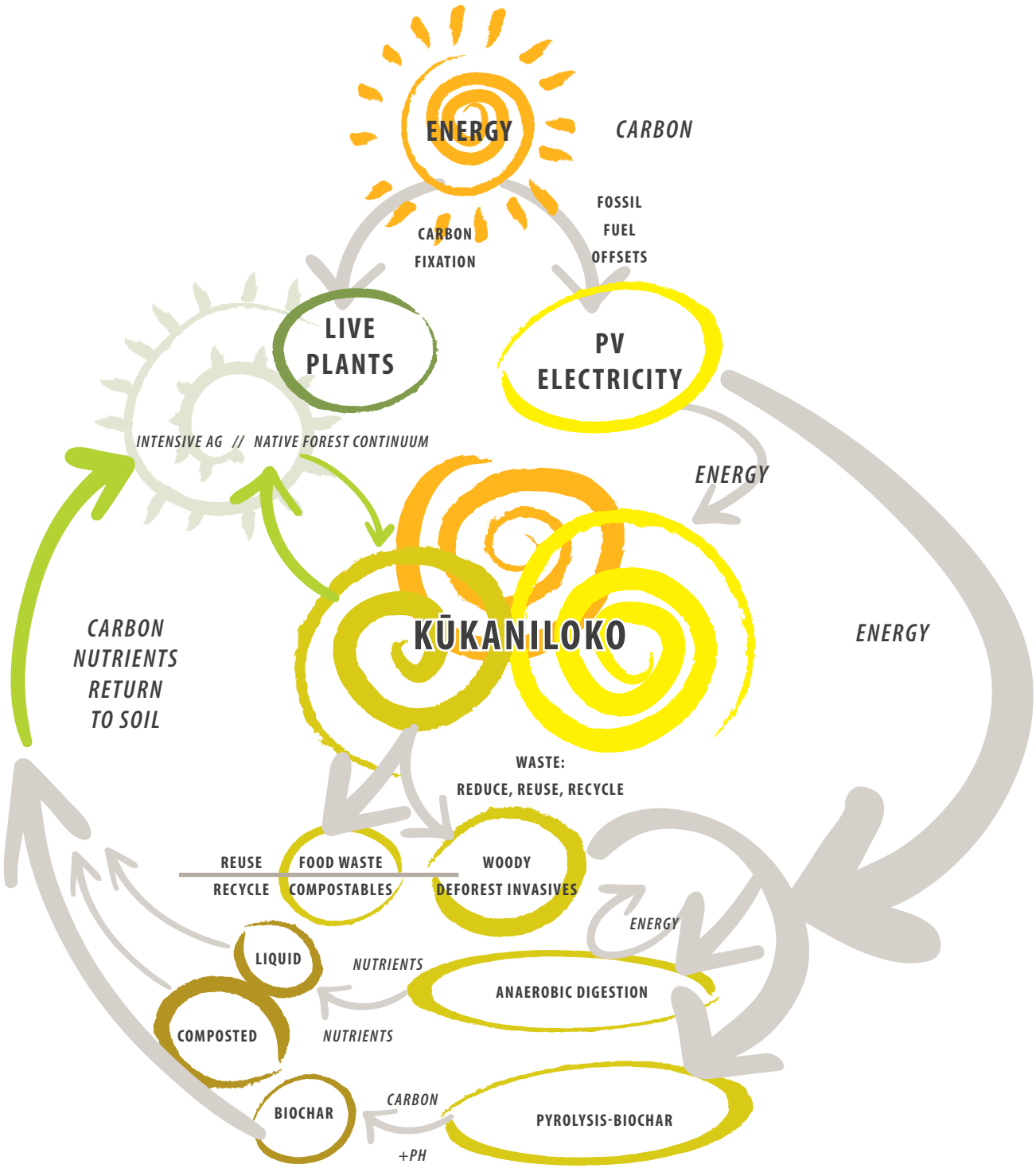

FIGURE 56: Energy, Carbon, Nutrient, Flows and the Agro-Ecosystem Diagram. Illustration created based on information from working group member Susan Crow, PhD.

to proliferate in this section of the Continuum. Other crops may include uhi, maiʻa, ʻawa, ʻōlena, and others that align with the function of this portion of the Continuum. For a complete list of other recommendations that were shared, please see Appendix M of this document.

» *Management Needs*: This section would be somewhat akin to "the wild" but contain a bit more structure, requiring more maintenance to water and harvest food crops than the Native Reforestation section of the Continuum. The OHA should anticipate moderate development, maintenance and management requirements in the establishment of the native-food forest portions of the Vegetation Continuum.

AGROFORESTRY

» *Purpose:* The agroforestry portion is the area is designated for the growth of food, medicine, cultural products, and vegetation that supports a holistic approach to growing plants in a formal manner. The goal of this section in the Vegetation Continuum is to ensure that there is not only rapid growth for the fast revival of carbon, but also production of plants that can be utilized for income generation (food, wood, etc.) as well as for medicinal and educational purposes.

» There may be fenced areas to keep pests and trepassers out, and they will be designed to be woven into their surroundings so that it will still feel like a natural environment. To understand the composition of a food forest, the Working Group referred again to Puʻu O Hoku Ranch as an example. Puʻu O Hoku Ranch allows their cattle to roam over grass pastures and employs careful field rotation to ensure good grazing practices that replicate natural herd movement. By moving the cows frequently, plants have a chance to regrow, which prevents erosion and combats invasive weed species.

» *Timing:* Moving this forward will be dependent on an overall planting plan, the availability of water, and the capacity to build-out, manage and maintain any required elements.

» *Crop-Mix:* Types of crops found in the managed agroforest area would include canopy of ʻulu, a sub-canopy of maiʻa, shrubs of ʻawa beneath and ground cover of kalo, ʻōlena, ginger, and other crops that align with the goals of this portion of the Continuum.

» *Management Needs:* This is an area that incorporates structured agroforestry planting strategies and would require a level of management that is consistent with agroforestry standards. The OHA should anticipate higher development, maintenance and management requirements in the establishment of the agroforestry portions of the Vegetation Continuum.

DEMONSTRATION PLOTS

» This portion of the Vegetation Continuum provides a venue to demonstrate various agricultural methodologies that are aligned with the Plan. An opportunity exists within the demonstration section of the Vegetation Continuum to grow food, medicine and other products, and show visitors (and the community) specific details of those demonstrations first-hand.

» *Purpose:* This area is envisioned to include agricultural planting demonstrations that may consist of a variety of crops that are not necessarily configured in the construct of a forest. In demonstration areas, the focus is to enable food, medicine, and utilitarian product production strategies that are "enterprise-minded" and function in a fiscally responsible manner that is economically and environmentally sustainable. MAʻO Farms is a successful model for this portion of the Vegetation Continuum, where some heavy food production is carried out. Focusing on the production aspect of culturally-aligned agriculture will highlight pono practices to contribute to the cultivation of healthy lands and communities.

» *Timing:* This can move forward with an overall planting plan, the availability of water, and the capacity to build-out, manage and maintain any required elements.

» *Crop-Mix:* Examples of crop mixes include garden/agricultural areas with maiʻa, kalo, greens, vines, controlled row crops, and other aligned species.

» *Management Needs:* This is an area that incorporates structured diversified planting strategies and would require a level of management that is consistent with the associated agricultural standards. The OHA should anticipate higher development, maintenance and management requirements in the establishment of the demonstration plot portions of the Vegetation Continuum.

HIGH-TECH AG

» *Purpose:* The high-tech agricultural portion of the Continuum incorporates the use of best-science agricultural methodologies and significant technological components to enable efficient production of food, medicine and other plant materials. Examples include hydroponics, aquaponics, and green house cultivation.

» *Timing:* This can move forward with an overall planting plan, the availability of water, and the capacity to keep up with any management requirements. It is anticipated that the area of the 511-acre property near the Karston-Thott bridge could be a good candidate for early development of this portion of the Continuum. It will be dependent on an overall planting plan, water availability and the capacity to build-out, secure and maintain any required elements.

» *Crop-Mix:* Crops such as lettuce, tomato, cucumber, bell pepper, eggplant and microgreens are recommended as high-margin crops to grow in greenhouses. May's Wonder Garden on the North Shore was noted for their high-volume of local greens and great potential to produce food with a tight nutrient cycle. Honey is also a high-yield item that was suggested by the Working Group members, in addition to aquaculture with shrimp, tilapia and lettuce.

» *Management Needs:* Many of these systems have large up-front costs and lower maintenance requirements when compared to demonstration plots. This area requires a lot of infrastructure, planning, permitting, and construction of more complex agricultural systems, and intensive management of those systems, their needs, and their outputs. The OHA should anticipate higher

development, maintenance and management requirements in the establishment of the high-tech ag portions of the Vegetation Continuum.

MANAGING THE VEGETATION CONTINUUM AS A SUSTAINABLE ECOSYSTEM

Ecosystems can be defined as a community of organisms interacting with their environment and functioning together as a system linked by flows of energy, carbon and nutrients. Healthy, well-functioning agricultural ecosystems are self-sustaining and contribute to resilience in the landscape which people depend on for food and other products. After the land is cleared of invasive species, flows of energy, carbon and nutrients can create a sustainable ecosystem to achieve soil remediation and enable management of the Vegetation Continuum in a culturally-appropriate and holistic way. Working Group member Susan Crow described how management of Kūkaniloko can be healthy, sustainable and resilient by adopting the system illustrated in Figure 56.

In this cyclical process, solar energy drives the system. Energy may be transformed to electricity using photo-voltaic systems integrated into the infrastructure of the site. Simultaneously, the sun powers photosynthesis by plants that draw carbon down from the atmosphere and fix it into plant biomass across the food-forest continuum. Both processes result in climate change mitigation, the former through the avoided fossil fuel-derived emissions typically associated with electricity production in Hawai'i, the latter through sequestration in soil carbon and other pathways that ensure carbon does not get released back to the atmosphere and reduces other greenhouse gas emissions. The waste stream on site shall be reduced, reused and recycled for materials and nutrients, when possible. Compostable materials, combined with agricultural residues and waste, woody biomass from trimming and invasive species removal, can go into compost piles, an anaerobic digester, and/or through pyrolysis. Each of these transform waste into energy and/or produces soil amendments that can go back into the agricultural practices across the Continuum. Generated electricity can be used to power an electric vehicle for travel about the grounds.

An opportunity exists within the demonstration side of the food-forest Continuum to show visitors firsthand how the soil amendments generated on site, or locally, feed back into the production system. First, high tech greenhouses have high yields but small carbon and energy footprints. Aquaponics and hydroponics can demonstrate food production and the importance of highly efficient nutrient and water use. Through the soil amendment generated on site from compost, anaerobic digester, and pyrolysis long-term treatment plots can be established. These could contain a few rows of sweet potato compost, fish bone meal, biochar and combinations plots. Plots could also demonstrate effects of changing climates and deficit irrigation to show drought. Maintenance of these long-term experiments could be supported by students for real life, hands-on education. For instance, students can run different tests on soil nutrients, greenhouse gas fluxes, water quality, yields, etc. Students can also learn about precision irrigation by building a network of sensors that communicate (in real time) gas flux, soil moisture, temperature changes that signal the irrigation to turn on, etc. These are just some demonstration ideas. These agricultural demonstrations, and investment in the long-term maintenance, can provide a basis for education, activities, and STEM grants that might attract financial support and provide education opportunities for youth and college students.

Sample Kūkaniloko Quarterly Report
Quarter __: __/__/__ through __/__/__

1. Summary:

   This opening section should be no longer than a paragraph and contain a brief snapshot of the general condition of the property, the activities that occurred, number of visitors/beneficiaries taken, and any important updates or milestones.

2. Meetings:

   a. List here the dates of each regular meeting and any pertinent or important (high level) information that relative to each meeting.
   b. May also list any other occurrences outside of the regular meetings, as appropriate.
   c. Important updates, milestones, challenges and solutions should be described accordingly and provided enough information as necessary.

3. Site Activity:

   a. List here the various types of activities that occurred on site.
      1) This should include groups and organizations and their purpose or activity during their time on site, i.e.:
         a) 12 employees of _____ restaurant spent 2 hours on site learning of its cultural and historic value, and hand-weeding the Chinese violet in the lower portions of the heiau (not on any walls or structures).
         b) Include the date of the activity and any other pertinent information

4. Expenditures:

   Without being reduplicative of the Itemized Invoice that will be submitted with this Quarterly Report, this section can be used to list out and provide more information regarding the various expenditures and any justifications for such expenses and/or for future or unforeseen expenses that may be required. This section can be as detailed as needed.

5. Photos:

   Copy and paste and/or email any relevant pictures from site activities and be sure to caption it so they are identifiable.