Section I. INTRODUCTION

RATIONALE

Kawai Nui Marsh, at over 830 acres, is the largest wetland feature in the State of Hawai`i. The marsh is located on windward O`ahu in the *ahupua`a* of Kailua, bounded by Kailua Road, Kapa`a Quarry Road, and a flood control structure known locally as the Kailua levee (Figures I-1 and II-1). The upper drainage basin is Mauanawili Valley, and the marsh represents the receiving body for this large drainage, intercepting surface flow and discharging it into a brackish, man-made canal (Oneawa Channel) connected to the ocean near the western end of Kailua Bay. The size of the marsh and its prominent position within the watershed are central to the interests of the Kailua Bay Advisory Council (KBAC) whose mission centers around water quality issues in Kane`ohe-Kailua-Waimanalo area (windward O`ahu district of Ko`olaupoko). Understanding how the marsh can better serve the community as premier wildlife habitat, reducer of flood risks, cleanser of water quality, and recreational/educational resource is the basic rationale for undertaking both studies and restoration efforts within the marsh.

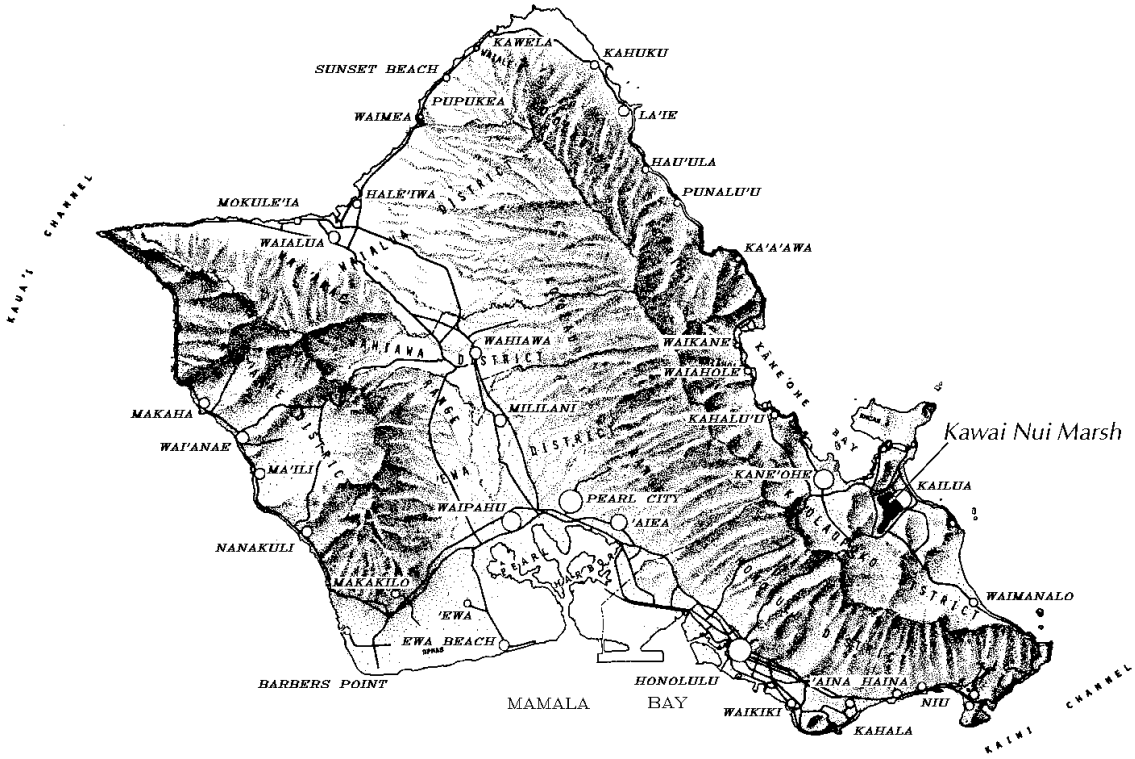

Figure I-1. Map of the Island of O'ahu showing location of Kawai Nui Marsh behind Kailua.

PURPOSE AND NEED

In December of 2001, the non-profit group, `Ahahui Mālama i ka Lōkahi (AML), received a grant from the Kailua Bay Advisory Council (KBAC) to undertake activities and studies directed towards wetlands restoration efforts in Kawai Nui Marsh. The grant was to run from January2002 through June 2003[1]. At its core, the grant was to support actions and studies by a community-initiated wetland restoration project underway since 1997 at *Na Pohaku o Hauwahine* on the eastern side of Kawai Nui Marsh. That is, problems encountered in the restoration efforts should drive both equipment needs and research goals. In this area, two groups: `Ahahui Mālama i ka Lōkahi (AML) and Kawai Nui Heritage Foundation (KNHF) have been organizing the removal of alien vegetation and restoration of native plants to the lowland forest on a 12-acre parcel of State land. A part of that project involves removing, by hand, the vegetation mat covering an adjacent area of Kawai Nui marsh (area herein referred to as simply Na Pohaku) to create open waters in the marsh, then replanting and maintaining pond margins with various native wetland plants.

Of course, in as much as one goal of the wetland restoration project (supported also by a NAWCA small grant[2]) is to establish an education/demonstration site, a parallel goal of the KBAC-funded research effort is that of supporting education with current knowledge about the ecology of the wetland. The vision for the restored wetland at Na Pohaku is an accessible area having a diverse mixture of open water, native vegetation, short nature trails, and varied habitat for wetland flora and fauna. In time, the planted and restored areas at Na Pohaku will become part of the windward O`ahu communities' long-term recreational and educational goals for Kawai Nui Marsh (DLNR, 1994).

With respect to restoration efforts, a basic explanation of why and how a portion of the vast Kawai Nui Marsh has commanded our attention is in order. Although over 830 acres in extent, Kawai Nui Marsh is more than 98% covered by vegetation. Most of this vegetation is NOT a thin layer of floating plants like *Salvinia* (*S. molesta*, see page IV-3) or water hyacinth (*Eichhornia crassipes*), but a community of wetland and upland species (see page IV-) supported on a layer of peat material that generally exceeds 1 foot in thickness. An absence of open water means there is precious little habitat for wetland birds, despite the fact that Hawaiian waterbirds include endangered species and Kawai Nui is the largest wetland in the Islands. A body of water covered by a layer of peat is (except for bacteria) biologically dead. Without light penetration, oxygen cannot be

[1] Extended by the KBAC through February 2004.
[2] North American Wetland Conservation Act (NAWCA) small grant was obtained using our volunteer labor and KBAC funds as matching funds/in-kind-services for this federal grant.

generated by algae, and therefore the subsurface of the wetland supports no invertebrates (such as aquatic insects and prawns) or vertebrates (such as fishes) over most of its area. Removal of the overlaying living and dead vegetation will produce a pond. And a pond can be expanded and shaped to produce a wetland with a combination of open water and vegetated margins, which will attract and support aquatic life.

KNHF and AML have undertaken this process of creating open water in Kawai Nui at the place called *Na Pohaku o Hauwahine*. The location is not conducive to use of mechanical equipment (no roads or electrical service), but is very suitable in other respects (scenery, educational aspects, privacy, State ownership of the adjacent upland). Consequently, creation of ponds has been done entirely by hand, and mostly by volunteer labor (school groups, environmental groups, firemen, community groups). During this process, a number of problems have arisen that suggest the nature of the marsh might not allow serious restoration by removal of the vegetation layer. That is, our removal of the vegetation mat sets phenomena in motion that obliterate newly created open water in a relatively short time (under one year). Understanding and dealing with these phenomena was the primary purpose behind seeking funding for the project. This was expressed as follows in the grant application:

> This grant will attempt to translate that experience [of opening up the wetland] into useful data by applying scientific methodologies to acquire a better picture of the marsh as it exists today. The purpose and benefit of this study are to understand what restoration of the marsh will really mean, and make available to KBAC, the public, and government agencies an intimate picture of this largest wetland on O`ahu. The study is important to KBAC because marine water quality enhancement efforts on Windward O`ahu will ultimately come down to our ability as a community to create and restore the coastal wetlands that once protected marine resources of old Hawai`i from man's activities on the watershed.

GRANT DETAILS

The main components of the grant proposal (AML, 2001) are:

1. develop physical and chemical characterizations of the marsh through water column sampling, profiles, and recording arrays;
2. experiment with confined sediment columns to observe changes in water-solid relationships of the organic rich sediments of the marsh under normal and low flow conditions;

3. undertake limited biotic sampling to better understand where aquatic species are distributed across the marsh;
4. restore, as a demonstration, water bird habitat on one islet located near the Oneawa (outlet) end of the marsh.

This report, in the several sections that follow, will detail the results and accomplishments from the grant. These are discussed here only in summary as they relate to the listed above components of the grant. It is important to realize that items listed as goals in the beginning (i.e., in the grant proposal) sometimes took new directions as the work progressed.

1. **Physico-chemical characterization of the marsh** — Grab samples of water quality, recordings of temperature, and under-the-mat measurement of a range of water quality parameters was accomplished and a general picture of water quality in the marsh is presented in **Section IV**. In addition, monitoring wells were established to follow changes in the floating and deposited materials that cover the basin and constitute the most salient features of the system. These results are presented in **Section III**. Related to this item are studies undertaken by our geologist (team member Robert Moye) collecting and analyzing core samples from around the marsh, and using the results to formulate a broad picture of the structure of the wetland (see **Sections II & III**).

2. **Experiments with sediment column** — A large plexiglass column was to be donated for use by *AECOS* Inc. While this was eventually done late in the grant cycle, other approaches at understanding the characteristics and properties of the sediment and peat layers were sought. These approaches centered around measurements made at the monitoring wells (**Section III**). Understanding the transformations that disturbed layers can undertake is central to success in restoration as discussed in detail in **Sections III & V**.

3. **Undertake sampling of biota in the marsh** — Some biological sampling was undertaken (**Section IV**), although this open-ended component could be carried much further. It was possible to create a reasonably detailed vegetation map (**Section IV**) based upon a recent aerial photograph (1996) provided by Dave Smith of the State of Hawaii, Department of Land and Natural Resources. Certain features and differentiation of vegetation types were updated by field reconnaissance surveys. Therefore, the resulting map reflects vegetation distribution in 2004. It was hoped to visit and collect physical and biological data widely over the marsh so that the vegetation map could relate the physical structure of different parts of the marsh to the nature of the vegetation found in each area. In the end, it proved too daunting a task to range all over the marsh making measurements of mat/water/sediment profiles, so these were limited to

transects established off Na Pohaku. However, the results allow for speculation on the relationship between the findings and the types of vegetation present, as discussed in **Section VI**. Further, because a survey of marsh vegetation communities and past water management practices had been undertaken in the late 1970's as a University of Hawaii, Masters Thesis by Linda L. Smith (1978), the opportunity existed to review that work in light of our observations of the marsh vegetation one-quarter of a century later (see **Sections IV and VI**). The marsh restoration effort also includes knowledge gained from observations on the biota (especially plants) inhabiting the restored area. This knowledge is presented mostly in **Section IV**.

4. **Bird habitat restoration at the levee (Kaha Park)** — Restoration of a small "mitigation islet" originally created as part of the Army Corp's (ACOE) levee modification was successful in attracting a number of student volunteers to implement the project goals. The selected islet has been substantially and favorably modified from its former configuration (see **Section V**) and is now favored by water birds in the area (mostly ducks). A survey to establish whether changes in use patterns by water birds has been so far inconclusive. The latest phase in the conversion process has been to plant native vegetation on the altered islet.

WORLD WIDE WEB CONTRIBUTIONS

Because it is an important part of the KBAC mission to provide educational value from the findings of funded studies, results from the project have been (and will continue to be) distributed on illustrated web pages. Links to the project pages are found at URL: **http://alohahosting.net/~ahahui/PROGRAMS/KBAC.html**