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MANELE

GOLF COURSE AND GOLF RESIDENTIAL PROJECT

LANAI, HAWAII

FINAL
ENVIRONMENTAL
IMPACT STATEMENT

Prepared for
Lanai Company, Inc.
October 1991

MANELE

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FINAL ENVIRONMENTAL IMPACT STATEMENT

Prepared for:
Lanai Company, Inc.

Prepared by:
Belt Collins & Associates
October 1991

Submitted by:

Anne L. Mapes

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CHAPTER I

INTRODUCTION AND SUMMARY

1. APPLICANT AND BRIEF PROJECT SUMMARY

Lanai Company, Inc., developer of the Manele Bay Resort on the southern coast of the island of Lanai and subsidiary of Dole Food Co., Inc. (formerly Castle & Cooke, Inc.), which is a wholly owned subsidiary of Castle & Cooke, Inc., proposes to amend the Lanai Community Plan to expand the Lanai Project District 1-Manele boundaries for purposes of developing a golf course and residential project. An additional 458 acres to the west of the existing Project District boundary would be required for the low density resort type development. The State of Hawaii Land Use Designation for the project site included 285 acres within the Rural district immediately west of the Manele Bay Hotel and 173 acres within the Agricultural district northwest of the hotel. Recently, 139 acres of the 458 acres were designated Urban by the State Land Use Commission; the area will be used for golf development. The project area's Community Plan designation is Open Space and Agriculture. Maui County zoning for the project area is Rural and Agriculture.

The Lanai Company (hereafter referred to as the "applicant") proposes to obtain necessary reclassifications, permits and approvals for the proposed action through a two-step process whereby the golf course project would be developed first with the reclassification and permits for the residential development being sought at a subsequent time.

The development concept involves multi-family residences, portions of the golf course, some single-family residences, and a commercial area to be constructed within the existing Lanai Project District 1-Manele Boundary. In the proposed amendment area (hereafter referred to as the "amendment lands") a portion of the 18-hole golf course, golf clubhouse, and large lot single family residences would be constructed.

2. PROPOSED GOVERNMENT ACTION

Lanai Company, Inc. is currently seeking the Lanai Project District 1-Manele boundary amendment and Lanai Community Plan amendment to allow development of a golf course in an aesthetically pleasing lower density manner as part of the Manele Bay Resort complex. Permitted development within the existing Project District includes hotel, commercial, residential, and park of which hotel and park improvements have already been constructed. The amendment lands would be developed as residential lots, a driving range and golf clubhouse, and 15 of the 18 holes of an 18-hole golf course.

Through a series of formal State redistricting and County amendment actions and the subsequent hearings and informal meetings with the County officials and community groups (see Section 3, Project Background), a two-step approval process has been agreed upon for the project development:

- Obtain the necessary reclassifications, permits and approval for and develop the Manele Golf Course Project

- Obtain the necessary reclassifications, permits, and approvals for the Manele Golf Residential Project

Manele Golf Development

The necessary permits and approvals for the development of the Manele Golf Development would be obtained first and the golf course and clubhouse construction initiated.

From the County of Maui, the proposed golf development would require an amendment to the Lanai Community Plan to address the amendment of the Lanai Project District 1-Manele to expand it by 139 acres (Figure II-2). In addition, the amendment would include golf use within the Lanai Project District 1-Manele permitted uses.

The County of Maui's response to the environmental assessment prepared in 1989 and included in the applicant's petition to amend the Land Use District Boundary (State of Hawaii, Land Use Commission, Docket No. A89-649, 1989) was that the proposed addition of the golf use within the project district did not in itself warrant an environmental impact statement (EIS) pursuant to Chapter 343, Hawaii Revised Statutes.

The development of golf outside of the existing Project District Boundary requires appropriate State Land Use designation pursuant to the State of Hawaii Land Use Law (1961). Recently, approximately 110 acres in the Rural district and 28 acres in the Agricultural district were redesignated Urban (Figure II-3).

Residential Development

Subsequent to Maui County's above response that the addition of a golf course within the project district does not in itself warrant the preparation of an EIS, the Maui Planning Commission issued a Notice of Determination requiring the preparation of an EIS. As agreed to by the parties of the Memorandum of Agreement (MOA) (see Appendix K), the EIS is to be a cumulative EIS on the Manele golf development and residential development.

Following submission, review and acceptance of a cumulative EIS addressing potential specific and cumulative impacts of the golf and residential projects, the second step in the approval process would be to obtain the necessary reclassifications, permits and approvals for the development of the residential subdivision surrounding the golf course.

The proposed residential development would require an amendment to the Lanai Community Plan to address the amendment of the Lanai Project District 1-Manele to expand it by 319 acres within the land currently zoned agricultural.

The State of Hawaii LUD change involves the redesignation of 319 acres of land for purposes of the residential development. Approximately 174 acres in the Rural district and 145 acres in the Agricultural District would be redesignated to Urban LUD (Figure II-3).

The State and County approvals and permits required for the Manele Golf Course and Golf Residential Project are listed in Section 10 of this chapter.

3. PURPOSE OF THIS DOCUMENT

The purpose of this EIS is to identify and assess environmental impacts that could result from the development of the proposed golf course, single- and multi-family residential units, infrastructure and other project features within and outside of the existing Lanai Project District 1-Manele. Additionally, the report will address the land use changes that would occur through expansion of the project district boundary and the cumulative effects of the golf and residential with regard to the ongoing developments on Lanai.

Through this process, as well as the technical studies performed in support of the assessment and land use petitions, the applicant expects to identify weaknesses in the project plan, to propose appropriate mitigation measures for potential negative impacts, and to ultimately create a well-planned, environmentally sound project.

Surveys and assessments prepared for and used in the assessment process and impact analysis include the following:

- Environmental Assessment for Manele Golf Course and Golf Residential Project
- Lanai Resort Partners Petition before the State Land Use Commission for Redesignation of the Agricultural and Rural Lands (including 43 exhibits)
- Archaeological inventory survey of the Hulopoe and Manele Bay Areas, 1987
- Archaeological inventory survey of the 300-acre Rural district
- Data recovery and preservation plan for the 300-acre Rural district
- Archaeological inventory survey of the 173-acre Agricultural district parcel
- Biological Survey, Manele Rural Development
- Lanai Project District 1-Manele Extension Biological Survey and Report on *Canavalia* Status
- Quantitative assessment of marine communities and water quality
- A supplemental assessment of the uses of fertilizers and biocides on the golf course
- Manele Golf Course Integrated Management Plan
- Water resources development plan for Lanai
- Lanai Water Master Plan
- Soil reconnaissance report for the Manele Sewage Pump Station No. 1
- Traffic assessment report and updates
- Market assessment of the proposed developments on Lanai
- Social Survey and Impact Assessment of planned developments for Lanai

- Air quality impact assessment
- Economic and fiscal impact analysis
- Noise impact analysis

4. STATEMENT OF OBJECTIVES

Manele Bay Hotel and Resort is one of two major destination resorts on Lanai that were recommended through the county planning process in the Lanai Community Plan (1983) and Project District Ordinance (Maui County Code, CHS 19.70 and 19.71). The Koele Resort, a 102-room country lodge (with expansion planned to 250 rooms) with golf, tennis, picnicking, lawn bowling, putting course, and horseback riding amenities has been developed in the Lanai Project District 2 in Koele near Lanai City. The Manele Bay Hotel, 250 rooms with expansion to 400, and Resort including golf, beach park, tennis, water sports, and residential use is planned to promote the visitor industry and to provide direct and indirect employment for Lanai residents.

The Manele Golf Course and Golf Residential Project plays a specific role in the development of the Manele Bay Resort. In developing the golf course and residential units, Lanai Company, Inc. hopes to attain several major objectives:

- Further the mission of the Lanai Project District 1-Manele as set forth in the 1983 Lanai Community Plan and codified in the Maui County Project District Ordinance (Maui County Code Chapter 1970)

- Add a golf and residential amenity which will be an integral part of the Manele Bay Resort, compatible with the resort's established character: low density and designed for maintenance of environmental integrity

- Add a new recreational dimension which will enhance the resort's competitive market position

- Add a distinct, low density residential product to those already provided in the resort complex

- Add employment opportunities, primarily for Lanai residents, and

- Create an attractive project that is accessible to the public as a golf course, park/community center and commercial center for the island.

5. PROJECT DESCRIPTION

5.1 Project Setting

The Manele Bay Resort site is located near the Hulopoe Bay just west of the Manele Bay on the southern coast of Lanai, Hawaii. Lanai is a 89,280 acre island leeward of Maui that is accessible by inter-island commercial flights, barge service, and boat from Maui. The Lanai Airport is the island's only airport and Lanai City is the only town center.

Lanai City is approximately eight miles north of the Manele Resort and access to the site is by way of Kaupili Road from the airport past Lanai City to Manele Road (State Route 440). The Manele Resort and project site lies on approximately 870 acres of land on a relatively remote, rugged coast.

The various components of the Manele Golf Course and Golf Residential Project are described below.

5.2 Golf Course and Clubhouse

The 200-acre golf course (with 139 acres within the amendment lands) will be developed in the open space west and mauka of the existing hotel to include 18 holes of championship golf, a practice driving range, and a clubhouse adjacent to the driving range. The open space for golf will be configured to take advantage of the terrain, views, and shoreline, and to protect the archaeological or natural features. Holes 7, 8 and portions of 1, 2, 6 and 9 are within the west end of the existing Project District. The golf course is based on the "target course" concept whereby the total irrigated acreage is limited by leaving some areas between tees and fairways in natural grasses.

The clubhouse and driving range will be central to the course and single family residences will be interspersed primarily mauka of the fairways. The golf course will be semi-private and will be open to the public. Residents of the Koele Resort will be encouraged to use the golf course.

5.3 Residential Development

Lanai Company plans 425 resort-residential lots/units, 325 single-family residences and 100 multi-family units. The single family residences are planned as vacation or second homes and will be primarily mauka of the fairways with lots interspersed and in the project district area mauka of the Manele Small Boat Harbor and east of Manele Road. Each of the single-family homes will have full or partial ocean views.

The total density of the single-family residential use will decrease; although the total number of units will increase by 9. Four hundred sixteen residential units are currently authorized under the existing Project District Ordinance 1578 of the County of Maui. As originally established, the project district 416 residential units were to be comprised of 342 single family homes over 137 acres (i.e., 2.5 units per acre) and 74 multi-family homes over 18.60 acres (i.e., 4 units per acre). Under the proposed amendment, the 425 residential units would be comprised of 325 single family homes over 379 acres (i.e., less than one (0.85 units per acre) and 100 multi-family units over 30.00 acres of land (i.e., approximately 3.3 units per acre). The lot size of the single-family homes will vary depending on the location within the resort development and range from 10,000-square-foot lots to possibly one acre in size.

The multi-family residences were planned as part of the Manele Bay Hotel development (Phase I). At this time, some of lots are planned adjacent to the hotel property in order to take advantage of the hotel services. All multi-family units are planned within the existing project district boundary.

The value for a residential lot is projected to range from $780,000 to $3 million (in 1990 dollars) based on the price that the market will bear when the units are constructed. The multi-family units are projected to begin at an average of $800,000. The actual sales price of these properties would vary depending on the final site configuration and other factors that affect value at the time that the units are available for sale. Total residential development value, based on a maximum of 325 single family and 100 multi-family units, would be $300 million to $700 million.

5.4 Park and Open Space

Hulopoe Beach Park (66.33 acres) is an existing recreational amenity for the public that under this proposal would remain in the existing location between the hotel and the Manele Road and residential lots. The development concept includes additional improvements to access, parking, restrooms, and addition of a water safety kiosk in this park. Phase I improvements to Hulopoe Beach Park are being constructed under the Manele Bay Hotel development; other Phase II and III improvements will be planned with the golf and residential project. Other park areas along the shorelines of Hulopoe and Manele bays will remain in the existing condition.

The open space in the proposed project that is not used for golf would be reconfigured to take advantage of the terrain, views, and shoreline, and to protect the site's cultural features.

5.5 Commercial

The commercial establishments will be adjacent to the Manele Bay Small Boat Harbor and adjacent to the park overlooking Hulopoe Bay as proposed in the existing Project District. No specific restaurants or retail shops are planned at this time; however, the facilities will comply with the Project District guidelines and focus on small resort type retail and craft type shops. No specific analysis of the impact of the proposed commercial development is required under this EIS; however, it is mentioned here to be included in the overall development concept.

5.6 Circulation and Access

Vehicular access to the resort and golf course will be through Manele Road, Highway 440. The major resort entrance road will branch off to the right from the existing road which continues past Hulopoe Beach Park and ends at Manele Boat Harbor.

The main branch road from Manele Road will be the principal egress and ingress to the residences. An alternative access route from the Lanai Airport is being considered by the State Department of Transportation which could replace Manele Road as the primary access to the project if it is constructed. This alternate access route would provide safer and more direct access to the Manele Hotel and residential area. Under this proposal, however, the primary access and circulation is evaluated using Manele Road as the singular egress and ingress.

5.7 Shoreline Improvements

The existing Hulopoe Beach Park and coastal trail will essentially be maintained in open space with some improvements to enhance the physical setting and to improve public usage and safety. Park improvements have already been planned and approved through the permitting process for the Manele Bay Hotel project.

Public access will be protected through the dedication of a public easement from Hulopoe Bay to the westernmost boundary of the project area that will allow public pedestrian access along the accessible cliff coastline in perpetuity. As set out in the MOA (see Appendix K), the setback zone is planned to be 50 feet from the edge of the cliff along the accessible cliff coastline except along "signature hole" 16. The area within 75 feet from the cliff edge would remain in its natural state except with respect to holes 12, 16 and 17. Vertical improvements would be prohibited within 150 feet of the cliff edge. At the appropriate time, the applicant will seek a Shoreline Setback Variance for these setbacks.

Archaeological resources along the shoreline that provide good examples of cultural sites will be preserved and have interpretive displays. The signs will provide recreationists with information about the cultural features.

Improvements for Hulopoe Beach Park as a part of the Manele Bay Hotel project include new restroom facilities, picnic tables, trash receptacles, improved loop access road, water safety kiosk, lighting and landscaping in and around the public use areas. Most of these amenities are in place.

5.8 Project Schedule and Construction Cost

The proposed construction schedule for the Manele Golf Course and Golf Residential Project development is shown in Table II-2. The golf course, clubhouse, and driving range are scheduled for completion in 1992/1993. The opening date is dependent upon the approval and regulatory process.

The first increment of single family residences (those planned for within the existing Project District) would be ready for sale within twelve months of the opening of the golf course. The multi-family units will be available sometime between the golf opening and the availability of the single-family homes. The residences would be constructed in increments appropriate to the market and the residences to be built in future increments would be available over a five to ten year period depending on the real estate market.

Total construction cost of golf course development is estimated at $30-35 million. Estimates are based on 1990 dollars.

6. SUMMARY OF POTENTIAL ADVERSE IMPACTS AND MITIGATION MEASURES

Impacts to the environment are expected as a result of the construction and operation of the Manele Golf Course and Golf Residential Project. Adverse impacts will be mitigated where possible and offset by benefits resulting from the project.

6.1 Short-term Construction Period Impacts

6.1.1 Physical Environment

IMPACT: Alteration of the soil and natural topography of the site.

MITIGATION: Immediate sodding and planting of cut and fill slopes after completion of grading work. Erosion would be minimized by limiting the soil exposed at any given time, careful design of residential areas, and implementing a comprehensive landscaping program during each stage of development. Management controls such as watering, sediment basins, and temporary grassing would be employed to protect the existing soil layer.

IMPACT: Clearing, grading, and excavation of about 458 acres of land in the amendment area approximately 170 acres within the existing Lanai Project District 1-Manele.

MITIGATION: Any clearing and cut and fill activities would be performed in compliance with county, state, and federal design requirements.

IMPACT: Potential disturbance of natural drainage patterns along the coastal slopes.

MITIGATION: Natural drainage features will be maintained as far as possible; contour design plans and internal drainage features of the golf course would increase soil percolation; some sump drainage is planned. The golf course design, prepared by Jack Nicklaus Golf Services, includes specific measures for managing surface water and drainage.

All sites, except those recommended for preservation, will be designed and constructed in full compliance with Maui County Department of Public Works and State Department of Health standards for roadways, drainage and golf course construction.

IMPACT: Temporary introduction of non-conforming visual elements to the planned low-rise, low-density character of the proposed resort; such elements as temporary construction trailers, exposed pipelines, stockpiles of topsoil and gravel and other construction activity needs.

MITIGATION: Where possible these temporary structures are in place that are obscured from views from the popular or high use areas of the island and the resort. This impact would be temporary and such activities as topsoil and gravel stockpiles, exposed pipelines, and most of the construction trailers will most likely be removed after the golf course and residential infrastructure is in place. During construction, mitigation measures involve limiting the time rock and bare soils are exposed to erosion, placing sod as soon as practicable, and planting vegetation on developed sites that complements the natural environment.

IMPACT: Potential increase in surface water runoff while the site is devoid of vegetation.

MITIGATION: Use of temporary drainage facilities (i.e., culverts, diversions) to prevent mass surface erosion.

6.1.2 Natural Environment

IMPACT: Clearing substantial portions of the project site of scrub and kiawe forest vegetation.

MITIGATION: Increasing ground cover through reseeding and landscaping of barren areas.

6.1.3 Historic and Archaeological Resources

IMPACT: Potential disturbance of archaeological or cultural features as a result of site excavation and grading.

MITIGATION: Should any additional sites be uncovered during construction, work will stop and the appropriate State and County officials notified. If necessary, data recovery will take place prior to any further construction in the area of concern.

6.1.4 Socioeconomic Factors

IMPACT: Increased construction activity with the project would require hundreds of construction workers to temporarily reside on Lanai and potentially overtax the available room and board facilities.

MITIGATION: Temporary housing and meals will be provided to the construction workers while they are employed by Castle & Cooke Properties, Inc.

IMPACT: Temporary interruption of continuous lateral public shoreline access.

MITIGATION: Temporary interruption should not significantly affect use of the site; no mitigation is required.

6.1.5 Infrastructure and Public Services

IMPACT: Temporary addition of windblown dust, debris and silt due to the soil disturbance during construction earthwork and from increased construction vehicles traveling over exposed soils and rock.

MITIGATION: Because the project site is very dry and dusty, a conscientious fugitive dust control program would have to be implemented during project construction to prevent potential problems with the wind blowing particulates into the existing hotel complex. Mitigative measures include frequent watering of exposed ground during construction, temporary grassing, covering of trucks transporting loose soil, using wind screens, and landscaping or paving of bare dirt areas as early as feasible in the development process.

All worst-case projected levels of carbon monoxide were well within acceptable air quality standards, and thus no mitigation measures are recommended in this regard. It is recommended, however, that Manele Road be widened to two full lanes in order to alleviate the dust generation that now occurs when oncoming vehicles have to travel with one set of wheels on the unpaved roadway shoulders in order to safely pass each other.

IMPACT: Increased traffic of heavy construction vehicles on the service road and primary access road.

MITIGATION: Vehicles will be kept on existing access roads and unnecessary heavy equipment trips will be eliminated. Mufflers will be used to reduce construction period noise and construction activity will be restricted to normal weekday hours. A maintenance road will be used for construction vehicular access and for moving construction materials into and out of the area.

IMPACT: Increased demand on the Kaumalapau harbor facilities to handle construction materials for the golf course and residences.

MITIGATION: This temporary increase in demand can be planned for and managed within the existing harbor system; no specific mitigation is required.

IMPACT: Increased demand for potable water for watering the project site to control dust and soil loss prior to planting areas under construction.

MITIGATION: The water used for watering during construction would be required only during the earth work phase of construction and prior to any water use for residences. There should be sufficient water available for this temporary increased demand.

IMPACT: Some construction noise temporarily exceeding the State Department of Health standard resulting from construction activities including: blasting for site excavation, heavy vehicles and machinery.

MITIGATION: Properly muffled construction equipment should be required on the site and incorporation of standard Department of Health noise limits and curfew times should be upheld. Blasting should be monitored closely to ensure that the timing of blasting be scheduled to avoid unnecessary disturbance to guests or vibration damage.

6.2 Long-term Impacts

6.2.1 Physical Environment

IMPACT: Change in the visual quality of the site from open scrub land to low density residential development.

MITIGATION: The primary mitigation measure that will be employed to minimize potential adverse visual impacts will be the use of extensive landscaping in and around the residential areas. In addition, the buildings and homes will be designed to blend in with the natural environment of the area. The golf course would be a "target golf" concept which minimizes the extent of the turf area required and allows for maximum natural vegetation to remain.

6.2.2 Natural Environment

IMPACT: Permanent loss of naturally occurring koa-haole, ilima and kiawe scrub vegetation, and ilima-ukaloa-pili grass association.

MITIGATION: Vegetation that is cleared will be replaced with native and other appropriate landscape materials. Much of the site will remain in open space used as a public park. The areas around the archaeological site will be preserved in natural vegetation for aesthetics and to retain any native plants as part of the historical record. Where possible, the ilima-uhaloa-pili grass association will be preserved in the golf course rough and in other areas within the residential landscaping. The landscaped areas will include native species wherever appropriate and aesthetically pleasing.

To mitigate the loss of naturally occurring vegetation, natural landscape elements, including endemic species, will be used in landscaping plans for the golf course and house lots, particularly along the coastline. Individual owners of house lots will be encouraged to use native and naturally occurring plant species to the maximum extent possible in their landscape plans.

IMPACT: Potential loss of natural habitat for fauna.

MITIGATION: Given the lack of expected significant adverse impacts that might result from the Project, specific mitigation measures for fauna are not warranted. There will most likely be an increase in habitat value of the site through introduction of more diverse vegetation, cover and food sources for birds and small mammals.

IMPACT: Potential loss of habitat for Canavalia pubescens, considered a species monitored for its rarity within Hawaii.

MITIGATION: This plant will be monitored during construction to determine the extent of the population and the populations would be avoided when excavating for home sites.

IMPACT: Potential long term effect on the groundwater and marine water quality due to the leaching of inorganic nutrients or toxic chemicals into the aquifer during frequent maintenance applications of fertilizers and pesticides.

MITIGATION: Potential adverse impacts from pollutants will be mitigated through use of time release or rapid uptake fertilizers, and the

application of EPA- and DOH-approved biocides under the direction of certified applicators. In addition, management practices for the golf course will include use of a sophisticated weather station to control the irrigation system and limit chemical dispersion by closely controlling water requirements.

A long-term comprehensive management program for the Manele-Hulopoe Marine Life Conservation District will be conducted which involves a comparative analysis of quantitative data for marine communities (e.g., water quality parameters, benthic composition, biomass) directly affronting the project site and at selected sites well removed to serve as controls. Sites at each location will be sampled at a number of points in time, thus assuring both a spatial and temporal dimension in each comparison. Sampling is planned to occur every three months during the construction of the golf course and every six months for post-construction surveys to determine equilibrium.

6.2.3 Historic and Archaeological Resources

IMPACT: Potential loss or degradation of archaeological sites or cultural features due to accidental destruction, vandalism, scavenging (see Chapter IV for a description of the significance of the sites).

MITIGATION: Major habitation and religious sites which form an almost contiguous complex on both sides of Kapihaa Gulch will be preserved as open space in the Manele Golf Course and Golf Residential Development Plan. Other clusters of sites in the eastern portion of the project mauka of Manele Small Boat Harbor will be preserved in place as well, unless they cannot be avoided because of excavation for residential lots.

Because many of the significant historical and archaeological resources were incorporated into the design of the golf course and residential lot plan, the impact to the site has been avoided. If, however, substantive changes are made in the proposed action that affect the location of the golf fairways and tees or the residences, suitable measures must be taken to protect the valuable archaeological remains and data from potential adverse impact.

Data recovery is recommended for the significant features of other sites. The method for excavation and documentation of the data recovery for these sites involves a sequence of excavation and laboratory techniques. All findings will be documented in a report that will be reviewed by the State Historic Preservation Office, the Maui County Planning Department, and

the Lanai Historic Preservation Committee prior to finalizing the report and distributing it to reviewing agencies.

6.2.4 Socioeconomic Factors

This section first provides an overview of the potential adverse impacts that could result from the project and then lists the proposed and planned mitigation measures at the end of the section. Specific mitigations have not been listed after each impact as under the other resource categories above.

IMPACT: More visitors and resort residents will come to Lanai as a result of the project. A total resort population of over 1,800 people, on average, at the two resort areas in 2001. This is about twice as many as would come to Lanai without the project. The project could result in:

- Higher hotel occupancies
- Demand for additional hotel rooms
- Buildout and sale of resort residential units in both resort project districts during the coming decade
- Purchase of residential units by upscale buyers primarily for part-time residence; for example, about 25% of Manele single-family units would be bought by full-time residents and 65% by part-time residents, versus 20% and 50% without the project.

IMPACT: Resort operations with the project would generate about 275 additional jobs on Lanai in 1991 than would be generated without the project scenario. Many of the additional jobs would be due to construction of the golf course, but most would be resort direct jobs and the induced jobs associated with them. By 1996, the Lanai resorts could generate almost 675 more jobs with the project than without it. In 2001 and afterwards, the resort would support about 950 more jobs with the project than it would otherwise.

Employment impacts of the project involve higher numbers of jobs, both on the resort and elsewhere on Lanai, as a simple function of increased numbers of visitors. However, two complex issues deserve mention:

- With a substantial on-island market for specialty crops, the diversified agricultural operations on Lanai could be introduced, then marketed elsewhere. The resort would thus be a catalyst for further growth of these operations.

- The larger Lanai resident population would support expanded commercial, service, professional, and government activities on Lanai, provided that facilities for such growth are available. Availability of space for new or expanded support activities could be a constraint on growth. To minimize this constraint and as a mitigation measure, Dole Food Co., Inc. is working to provide opportunities for expanded growth in these areas.

IMPACT: The increased hotel occupancies will create a demand for additional workers to support a larger visitor population. Increases in the number of hotel units will fuel the creation of additional hotel jobs. Approximately 1,000 additional workers would eventually be required.

The population supported by in-migrant workers would rise from over 200 in 1991 (according to the immediate impact scenario) to a peak that could exceed 2,200 by 2001 (according to the ultimate impact scenario). In-migrants and their dependents could grow from about 20% of Lanai's population to half the population.

The ultimate impact scenario indicates substantial population growth with the project. Much of that growth would occur in the next five years. After 1996, the rate of growth would decline and many of the "newcomers" could become established members of Lanai's community.

IMPACT: Housing demand from working in-migrants would increase substantially. Current Castle & Cooke housing initiatives should be sufficient to accommodate this demand through the mid-1990s. However, major hotel expansions thereafter will generate additional in-migration and housing need.

IMPACT: Total County revenues from the Lanai resort would be higher with the project than without the project for all years until 2010. The cumulative increase in revenues is estimated as about $50 million over the 20-year period from 1991 to 2010.

IMPACT: The net impact of the project on Maui County finances is estimated as being positive for all years from 1991 to 2010. The net additional revenues would be over $1 million annually after 1991. The cumulative impact would be an estimated gain for the County of $25 to $30 million.

IMPACT: With the project, State revenues from resort development on Lanai would be nearly $4 million to $5 million higher than without the project in 1991. The with-project increase in State revenues would stabilize at a level estimated at $10 million to

$15 million annually. The cumulative increase in revenues is estimated at about $200 million between 1991 and 2010.

IMPACT: The net impact of the project on State finances is estimated as positive for all years from 1991 to 2010. The balance of State revenues over expenditures attributable to the project would reach the $3 million to $5 million range by 1996. Annual net revenues would reach somewhat higher levels in later years. The cumulative impact from 1991 to 2010 would be an increase in State revenues estimated at a minimum of $50 million, and possibly amounting to $100 million.

IMPACT: The impacts of the project on the shoreline recreational activities in the project site will be minimal for most activities. The impacts on in-water activities such as scuba diving and spear fishing from boats will be the same as those described in Recreational Impacts Without the Project, but the impacts on land-oriented activities will differ.

The golf course will provide easy pedestrian access to 1.2 miles of shoreline which, in its present natural state, is difficult to traverse for most users. After the golf course is developed, the walk will be much easier and the travel time will be considerably reduced. Hikers, fishermen, and opihi gatherers who do not use the area now will be attracted to the area to reach Huawai Bay and other sites to the west. In general these users are unobtrusive and their occasional presence should not generate significant conflicts with the golfers.

The golf course will destroy an established, although privately-owned, deer hunting area. Resentment about this potential loss was expressed in the field interviews by several informants. However, the loss of 458 acres must be viewed in the context of a total available 36,000 acres for deer hunting on Lanai.

IMPACT: Project impacts on community stress or satisfaction are likely to be small in comparison with the cumulative changes expected from cumulative resort development and the Dole phase-down. There is no basis for assuming a golf course would produce significant community stress, independent of recreational concerns discussed previously. The upscale homes around the golf course are unlikely to have any detectable crime impact compared to the alternative Manele residential development plan, according to the Lanai police commander (personal communication, Lt. Paul Winters, September 24, 1990) -- although they may add to a feeling of resentment of outsiders.

The major impact thus would probably be psychological: a reduced sense of "community" on Lanai because of greater socioeconomic differences between the two urbanized areas of Manele and Lanai City/Koele.

MITIGATION: **Housing**: Two general approaches to the mitigation of housing impacts are possible. In-migrants could be encouraged to come with few dependents, minimizing housing demand but risking high turnover and, it is likely, little integration with the Lanai community. Alternatively, in-migrants could be encouraged to live settled family lives through the provision of housing and through actions to integrate them with the existing community. The two approaches could be combined, to a limited extent, if some in-migrants can be identified as likely short-term residents.

Recreation: Increased consumptive pressures and declines in food species populations is a common result in many boat harbors in Hawaii and can only be resolved by the imposition of regulations restricting consumptive activities.

The issue of a setback to preserve public access and the viewplane at the seaward edge of the golf course has apparently been agreed to in an October 1990 Memorandum of Agreement between Lanaians for Sensible Growth, the Office of Hawaiian Affairs, and Castle & Cooke, Inc. In this agreement, under "Shoreline Access", a 50-foot public easement is to be dedicated along the accessible cliff coastline from Hulopoe Bay to the intersection of the westernmost boundary of the project; a 75-foot corridor from the edge of the sea cliffs to the golf course is to be left undeveloped except for three holes; and a 150-foot corridor from the edge of the sea cliffs is to be left free of any vertical improvements. Ultimately, the setback issue will be resolved when the applicant seeks a Shoreline Setback Variance from Maui County.

Social Stress: Mitigation measures implemented or planned by Dole Food Co., Inc. include:

- The various housing commitments already made by Dole Food Co., Inc.

- Provision of dormitory housing for construction workers, and perhaps also some young in-migrant resort employees, in order to lessen demand for homes in the Lanai City area.

- Assurances to older workers or retirees that their rentals are guaranteed at controlled rates. Such guarantees are

now given to Dole Company retirees. Guarantees will be extended to residents retiring from Lanai Company and Koele or Manele hotel jobs, so long as they meet the company's minimum level of prior service (measured as total service with any Dole Food Co., Inc. entity, including Lanai Resort Partners).

Both assessment practices and recent changes in Maui County's property tax laws protect long term non-resort residents from the property tax increases that some fear. Some of the most critical mitigation measures would include those discussed previously -- i.e., absorption of Dole pineapple workers and provision of housing. These will ease the most immediate source of community anxiety (the future of Dole workers) and mitigate what is arguably the most significant negative impact of rapid development in Hawaii (affordable housing shortages).

There are four major additional areas in which mitigation efforts are or could be carried out:

- Integrating new upscale resort residents into the larger Lanai community,
- Political and economic diversification,
- Easing transitional problems of social stress,
- Improving communication between residents and developers.

Dole Food Co., Inc. has already initiated a number of efforts in these areas. Some of these are described below. Mitigation recommendations not identified as initiatives by Dole Food Co., Inc. (or other agencies) represent consultant suggestions only and do not imply any commitment by the applicant.

Integrating New Upscale Residents Into Larger Community

(1) Resort residential projects such as those planned for Koele and Manele typically have community associations responsible for maintenance of private roads, provision of security, etc. Owners are assessed monthly fees to provide such services.

These community associations could be vehicles for educating new resort residents about Lanai. They could provide members with historical information about the community and newsletter updates about community events.

(2) The association(s) could also be a mechanism for soliciting contributions for a community development trust fund, or for specific community projects. This would have to be decided by the respective association(s).

(3) Dole Food Co., Inc. has hired an Activities Coordinator for Lanai, who is responsible for developing a variety of community-wide recreational programs. As the resort residential population begins to be established, the Activities Coordinator could be instrumental in assessing the types of activities, entertainment, and civic programs which would attract residents of all Lanai communities--Lanai City, Koele, and Manele.

(4) Dole Food Co., Inc. is continuing its search for a Vice President of Community Affairs for Lanai, whose responsibilities will include active problem solving within the community.

(5) The Po'okela program workshops now being offered to Lanai Resort Partners employees (but open to all community members) could be used to target new resort residents. The program component which focuses on the cultural values and ethnic history of Lanai is particularly important for educating new residents, including resort residents.

(6) Dole Food Co., Inc. has commissioned an "Interpretive Master Plan" (D&M BUCY and Associates, 1989), which is aimed at helping visitors understand and appreciate the history of Lanai. The plan does not currently focus on new full- or part-time residents, although there are obvious areas of applicability. Dole Food Co., Inc. may wish to consider asking its consultants for the plan to prepare an appendix pointing out strategies for assuring that new residents are given equal or greater awareness of Lanai's history.

Political/Economic Diversification

(1) Dole Food Co., Inc. is continuing its master planning effort for Lanai City, in conjunction with a revived Retail Merchants' Association. Renovation of existing space and new construction could result in expansion of the current 39,000 square feet of commercial space to a total 60,000 square feet. The actual steps taken in this area will be primarily dependent on the economics and potential of each individual store to finance business expansions.

The master planning will include an effort to identify all Lanai residents (or off-island family members) interested in any sort of local business, including arts and crafts. Following redevelopment, long-term leases would be granted to businesses.

(2) The company has signed a Memorandum of Agreement with Lanaians for Sensible Growth (LSG) which pledges to:

- provide an annual grant for two consecutive years to aid in the creation of a Community Development Corporation, which will stimulate community-based economic development projects on Lanai;
- provide grants in 1991 to fund projects, proposals, and programs, including a "backyard aquaculture" demonstration program;
- thereafter, provide additional funding for proposed projects on a case-by-case basis.

(3) Dole Food Co., Inc. is planning to contract for a business skills inventory on Lanai and to identify the major small business opportunities which have emerged in other rural Hawaii resort areas.

(4) Under the Lanai Co., Dole Food Co., Inc. is developing a three-year plan for expanding its diversified agriculture operations on Lanai. Much of the program would be aimed at Lanai's own visitor and residential market, but some potential off-island export crops (such as forage for cattle on other islands) are being considered.

(5) Additionally, Castle & Cooke Properties, Inc. has made a verbal commitment to the Office of State Planning to provide land for a State agricultural park, to be utilized by independent farmers.

(6) The company is founding and funding a Lanai Arts Program to encourage local arts and crafts on a professional level. Dole Food Co., Inc. has already contracted with local artists for artwork at Koele Lodge, and proposes a similar local arts program at the Manele Bay Hotel.

(7) Depending on resolution of current federal budget uncertainties, the national Economic Development Administration (EDA) may be able to invoke Title IX of the EDA Act for Lanai as a result of the Dole phase-down. This could provide local government with matching federal

grants for infrastructure which would promote local economic development.

Easing Transitional Social Problems

(1) Dole Food Co., Inc. has agreed to a proposal by the Office of State Planning that it provide land for a joint County-State building to house more social service and public health agency workers.

(2) To deal with personal stress or mental health problems, the company currently provides an Employee Assistance Program (EAP) to all employees and family members. Discussions are underway about the possibility of RockResorts utilizing the same program for its hotel employees, and some preliminary services have already been provided at The Lodge at Koele.

(3) Dole Food Co., Inc. has been subsidizing the shortfall for the Lanai Day Care Center, which has extended services through the summer months for the first time. The company is now looking at options for further assistance.

(4) Lanai social workers are applying for a Community Coalition grant to the Federal Alcohol and Drug Administration. This will include leadership skill training, which would aid in the larger effort for community "empowerment."

(5) To ease the sense of new development "taking over" on Lanai, Dole Food Co., Inc. could plan for certain commercial and recreational areas to orient primarily to local residents. This would imply simple architectural design and location away from visitor-oriented shops.

Improving Resident-Developer Communication

(1) Dole Food Co., Inc. (along with RockResorts and a few other companies) underwrites a new monthly newspaper, the *Lanai Times*. The paper provides space for alternative editorial views on Lanai's future. If economically feasible, more frequent publication would provide Dole Food Co., Inc. with a better opportunity to inform Lanai residents of the various programs intended to ease the transformation from pineapple to tourism.

(2) As development proceeds, more senior executives of the Lanai Company might be located on Lanai itself. The island's communication patterns still rely very heavily on informal personal contact. While Dole Food Co., Inc. has

been willing to communicate through a variety of public meetings and forums, individual communication with major community leaders is an important need on Lanai.

(3) At the same time, agreements need to be recorded so that future executives know what their predecessors have promised. The Memorandum of Agreement (Appendix K) which Castle & Cooke (now known as Dole Food Co., Inc.) has signed with Lanaians for Sensible Growth is an important first step.

Dole Food Co., Inc. recently began implementing a policy guidelines development approach by transcribing all questions and answers from certain community meetings, thus providing a record of community concerns and responses made to those concerns at particular points in time.

6.2.5 Infrastructure and Public Facilities

IMPACT: Increase in vehicular traffic at all major intersections between airport, Lanai City and the project site with the largest increase occurring from vehicles turning right onto Kaumalapau Highway going toward Lanai City and from vehicles turning left onto Manele Road.

MITIGATION: Increased traffic can be accommodated by the existing roadways.

IMPACT: Increased demand for air transportation facilities including heavier demand on the passenger terminal, parking facilities, air cargo operations and aviation support facilities.

MITIGATION: Increased air traffic and air facilities demand can be accommodated through implementation of the approved Lanai Airport Master Plan.

IMPACT: Potential increase in air emissions due to electrical generation and from equpiment used for solid waste disposal.

MITIGATION: The residential units included in this project will create an increased demand for electricity and an increased need for solid waste disposal. The additional levels of air pollutants resulting from diesel-fueled generation to meet project electrical needs have been computed to be small. Even so, this potential impact could be somewhat mitigated by employing solar energy design features in new unit construction to the maximum extent possible. Such features include solar water

heating for all units, and window orientation to maximize cross ventilation and light without unduly increasing indoor heat buildup, thus minimizing the need for air conditioning. Current plans call for disposal of solid wastes in landfills. Exhaust emissions from refuse trucks and heavy equipment working in the landfill to meet this additional solid waste disposal demand should be very small. Special mitigation measures to limit these emissions should not be needed. Particulates in the air can be controlled through following the standard construction practices of incremental excavation and sitework and frequent watering of the exposed soils.

IMPACT: Increased demand on harbor facilities because of the indirect effect of larger volume of imported goods for residents and visitors.

MITIGATION: Increased demand for harbor facilities can be accomodated within the existing layout of the harbor facility providing sound management practices are followed.

IMPACT: Increased ambient noise level from increased traffic flow.

MITIGATION: Projected increase does not exceed noise standards as established by the Department of Health; therefore, no mitigation is warranted.

IMPACT: Increase in the demand for potable water to supply the residential development and the golf clubhouse. Increase in demand for non-potable water sources to serve the golf course irrigation and other landscaping.

MITIGATION: Landscaping and water conservation measures include using natural plants that have low water requirement is an excellent way of reducing the irrigation needs in landscaping. Landscape design guidelines could include plant lists of attractive dryland plants and residents encouraged to use them in their lawns and landscapes.

Water resource management measures include consolidation and centralization of the water management function on the island to provide better communication, better record keeping, and better planning and implementation of the water system improvements island-wide. The Lanai Water Master Plan (July 1990) was produced as part of this mitigation.

Working with and implementing the State of Hawaii Commission on Water Resource Management recommendations to conserve potable water and to investigate ways to make greater use of the non-potable water for irrigation.

An extensive exploratory well testing program initiated is ongoing whereby, new potable and alternate sources have been identified and are being developed.

IMPACT: Increased demand for sewage disposal from the residences (maximum 0.19 mgd) and the golf clubhouse.

MITIGATION: Anticipated wastewater flows from this project can be accommodated in the program of WWTP expansion and system planning for the existing Manele Project District. Hence, no additional mitigation measures are necessary.

IMPACT: Increased demand for solid waste collection and disposal and indirect effect of increased requirement for additional landfill capacity on the island.

MITIGATION: The cumulative effect of constructing and operating the resort developments planned for Lanai will substantially increase the waste stream through addition of materials cleared and grubbed during construction, cardboard packaging, construction materials used and discarded, etc. In order to manage this vast accumulation of materials, some of which could be reused, a Solid Waste Management Plan should be developed that evaluates and provides guidelines for feasible management techniques for Lanai (i.e., composting, waste reduction, recycling, etc.).

IMPACT: Increased electrical power demand estimated to be 750 kw for the fully operating hotel, 490 kw for the wastewater treatment plant, and 160 kw for the other improvements in the Phase I Manele Resort development. Addition of a new power requirement to serve the golf and residential use estimated to be about 2,800 kw.

MITIGATION: Extension of the distribution for power and communication facilities will be planned to coincide with the residential and golf development and the electrical distribution system will be constructed and maintained according to approved utility standards. The on-site electrical system will be an underground facility with the exception of service transformers and switching equipment. A network of underground ducts and

handholes will be provided to facilitate cable installations by the utility companies.

7. SUMMARY OF ALTERNATIVES CONSIDERED

The alternatives evaluated include a wide range of densities, facilities, and amenities, as well as differing social, economic and natural environmental impacts. Although there may be other configurations, layouts, and combinations of facilities and amenities that could be studied, the alternatives analyzed below cover the spectrum of possibilities and allow the analyses performed to be sufficiently detailed and comprehensive for a comparative evaluation of the environmental benefits, costs, and risks of the proposed project and each reasonable alternative.

7.1 Alternative 1 - Proposed Action

The Lanai Company, Inc., proposes to develop a golf course and residential lots as part of the Manele Bay Hotel complex at Manele, Lanai. The Manele Bay Hotel, located within the Urban Lanai Project District 1-Manele, has recently been completed and is now receiving guests. The golf course and residential area will partially extend outside the 410-acre Urban Project District. An additional 458 acres are required for the larger single-family residential lots and golf course development. The target markets for the golf course are the visitors who will be staying at either of the two luxury hotels on the island: Manele Bay Hotel or the Lodge at Koele.

The preferred alternative necessitates revising portions of the current land use designations in the expansion area, and redesignating portions currently in Agriculture to Urban and portions currently in Rural to Urban. In addition, amendments will be needed to the Urban Project District boundary to reconfigure existing residential and open space areas and to allow the inclusion of golf and resort residential as permissible uses in the expansion area.

Alternative 1 has been judged to be the preferred alternative due to (1) the appropriate mix and sizing of guest accommodations and amenities to be provided; (2) the expected high quality visitor experience that would result from the amenities of hotel rooms, low density multi-family and single-family residential units, commercial shops and services, and recreational facilities throughout the entire Lanai Project District 1-Manele; (3) the appropriate density, i.e., number of hotel rooms, multi-family and single family residential units, commercial shops and services, and recreational and support facilities on the available land; (4) the relatively moderate, adverse or favorable, natural and socioeconomic impacts as compared to other alternatives; and (5) the expected positive economic, guest occupancy, and expenditure impacts.

7.2 Alternative 2 - "No Action"

This "No Action" alternative, also referred to as "Future Without the Project," would maintain the Lanai Project District 1-Manele boundaries at their present locations. No amendments would be sought for rezoning areas currently designated or for allowing golf related activities within the Project District. The hotel and single- and multi-family

housing (up to 416 units), as well as the open space and park, would be developed but golf would not be included in the plan. Densities for the Project District would be higher than for Alternative 1. The overall environmental impacts to the area would be minimized, but the natural attributes of the area would continue to be underutilized. The ability to improve beach facilities and access, and to manage and preserve the historical and archaeological features of the area would be lost with this alternative.

Market assessments for the project have determined that golf-related activities and the low density single-family residential units are essential for the economic viability of the Lanai Project District 1-Manele. Under a "no action" scenario, the landowner and resort operator would take measures to minimize annual operating losses due to the overall lack of visitors. Operating facilities, including the hotel, restaurants, and commercial shops, could be radically scaled back or closed given no future prospects for improved operations.

Due to the permanently impaired economic potential associated with this alternative, no additional development would be foreseen in the Lanai Project District 1 - Manele. This lack of development would have a serious negative impact on the neighboring resort at Koele, and especially on the community of Lanai Island. Economic viability at both the Koele and Manele Resorts is essential to provide the employment opportunities required in light of the current phase-out of pineapple production. A "no action" decision could result in the eventual unemployment of current Lanai workers, with the resulting social problems left for mitigation by the public sector (see Chapter IV, Section 5). This alternative would not meet the project goals and objectives for the developer or for the community.

7.3 Alternative 3 - Golf Use Within Existing Project District Boundary

This alternative would consist of building the proposed golf course entirely within the existing Lanai Project District 1 - Manele boundaries. This would necessitate amendments to allow golf related activities as permissible uses within the District and to rezone lands within the area to accommodate the course.

This alternative would provide revenue-making uses, but would severely impact the proposed land available for public open space and residential units. In order to achieve the critical mass of multi-family and single-family units needed for economic viability, densities would need to be increased. Resulting environmental impacts would be the loss of sensitive historic and archaeological areas, loss of scenic views, and smaller than desirable activity areas within the Project District. Quality of visitor experience would drop, resulting in lower occupancy and a decrease in economic viability.

7.4 Alternative 4 - Golf and Residential Use Within a Reduced Amendment Area

This alternative would include a full size 18-hole golf course surrounded by residential with less open space and higher density residential lots sited over approximately 200 acres rather than 458 acres of petitioned lands. This would necessitate a land use designation change from Agriculture and Rural to Urban for those portions affected

by the proposal. Amendments to the Lanai Community Plan and Project District would be required should any portions of the golf course fall within its boundaries.

Under this alternative the design of the golf course would be more confined and the density of the residential areas would increase. This could lead to greater impacts upon the historic and archaeological sites within the area, as well as on the aesthetic qualities. Loss of ambiance would detract from the overall visitor experience and result in lower occupancy and adverse socioeconomic impacts.

8. SUMMARY OF UNRESOLVED ISSUES

The project planning has evolved to the point that the majority of issues have been resolved to the satisfaction of the applicant, the state and local agencies, and the community. Ongoing public participation has been formalized through a Memorandum of Agreement between the applicant and the Lanaians for Sensible Growth (a citizens group on Lanai that has taken a lead in expressing the concerns of the Lanai community) and the Office of Hawaiian Affairs.

Issues that should be noted however that apply to this action are:

The alignment of the extended Manele Road in relation to the multi-family residences in the project district and throughout the amendment area has not been fixed because it is a decision that must be made by the State Department of Transportation since the road is within their jurisdiction.

No residential lots within designated residential areas have been delineated in this EIS. The applicant intends to bring forth specific lotting plans and design guidelines for the residential development after the environmental impact statement and mitigation measures are reviewed and approved by the approving agency.

Shoreline setback issues will be resolved during Shoreline Setback Variance processing by Maui County.

In addition, many indirect or long-term social impacts of resort development can almost always be considered "unresolved issues."

9. SUMMARY OF COMPATIBILITY WITH LAND USE PLANS AND POLICIES

A full discussion on how the proposed project fulfills the requirements of State and Local policies is contained in Chapter V. Briefly, the site of the proposed project is designated as Urban, Rural and Agriculture by the State of Hawaii Land Use Commission. The Commission has recently redesignated the golf course portion of the site as Urban. Eventually, reclassifying the remainder of the site to Urban will make it more compatible with the adjacent Lanai Project District 1-Manele.

The applicant has also applied to the County of Maui for an amendment to the Lanai Community Plan and the Lanai Project District 1-Manele boundary. Upon completion of the land use reclassification the project will be fully compatible with the Hawaii State Plan, the Maui County General Plan, and the Lanai Community Plan as outlined in Chapter V.

10. NECESSARY APPROVALS AND PERMITS

This EIS supports the Maui County Project District Boundary Amendment. The following is a listing of major approvals and permits required for the Manele Golf and Golf Residential Project. Other approvals and permits are also required for development to go forth after the following have been obtained.

APPROVAL	APPROVING AGENCY OR BODY
Maui County	
Project District Boundary Amendment	Planning Commission, County Council
Lanai Community Plan Amendment	Planning Commission, County Council
Special Management Area Use Permit	Planning Commission
Shoreline Setback Variance	Planning Commission
Project District Phase II	Planning Commission
Plan Approval, Project District Phase III	Planning Department
Subdivision Approval	Department of Public Works
State of Hawaii	
Land Use District Boundary Reclassification	State Land Use Commission
Historic Sites Review	Dept. of Land and Natural Resources, Historic Preservation Program Division

CHAPTER II

DESCRIPTION OF THE PROPOSED PROJECT

The Lanai Company, Inc, a subsidiary of Castle & Cooke Properties, Inc. which is an wholly-owned subsidiary of Dole Food Co., Inc. (formerly Castle & Cooke, Inc.), proposes to develop a golf course and residential lots as part of the Manele Bay Hotel complex at Manele, Lanai (Figure II-1). The Manele Bay Hotel, located within the Urban Manele Project District, was completed earlier this year and is now operating. A golf course and residential area is planned as part of the resort complex, but they will partially extend outside of the 410-acre Urban Project District. An additional 458 acres are required for the larger single-family residential lots and golf course development. The target markets for the golf course are the visitors who will be staying at either of the two luxury hotels on the island: Manele Bay Hotel or the Lodge at Koele. The project site is identified by Tax Map Key as TMK 4-9-2: por. 1.

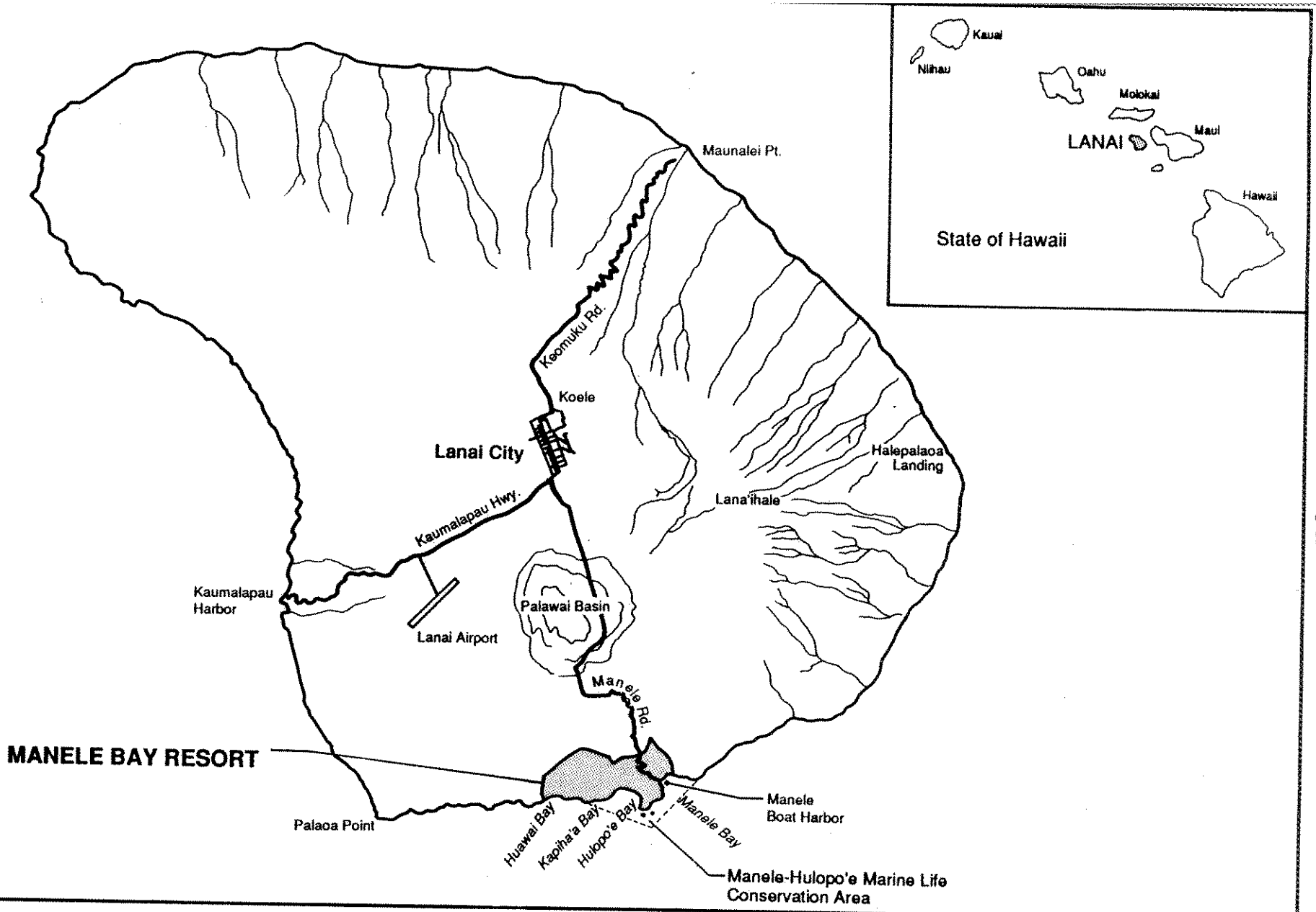
The Lanai Company (hereafter referred to as the "applicant") proposes to obtain necessary reclassifications, permits and approvals for the proposed action through a two-step process whereby the golf course project would be developed first with the reclassification and permits for the residential development being sought at a subsequent time.

The development concept involves multi-family residences, portions of the golf course, some single-family residences, and a commercial area to be constructed within the existing Manele Project District Boundary. In the proposed amendment area, hereafter referred to as the "amendment lands," a portion of the 18-hole golf course, golf clubhouse, and large lot single family residences would be constructed.

This environmental impact statement has been prepared to describe the potential direct and indirect impacts and cumulative effects that could result from the proposed development of golf and residential use with regard to the entire Manele Resort development and other development proposed for the island of Lanai. In addition, this EIS describes the effect of the proposal on the County of Maui and State of Hawaii plans and policies.

1. PROPOSED GOVERNMENT ACTION

Lanai Company, Inc. is currently seeking the Manele Project District boundary amendment and Lanai Community Plan amendment to allow development of a golf course in an aesthetically pleasing lower density manner as part of the Manele Bay Resort complex. Permitted development within the existing Project District includes hotel, commercial, residential, and park of which hotel and park improvements have already been constructed. The amendment lands would be developed as residential lots, a driving range and golf clubhouse, and 15 holes of an 18-hole golf course.



MANELE GOLF COURSE AND
GOLF RESIDENTIAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
For: Lanai Co., Inc.
By: Belt Collins & Associates November 1990

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NORTH

FIGURE II-1
REGIONAL MAP

Through a series of formal State redistricting and County amendment actions and the subsequent hearings and informal meetings with the County officials and community groups (see Section 3, Project Background), a two-step approval process has been agreed upon for the project development:

- Obtain the necessary reclassifications, permits and approval for and develop the Manele Golf Course Project

- Obtain the necessary reclassifications and permits and approvals for the Manele Residential Project

Manele Golf Development

The necessary permits and approvals for the development of the Manele Golf Development would be obtained first and the golf course and clubhouse construction initiated.

From the County of Maui, the proposed golf development would require an amendment to the Lanai Community Plan to address the amendment of the Lanai Project District 1-Manele to expand it by 139 acres (Figure II-1). In addition, the amendment would include golf use within the Lanai Project District 1-Manele permitted uses.

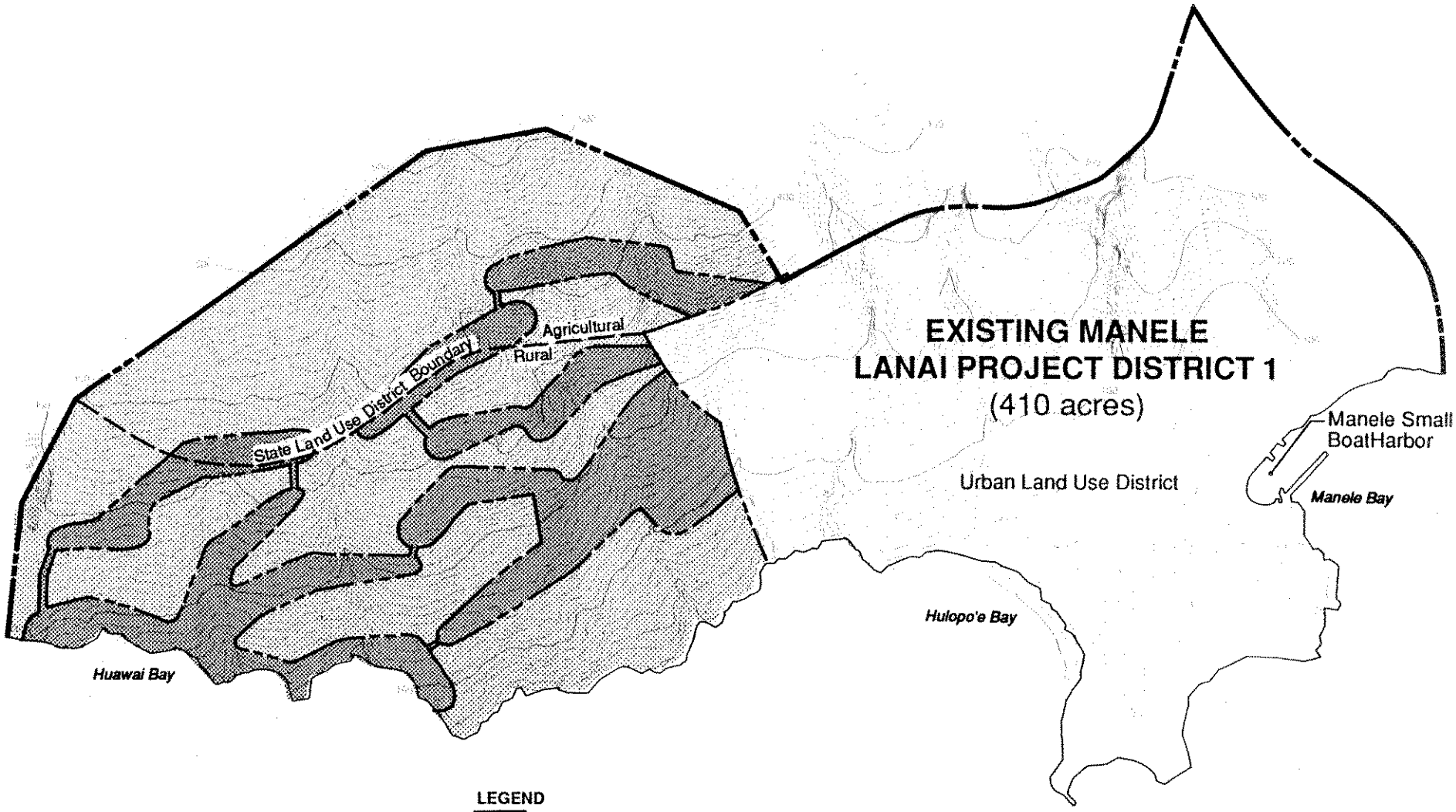
The County of Maui's response to the environmental assessment prepared in 1989 and included in the applicant's petition to amend the Land Use District Boundary (State of Hawaii, Land Use Commission, Docket No. A89-649, 1989) was that the proposed addition of the golf use within the project district did not in itself warrant an environmental impact statement (EIS) pursuant to Chapter 343, Hawaii Revised Statutes.

The development of golf outside of the existing Project District Boundary requires appropriate State Land Use designation pursuant to the State of Hawaii Land Use Law (1961). Recently, approximately 111 acres in the Rural district and 28 acres in the Agricultural district were redesignated Urban (Figure II-3).

Residential Development

Subsequent to Maui County's above response that the addition of a golf course within the project district does not in itself warrant the preparation of an EIS, the Maui Planning Commission issued a Notice of Determination requiring the preparation of an EIS. As agreed to by the parties of the Memorandum of Agreement (MOA) (see Appendix K), the EIS is to be a cumulative EIS on the Manele golf development and residential development.

Following submission, review and acceptance of a cumulative EIS addressing potential specific and cumulative impacts of the golf and residential projects, the second step in the approval process would be to obtain the necessary reclassifications, permits



LEGEND

	Manele Residential Amendment Area*	319 ac.
	Manele Golf Course Amendment Area*	139 ac.
	Total	458 ac.

* Golf Course area redesignated to Urban since publication of Draft EIS.

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By: Belt Collins & Associates May 1991

NORTH

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SCALE IN FEET

FIGURE II-2
LANAI PROJECT DISTRICT 1—MANELE AND PROPOSED AMENDMENT LANDS

and approvals for the development of the residential subdivision surrounding the golf course.

The proposed residential development would require an amendment to the Lanai Community Plan to address the amendment of the Lanai Project District 1-Manele to expand it by 319 acres within the land currently zoned agricultural.

The State of Hawaii LUD change involves the redesignation of 319 acres of land for purposes of the residential development. Approximately 174 acres in the Rural district and 145 acres in the Agricultural District would be redesignated to Urban LUD (Figure II-3).

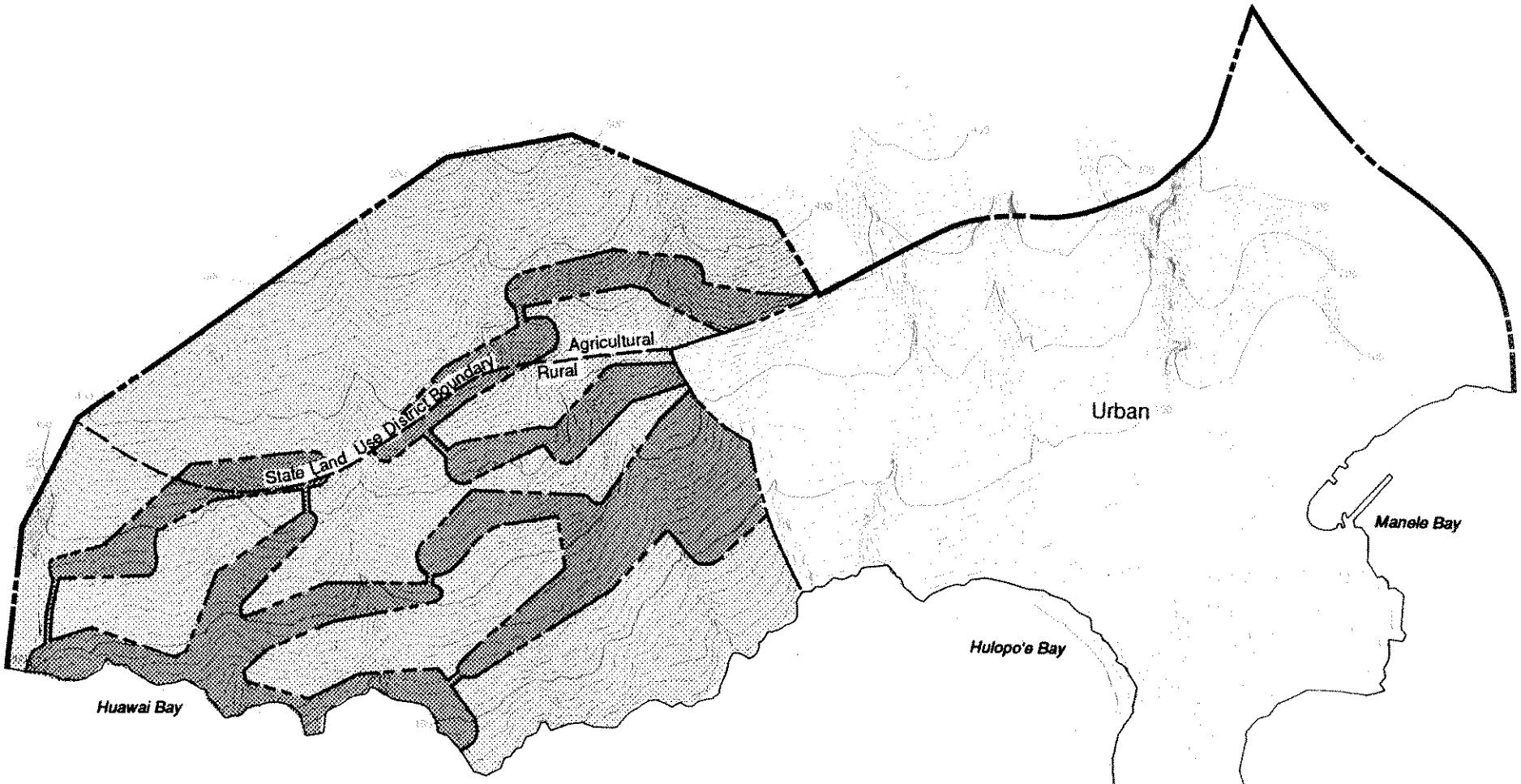
2. REGIONAL SETTING

The island of Lanai, a 89,280-acre island on the leeward side of Maui, is accessible by air, barge service, or tour boat from other Hawaiian islands. Approximately 98% of the island is owned by Dole Food Co., Inc. Most recently, it has been used for pineapple production, thus it is known locally as the "Pineapple Isle." Lanai City serves as the town and population center of the island. It is centrally located on the island approximately four miles from the Lanai airport, the island's only air transportation facility. The only other resort area on the island, the Koele Resort, lies approximately one mile northeast of Lanai City in the Koele Project District. The Lodge at Koele provides luxury accommodations for visitors to Lanai. An 18-hole world class golf course is under construction upland from the Lodge at Koele.

Lanai City is approximately eight miles north of the Manele Bay Resort and golf course project site and is the island's principal population and commercial center. Access to the Manele Bay Resort is by way of Highway 440, the Manele Road, from Lanai City and along the Kaupili Road from the airport.

The Manele Bay Resort site is located on the Hulopoe Bay just west of Manele Bay on the southern coast of Lanai (Figure II-1). Most of the property (TMK 4-9-2: portion 1) is within the Urban Lanai Project District 1-Manele as established in the Lanai Community Plan and through the Maui County Code (CH 190.70). The proposed Manele Golf Course and Golf Residential Project site includes the existing project district (410 acres) as well as 285 acres of Rural (State Land Use District) coastal land west of Hulopoe Bay and 173 acres of Agricultural lands mauka of the Rural land (Figure II-3). The proposed project extends west from the Manele Bay Hotel approximately 1.2 miles to Huawai Bay and mauka to approximately a 500-foot elevation contour.

Waters and shorelines within the Manele and Hulopoe Bays fall within the Manele-Hulopoe Marine Life Conservation Area. The Manele Bay Hotel property fronts Hulopoe Bay and extends to the Manele access road. The Manele Golf Course and Golf Residential Project site lies mauka and to the west of the existing hotel site and hotel expansion area now being used for a plant nursery and temporary lodging for construction workers.



LEGEND

Petition Lands	Ag to Urban	Rural to Urban	Total
Golf Course Development*	28 ac.	111 ac.	139 ac.
Residential Development**	145 ac.	174 ac.	319 ac.
		Total	458 ac.

*Golf Course area redesignated to State Urban since publication of Draft EIS.
**Includes Open areas not in Golf.

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SCALE IN FEET

FIGURE II-3
EXISTING STATE LAND USE DISTRICTS AND PROPOSED REDISTRICTING

3. SCOPE OF THIS ENVIRONMENTAL IMPACT STATEMENT (EIS)

This EIS evaluates the potential direct and indirect effects of the proposed golf and residential development on the surrounding environment. Evaluation of the direct and indirect environmental impacts of the Manele Bay Hotel and other developments planned for Lanai is not a part of this scope. Any discussion of these issues is to provide a context for the golf course and residential proposal.

In addition, this EIS:

- describes the potential cumulative impact of this additional development in relation to the other developments proposed for Lanai
- addresses the measures that the proponent has taken during the planning of this project to avoid or otherwise mitigate impacts on the environment and the community
- includes other mitigation measures that would be performed during the construction and operation phases of the project

4. PROJECT BACKGROUND

Manele Golf Course and Golf Residential Project is designed to add a new dimension to the existing resort while adhering to the guidelines developed in the Lanai Community Plan and Project District Ordinance. The Lanai Company wants to provide facilities and amenities which are of world class quality and at the same time sensitive to the natural environment and surrounding community.

County of Maui Community Planning Process

In an effort to implement the Lanai Community Plan as mandated by the Charter of Maui County (1977) and the Maui County General Plan (adopted June 24, 1980 as Ordinance No. 1052), Lanai Project Districts 1 and 2 were established at Manele and Koele, respectively, through the Maui County Code. In recent history, the island of Lanai has been used almost exclusively for pineapple production. The purpose of the project districts was to allow for the establishment of two low-density resort-residential developments that would provide Lanaians with another economic base. A variety of permitted uses within these project districts include revenue producing uses such as commercial, hotel, residential, and recreation.

Resort Development Planned for Lanai

In 1988, the Lanai Company broke ground for the Lodge at Koele in the upland rural setting of Koele, Lanai. Soon thereafter, plans for the Manele Bay Hotel were completed and the hotel construction was approved. The recently completed Manele Bay Hotel provides a 250-room hotel (with area for an additional 150 rooms), tennis courts, improved recreation facilities at Hulopoe Beach Park, and dining facilities.

Market studies prepared for the resort and golf course developments on Lanai indicated that the success of the resort depended upon the availability of the associated golf amenity (Peat Marwick & Associates, 1989; Robert Charles Lesser & Co., letter dated March 6, 1990). Consequently, the Lanai Company started to plan for the golf and resort-residential development as part of the Manele Bay Resort complex.

State of Hawaii Land Use Redistricting

Pursuant to the State of Hawaii Land Use Law, in November 1989, the Lanai Resort Partners ("Petitioner") petitioned the State of Hawaii to amend the Land Use Districts in the project area. The petition called for the redesignation of 285 acres of Rural to Urban and 173 acres of Agricultural to Urban. The first State Land Use Commission (LUC) hearing on the project occurred in March 1990 with subsequent hearings in July and August 1990. An environmental assessment (EA) was prepared by M&E Pacific Engineering for inclusion in the LUC petition. The information in this EA, the subsequent exhibits, and testimony at the LUC hearings are included by reference in this EIS.

The Lanai Company has recently obtained redesignation of portions of the Rural and Agricultural district to the Urban district to permit golf development. Further, the redesignation of some of the Agricultural land and Rural land to Urban will be required to allow development of the single-family residences.

The land use district (LUD) change involved the redesignation of approximately 139 acres of land to Urban LUD for purposes of the golf course and clubhouse development. Approximately 110 acres in the Rural district and 28 acres in the Agricultural district are now designated Urban (Figure II-3).

For purposes of residential development, the applicant intends to petition for the redesignation of 319 acres of land at a subsequent time. Approximately 174 acres in the Rural district and 145 acres in the Agricultural District would be redesignated to Urban LUD (Figure II-3).

County of Maui - Community Plan and Project District Boundary Amendment Process

On November 30, 1989, the Lanai Company submitted an application to the County of Maui for a Community Plan Amendment and Project District Boundary Amendment for the following reasons, as stated in their "Application for Community Plan and Project District Amendment":

To expand the area to permit the construction of an 18-hole golf course with associated facilities such as a clubhouse and practice area. In a resort complex such as this, it is essential to have a golf amenity available to provide an opportunity for the project to be successful.

The County of Maui Planning Department response to the application was that the addition of golf use to the project district was permitted without the acceptance of an EIS. They decided, however, that the issues of historic and archaeological preservation and the impact of residential development outside of the project district boundary

were potentially significant and that an EIS, pursuant to Chapter 343, Hawaii Revised Statutes, should be prepared for the proposed action.

5. DEVELOPMENT CONCEPT

Lanai Company intends to develop a golf course and integrated residential project as an essential part of the Manele Bay Hotel Complex. This would include an 18-hole world class golf course, driving range and clubhouse, 325 single family residential lots and 100 multi-family units, a few commercial establishments, public access, and shoreline park improvements (Figure II-4).

The specific low-rise, low-density character of the Manele Hotel will be maintained in the residential area, with land portions heavily vegetated to blend in with surrounding development. Public pedestrian access will be provided along the shoreline and Hulopoe Bay, as well as around the commercial activities at the hotel which will be available to resort visitors as well as the general public.

6. STATEMENT OF OBJECTIVES

Manele Bay Hotel and Resort is one of two major destination resorts on Lanai that were recommended through the county planning process in the Lanai Community Plan (1983) and Project District Ordinance (Maui County Code, CHS 19.70 and 19.71). The Koele Resort, a 102-room country lodge (with expansion planned to 250 rooms) with golf, tennis, lawn bowling, miniature golf, picnicking, and horseback riding amenities has been developed in the Lanai Project District 2 in Koele near Lanai City. The Manele Bay Hotel and Resort (with 250 rooms with expansion to 400 rooms) including golf, beach park, tennis, water sports, and residential use is planned to promote the visitor industry and to provide direct and indirect employment for Lanai residents.

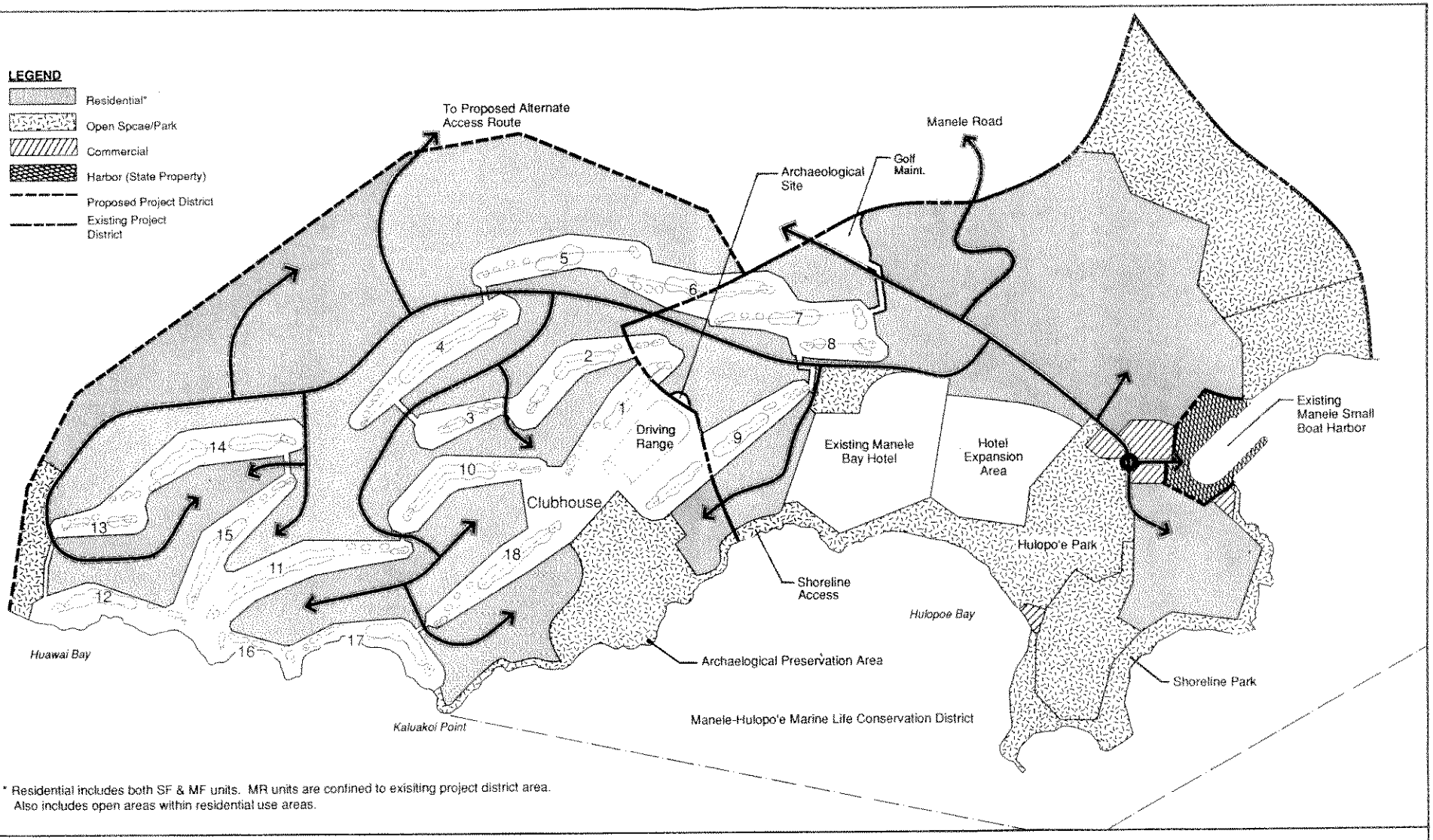
The Manele Golf Course and Golf Residential Project (Figure II-4) plays a specific role in the development of the Manele Bay Resort. In developing the golf course and residential units, Lanai Company, Inc. hopes to attain several major objectives:

- Further the mission of the Manele Project District as set forth in the 1983 Lanai Community Plan and codified in the Maui County Project District Ordinance (Maui County Code Chapter 19.70)

- Add an amenity which will be an integral part of the Manele Bay Resort, compatible with the resort's character: low density and designed for maintenance of environmental integrity

- Add a new recreational dimension which is essential for the resort's competitive market position

- Add a distinct, low density residential product to those already permitted in the resort complex



* Residential includes both SF & MF units. MR units are confined to exisiting project district area. Also includes open areas within residential use areas.

MANELE GOLF COURSE AND GOLF RESIDENTIAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
For: Lanai Co., Inc.
By: Belt Collins & Associates July 1991

North

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Scale in Feet

FIGURE II-4
DEVELOPMENT CONCEPT

- Create an attractive project that is accessible to the public as a golf course, park/community center and commercial center for the island.

7. NEED FOR THE PROJECT

The proposed golf course, designed by Jack Nicklaus Golf Services, is essential for the success of the Manele Bay Hotel development, given the competitive State of Hawaii, national and international markets. The recreational opportunities for visitors as well as the environmental setting of the Manele Bay Hotel development would be enhanced by the proposed golf course development. The proposed golf course development would provide both direct and indirect employment to residents of Lanai (Robert Charles Lesser & Co., letter dated March 6, 1990). A key element in the overall success of the resort is the residential component.

Market assessments for golf developments (Peat Marwick & Associates) and for resort residential development (Robert Charles Lesser & Co.) on Lanai acknowledge that the island of Lanai's visitor destination potential is as yet untapped. The island has sufficient attributes and attractions to emerge as the newest of the state's luxury resort destinations and to be competitive in a worldwide resort market. Key attractions of the island that are mentioned in the market assessments are Lanai's isolated yet easily accessible location; its friendly close-knit community; its extraordinary beaches and diverse mix of other physical attractions and recreational opportunities; its rural and relatively undeveloped nature; and its high degree of consolidation under a single private owner.

Visitors to Lanai are expected to be similar to those at other neighbor island luxury resorts with most being affluent individuals seeking a private exclusive retreat with a high level of personalized services and varied recreational opportunities. According to the market assessments, affluent and older guests (the guest mix expected at the two Lanai resorts) have a higher propensity to golf at luxury high-personal service hotels than at resorts which attract budget or group visitors.

The demand for golf at the two Lanai resort courses is based upon the projected daily overnight resort population, estimated to range from 340 in 1991 to 1,440 in 2000. The total non-resort population would consist of hotel guests, and visitors and residents of the multi-family units and single-family residences planned at the two resorts. A market analysis prepared by the applicant projects that occupancy rates for the two luxury hotels (without the Manele golf course) would range from 35 percent in 1991 to 55 percent in 2010 at the Lodge at Koele, and from 20 percent in 1991 to 40-50 percent in 2010 at the Manele Bay Hotel.

Luxury resort hotel guests play an average of 15 rounds per day per 100 guests. Based upon rounds of golf played at comparable resorts, the projection is for the following:

- Resort hotel guests--the rate of play is estimated at 18 rounds per day per 100 guests at the Lodge at Koele, and at 23 rounds per day per 100 guests at the Manele Bay Hotel (based on the Hotel being expanded to 400 rooms)

- Resort multi-family guests and residents--the rate of play is expected to stabilize at 14 rounds per day per 100 guests

- Resort single-family guests and residents--the rate of play is expected to stabilize at 11 rounds per day per 100 guests

- Nonpaying guests--complimentary rounds are expected to remain constant at about 4% of the total rounds played.

Based on the assumptions above, the demand for golf rounds would range from 70 rounds per day in 1991 to 260 rounds per day in 2000. (For comparison purposes the average daily rounds on representative courses range from 85 to 225 with an average of 147 rounds per day.) Total golf rounds per year would increase from 21,900 rounds in 1991 to 94,000 in 2000. The market share for each proposed golf course has not been determined for this analysis but the calculation would depend on the following factors:

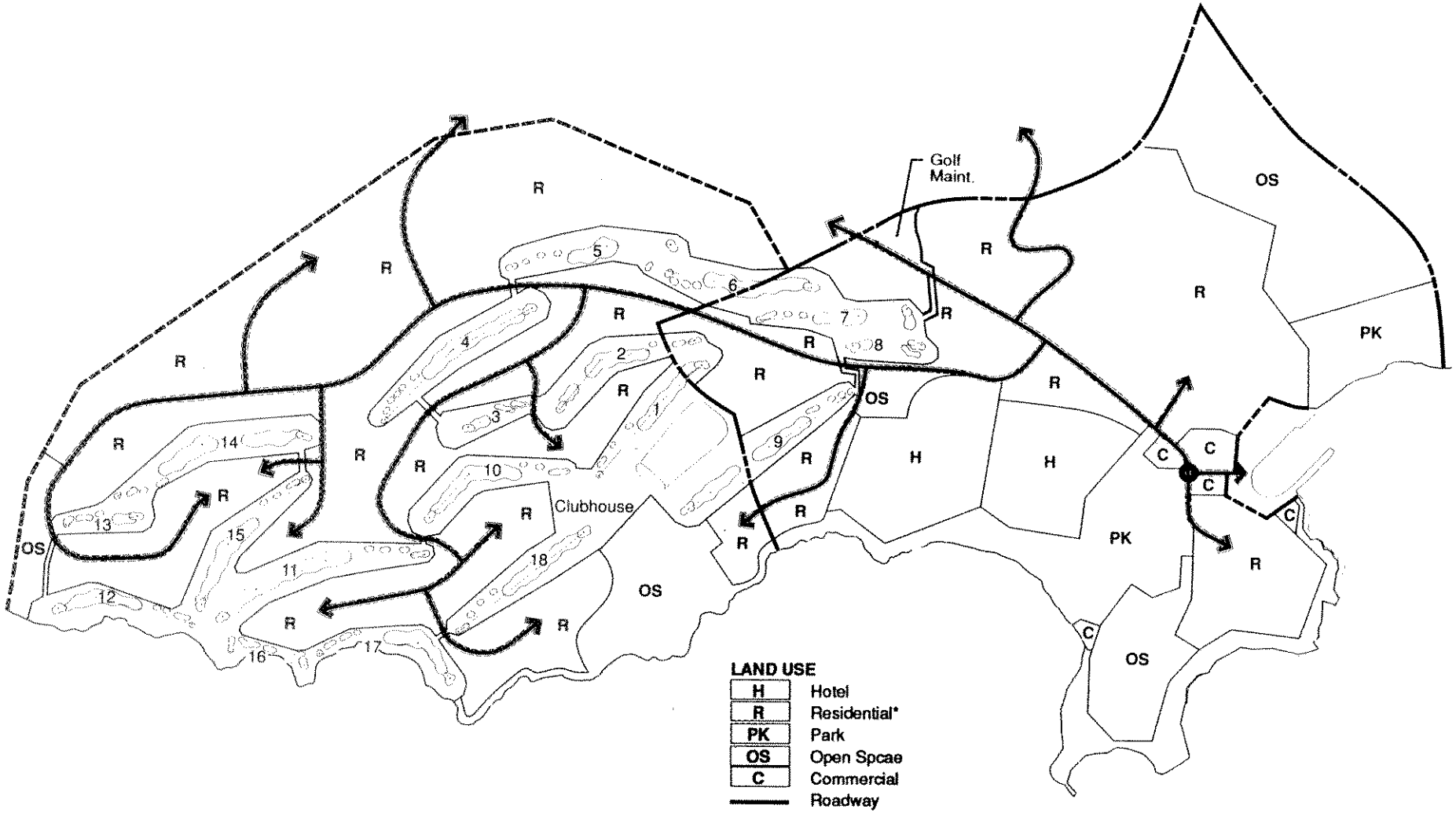
There are 61 resort, municipal, daily fee, private and military golf courses in the state. Of these, 21 are on Oahu, seven on Maui, five on Kauai, six on Hawaii, and one on Molokai. At least 19 new resort golf courses, additions or expansions are proposed for development in the State: seven on Oahu, three 18-hole and two 9-hole courses on Maui, two 18-hole and two 9-hole courses on Kauai and three 18-hole courses on Hawaii.

The supply of golf rounds at the two golf courses proposed for Lanai (Koele and Manele) are anticipated to grow from 100 rounds in 1991, when the Koele course is scheduled to open, to 220 rounds in 1992 when the Manele course is scheduled to open. Golf rounds are expected to stabilize at 260 rounds by 1999, meeting the demand for 260 rounds in 2000 (Peat Marwick & Associates, 1990).

Based on current resort green and cart fees and the design plans for the Koele and Manele courses, the published green and cart fees at the courses are estimated to average $80 per round for the Jack Nicklaus course at Manele.

8. PROJECT DESCRIPTION

The following sections describe the various components and the various uses and activities of the Manele Golf Course and Golf Residential Project (Proposed Action). The land use changes within the Manele Resort are shown in Figure II-5, Manele Resort Master Plan, and outlined in Table II-1, Land Use Summary for Manele Golf and Golf Residential Project. Please note Table II-1 summarizes both the land use "modifications" within the "existing" Project District as well as the land uses in the "Amendment Area" to yield the total area of each land use under the "Proposed Action." Specific project elements that are described below are shown in Figure II-4, Development Concept.



MANELE GOLF COURSE AND
GOLF RESIDENTIAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
For: Lanai Co., Inc.
By: Belt Collins & Associates July 1991

North

0 600 1200
Scale in Feet

FIGURE II-5
MANELE RESORT MASTER PLAN
LAND USE SUMMARY

8.1 Golf Course and Clubhouse

The 172-acre golf course (139 acres of which are within the amendment area) will be developed in the open space west and mauka of the existing hotel to include 18 holes of championship golf, a practice driving range, and a clubhouse adjacent to the driving range. The open space for golf will be configured to take advantage of the terrain, views, shoreline, and natural features. Holes 7, 8 and portions of 1, 2, 6 and 9 would fall within the west end of the existing Project District. The golf course is based on the "target course" concept whereby the total irrigated acreage is limited by leaving some areas between tees and fairways in natural grasses. Less than 100 acres will require irrigation.

The clubhouse and driving range will be central to the course and single family residences will be interspersed primarily mauka of the fairways. The golf course will be semi-private and will be open to the public. Residents of the Koele Resort will be permitted to use the golf course.

TABLE II-1
LAND USE SUMMARY (ACRES)

	Lanai Project District 1		Amendment	Proposed
	Existing	Modified	Area	Action
Residential	137.00	121.00	258.00	379.00
Multi-Family	18.60	30.00	0	30.00
Commercial	5.25	5.25	0	5.25
Hotel	50.00	50.00	0	50.00
Park	66.33	66.33	0	66.33
Open Space (excluding Golf)	113.91	87.42	46.00	133.42
Golf	0	33.00	139.00	172.00
Public (WWTP)	4.25	0	0	0
Roads/Other	14.66	17.00	15.00	32.00
Total	410.00	410.00	458.00	868.00

Note: This table is different from that shown in the Draft EIS. The golf course layout has since been revised and the number of acres in "Open Space" and "Golf" have changed. There is a decreased acreage in Golf, from 201 to 172 acres, and an increase in Open Space, from 104.42 to 133.42 acres. These numbers reflect an increase in Open Space in both the "Modified Lanai Project District 1" and "Amendment Area" categories. At the same time they reflect a decrease in Golf in both of the same categories.

Public access will be protected through the dedication of a public easement from Hulopoe Bay to the westernmost boundary of the project area that will allow public pedestrian access along the accessible cliff coastline in perpetuity. As set out in the MOA (see Appendix K), the setback zone will be 50 feet from the edge of the cliff along the accessible cliff coastline except along "signature hole" 16. The area within 75 feet from the cliff edge will remain in its natural state except with respect to holes 12, 16 and 17. Vertical improvements will be prohibited within 150 feet of the cliff edge. Final setback decisions will be made during the Shoreline Setback Variance process.

8.2 Residential Development

The applicant plans 425 resort-residential lots/units consisting of 325 single-family residences and 100 multi-family units. The single family residences are planned as vacation or second homes and will be primarily mauka of the fairways with lots interspersed, and in the project district area mauka of the Manele Small Boat Harbor and east of Manele Road. Each of the single-family homes will have full or partial ocean views.

The total density of the single-family residential use will decrease; although the total number of units will increase by nine. Four hundred sixteen residential units are currently authorized under the existing Project District Ordinance 1578 of the County of Maui. As originally established, the project district 416 residential units were to be comprised of 342 single-family homes over 137 acres (i.e., 2.5 units per acre) and 74 multi-family homes over 18.60 acres (i.e., 4 units per acre). Under the proposed amendment, the 425 residential units would be comprised of 325 single-family homes over 379 acres (i.e., less than one (0.85) units per acre) and 100 multi-family units over 30.00 acres of land (i.e., 3.3 units per acre).

The multi-family residences were planned as part of the Manele Bay Hotel complex; however, the siting of the condominiums will be decided later. At this time, some of lots are planned adjacent to the hotel property in order to take advantage of the hotel services. Other units are planned near the Manele Small Boat Harbor. All multi-family units fall within the existing project district boundary.

The value for a residential lot is projected to range from $780,000 to $3 million based on the price that the market will bear when the units are constructed. The multi-family units are projected to begin at $800,000. The actual sales price of these properties would vary depending on the final site configuration and other factors that affect value at the time that the units are available for sale. Total residential development value, based on a maximum of 325 single family and 100 multi-family residences, would be $300 million to $700 million.

8.3 Park and Open Space

Hulopoe Beach Park (66.33 acres) is an existing recreational amenity for the public that under this proposal would remain in the existing location between the hotel and the Manele Road and residential lots. The development concept includes improvements to access, parking, restrooms, and addition of a water safety kiosk in this park. Other park areas along the shoreline at Manele Bay will remain in their existing condition.

The open space in the proposed project that is not used for golf would be reconfigured to take advantage of the terrain, views, shoreline, and natural features. Archaeological features would be preserved within the open space (Figure II-5).

8.4 Commercial

The commercial establishments will be adjacent to the Manele Bay Small Boat Harbor and adjacent to the park overlooking Hulopoe Bay as proposed in the existing Project District. Only small resort type retail shops and eating establishments are planned at this time and the facilities will be designed to comply with the Lanai Project District guidelines and complement the resort design.

8.5 Circulation and Access

Vehicular access to the resort and golf course will be primarily through Manele Road, Highway 440. The major resort entrance road will branch off to the right from the existing road which continues past Hulopoe Beach Park and ends at Manele Boat Harbor. The branch road will be extended past the hotel and traverse the golf and residential development to its west end (Figure II-5).

The main branch road from Manele Road will be the principal egress and ingress to the residences. An alternative access route from the Lanai Airport has been evaluated by the State Department of Transportation which could replace Manele Road as the primary access to the project if it is constructed. This alternate access route would provide safer and more direct access to the Manele Hotel and residential area. However, under this EIS, the primary access and circulation is evaluated using Manele Road as the singular egress and ingress.

8.6 Shoreline Improvements

The existing Hulopoe Beach Park and coastal trail would essentially be maintained in open space with some improvements to enhance the physical setting and to improve public usage and safety. Public access will be protected along the accessible cliff coastline.

According to the agreement between the applicant, and the Lanaians for Sensible Growth, a Hawaii non-profit organization, and the Office of Hawaiian Affairs, public access will be protected through the dedication of a "public easement from Hulopoe Bay to the intersection of the coastline with the westernmost boundary of the project area which will allow public pedestrian access in perpetuity without obstruction or interference of such use, subject to reasonable rules and regulations for public safety..." (October 10, 1990). This shoreline setback easement is described in Section 8.1 above.

Mauka pathways which would tie into the golf course pathways would be provided to provide alternate access routes to the coastline trail.

Archaeological resources along the shoreline that provide good examples of cultural sites will be preserved and have interpretive displays. The signs will provide recreationists with information about the cultural features.

Improvements for Hulopoe Beach Park, as a part of the Manele Bay Hotel project, include new restroom facilities, picnic tables, trash receptacles, improved loop access road, water safety kiosk, lighting, and landscaping in and around the public use areas.

8.7 Project Schedule and Construction Cost

The proposed development schedule for the Manele Golf Course and Golf Residential Project is shown in Table II-2. The golf course, clubhouse, and driving range are projected for completion in 1992/1993. The opening date depends upon the approval and regulatory process and constructability of the site.

The first increment of the single-family residences (i.e. those planned within the existing project district) could be ready for sale within twelve months of the opening of the golf course. The multi-family units would be available sometime in between the golf opening and the availability of the first single-family homes. The residences would be constructed in increments and the others would be available over a five to ten year period depending on the real estate market.

The estimated construction cost for the proposed project is shown in Table II-3. Total construction cost of golf course development is estimated at $30-35 million. The golf course would be $19.4 million, the clubhouse $6 million, the sitework and additional costs, $7.6 million. The construction cost for the infrastructure for residential is estimated at $52.6 million. The cost of community improvements and subsidies provided by Castle & Cooke, Inc. to support the resorts and employees of the resort will amount to over $40 million. Housing construction already in place or authorized is estimated at $50 million (Table II-4). Estimates are based on 1990 dollars.

TABLE II-2

DEVELOPMENT SCHEDULE OF MANELE GOLF COURSE AND GOLF RESIDENTIAL PROJECT

PROJECT	DURATION	COMPLETION
Hotel and Landscaping Hulopoe Beach Park Improvements		Apr 1991
Infrastructure for Golf Course Golf Course and Clubhouse	0.5 yrs.	1991-1992
Infrastructure on Residential	1.5 yrs.	1992
Multi-family Units	1-5 yrs.	1993
Single-Family Homes	5-10 yrs.	1993-2003

TABLE II-3

CONSTRUCTION COST ESTIMATE (1990 dollars)

PROJECT	COST ($M)
Golf Course (18-hole)	19.4
Clubhouse	3.0
Clubhouse Equipment and Furniture	3.0
Sitework and Other (includes landscaping)	7.6
Subtotal Golf Course	33.0

TABLE II-4

CONSTRUCTION COST ESTIMATES FOR COMMUNITY IMPROVEMENTS (1990 dollars)

PROJECT	ESTIMATED COST ($M)
Housing • Lalakoa III • Waialua Multi-Family • Lalakoa Multi-Family • Lanai City Apartments	50.0
Other Subsidies	40.0
Subtotal Improvements	90.0

CHAPTER III

ALTERNATIVES CONSIDERED

1. INTRODUCTION

In compliance with the provisions of Title 11, Department of Health, Chapter 200, Environmental Impact Statement Rules, Section 11-200-17(f), the "known feasible" alternatives to the proposed Manele Bay Golf Course and Golf Residential Project are described in this chapter. Those alternatives which could "reasonably attain the objectives of the action--even though more costly" are described and evaluated. A rigorous exploration and evaluation of the environmental impacts of all reasonable alternative actions, particularly those that might enhance environmental quality or avoid or reduce some or all of the adverse environmental impacts, costs, and risks are included in order not to prematurely foreclose options which might enhance environmental quality or have less detrimental effects. In each case, the analyses have been sufficiently detailed to allow the comparative evaluation of the environmental benefits, costs, and risks of the proposed action and each reasonable alternative.

2. ALTERNATIVES ANALYSIS AND EVALUATION CRITERIA

2.1 Project Goals

In conformance with the applicable rules, the feasible alternatives have been evaluated relative to their capability and/or lack of capability to meet the goals of the proposed project. Those goals are:

(1) A high quality, successful resort development;

(2) A resort development which will be economically successful in terms of long-term operations;

(3) A development that provides a substantial amount of employment opportunities; and,

(4) A development that improves the overall economic and social well-being of the community to the advantage of the region as well as to the developer.

Applicable regulations require that the alternatives considered be evaluated and investigated relative to their ability and capability to meet the proposed project goals and objectives. The alternatives evaluated herein have been considered within the context of Lanai Company's Master Plan for the Lanai Project District 1-Manele, the project goals as stated above, and the project objectives as stated in Chapter II. Further, during the planning and alternatives evaluation process, fundamental planning/design issues and challenges were identified as being:

(1) Provide the greatest feasible visitor satisfaction through:

(a) man-made facilities and amenities which capitalize on, and present, the natural features of the site in an attractive physical environment.

(b) services and programs to provide a pleasing social environment.

(2) Provide a resort that is acceptable to the targeted visitor market and one that can be economically and socially acceptable at a planned level of occupancy.

(3) Provide a resort that incorporates and accommodates existing facilities, uses, site features, and environmental and community concerns.

2.2 Factors Evaluated

The factors that have been used to evaluate the various alternatives are listed below. These factors are interrelated, thereby allowing comparative analyses to be performed. Also, as noted previously, the factors evaluated consider the natural, social, and economic environments of the Lanai Project District 1-Manele, the surrounding community, and, in general, the island of Lanai and the State of Hawaii. No one factor in and of itself is sufficient to determine the viability of any alternative. Rather, all of the factors need to be considered collectively to determine the relative merits of each alternative. Those factors are:

- Density (Number of units per acre)
- Development Costs (Amenities, facilities, and utilities)
- Quality of Visitor Experience
- Total Occupancy
- Total Expenditures
- Community Economic Benefits (Jobs)
- Natural and Social Environmental Impacts (Shoreline access, etc.)
- Project District Development Viability

3. DESCRIPTION OF ALTERNATIVES CONSIDERED

The alternatives evaluated include a wide range of densities, facilities, and amenities, as well as differing social, economic, and natural environmental impacts. Although there may be other configurations, layouts, and combinations of facilities and amenities that could be studied, the alternatives analyzed below cover the spectrum of possibilities and allow the analyses performed to be sufficiently detailed and comprehensive for a comparative evaluation of the environmental benefits, costs, and risks of the proposed project and each reasonable alternative.

3.1 Alternative 1 - Proposed Action

The Lanai Company, Inc., as described in Chapter II, proposes to develop a golf course and residential lots as part of the Manele Bay Hotel complex at Manele, Lanai. The Manele Bay Hotel, located within the Urban Lanai Project District 1-Manele, was completed earlier this year and is now operating. The golf course and residential area will partially extend outside of the 410-acre Urban Project District. An additional 458 acres is required for the larger single-family residential lots and golf course development. The target markets for the golf course are the visitors who will be staying at either of the two luxury hotels on the island: Manele Bay Hotel or the Lodge at Koele.

The preferred alternative necessitates revising portions of the current land use designations in the expansion area by redesignating portions currently in Agriculture to Urban and portions currently in Rural to Urban. In addition, amendments will be needed to the Urban Project District zoning to reconfigure existing residential and open space areas and to allow the inclusion of golf and resort residential as permissible uses under the open space designation.

This proposal allows for the mitigation of potential impacts to historic sites, responds to the natural site features, and creates a greater opportunity for a successful resort. A complete environmental assessment is contained in Chapter IV. In order to achieve a "successful resort," it was determined (after evaluation of the design conditions at Manele) that there is a need for increasing amenity frontage. The changes result in the creation of a low density development that maintains large amounts of open space and scenic views. In addition, golf course related activities provide the additional mix of uses and activities necessary to achieve the critical mass required for economic viability.

Alternative 1 has been judged to be the preferred alternative due to (1) the appropriate mix and sizing of guest accommodations and amenities to be provided; (2) the expected high quality visitor experience that would result from the amenities of hotel rooms, low density multi-family and single-family residential units, commercial shops and services, and recreational facilities throughout the entire Lanai Project District 1-Manele; (3) the appropriate density, i.e., number of hotel rooms, multi-family and single family residential units, commercial shops and services, and recreational and support facilities on the available land; (4) the relatively moderate, adverse or favorable, natural and socioeconomic impacts as compared to other alternatives; and (5) the expected positive economic, guest occupancy, and expenditure impacts.

3.2 Alternative 2 - "No Action"

This alternative would maintain the Manele Urban Project District boundaries at their present locations. No amendments would be sought for rezoning areas currently designated or for allowing golf related activities within the Project District. The hotel and multi-family housing, as well as the open space and park, would be developed but golf would not be included in the plan. Densities for the Project District would be higher than for Alternative 1. The overall environmental impacts to the area would be minimized, but the natural attributes of the area would continue to be underutilized. The ability to improve beach facilities and access, and to manage and preserve the historical and archaeological features of the area would be lost with this alternative.

Market assessments for the project have determined that golf related activities and the low density single family residential units are necessary for the economic viability of the Manele Urban Project District. Under a "no action" scenario, the land owner and resort operator would take measures to minimize annual operating losses due to the overall lack of visitors. Operating facilities, including the hotel, restaurants, and commercial shops, could be radically scaled back or closed given no future prospects for improved operations.

Due to the permanently impaired economic potential associated with this alternative, no additional development would be foreseen in the Project District. This lack of development would have a serious negative impact on the neighboring resort at Koele, and especially on the community of Lanai Island. Economic viability at both the Koele and Manele Resorts is essential to provide the employment opportunities required in light of the current phase-out of pineapple production. A "no action" decision would result in the eventual unemployment of hundreds of current Lanai residents, with the resulting social problems left for mitigation by the public sector (see Chapter IV, Section 5.). This alternative would not meet the project goals and objectives for the developer or for the community.

3.3 Alternative 3 - Golf Use Within Existing Project District Boundary

This alternative would consist of building the proposed golf course entirely within the existing Lanai Project District 1-Manele boundaries. This would necessitate amendments to allow golf related activities as permissible uses within the District and to rezone lands within the area to accommodate the course.

This alternative would provide revenue-making uses, but would severely impact the proposed land available for public open space and residential units. In order to achieve the critical mass of multi-family and single-family units needed for economic viability, densities would need to be increased. Resulting environmental impacts would be the loss of sensitive historic and archaeological areas, loss of scenic views, and smaller than desirable activity areas within the Project District. Environmental impacts to the petitioned lands would be similar to those of the "No Action" Alternative. Quality of visitor experience would drop, resulting in lower occupancy and a decrease in economic viability.

3.4 Alternative 4 - Golf and Residential Use Within a Reduced Amendment Area

This alternative would include a full size 18-hole golf course surrounded by residential lots sited over approximately 200 acres rather than 458 acres of petitioned lands. This would necessitate a land use designation change from Agriculture and Rural to Urban for those portions affected by the proposal. Amendments to the Urban Project District would be required should any portions of the golf course fall within its boundaries.

Under this alternative the design of the golf course would be more confined and the density of the residential areas would be increased. Open space would be less. This alternative would lead to greater impacts upon the historic and archaeological sites within

the area, as well as on the scenic views. Loss of ambiance would detract from the overall visitor experience and result in lower occupancy and adverse socioeconomic impacts.

4. EVALUATION RESULTS

Measured against the overall project goals and objectives, Alternative 1 - Proposed Action satisfies the project goals and objectives and provides the best opportunity to create a "successful resort", one attractive to the target visitor market, containing minimal adverse environmental impacts, and one utilizing and preserving the area's natural and historic features. Through the completion of the golf course and residential development, the community's need for economic opportunities could be satisfied as it would be a major contribution to resolving a primary community barrier towards a healthy, prosperous and growing community.

CHAPTER IV

DESCRIPTION OF THE AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

1. INTRODUCTION

This chapter describes the general and specific physical, natural and social environmental setting, cultural resources, infrastructure, and public facilities serving the proposed project and project vicinity. The Manele Bay Hotel has been completed and Hulopoe Beach Park (Phase I) improvements are under construction; both will be well into operation before the proposed Manele Golf Course and Golf Residential Project (Project) is constructed. Therefore, both the existing setting and the future conditions without the proposed golf and residential project have been evaluated in this EIS. In this way, the probable impacts of golf and residential development alone could be legitimately evaluated separate from the impacts of the Manele Bay Hotel development. Potential impacts are described in terms of direct or indirect and by type (i.e., construction or operational). Cumulative impacts of the development with regard to other developments at Manele and on Lanai are evaluated as appropriate to the factors being evaluated.

Many of the potential adverse environmental impacts to biological, archaeological, and marine resources have been avoided through the design process using sound planning principles. For the remaining impacts, the mitigation measures proposed are of two types: generic and specific. Generic mitigation measures are those where standard actions to reduce or eliminate impacts have already been institutionalized through the County, State or Federal regulations, codes or ordinances. These types of mitigation usually apply to control of construction impacts of soil loss, noise, air quality effects, etc. Specific mitigation actions are included for those potential residual or long-term effects that require monitoring or some kind of compensation for the environmental effect.

The information in this chapter was compiled from field notes and photographs, personal interviews, and from numerous written sources referenced in Chapter I and the references section (Chapter VI) of this EIS. The impact analysis was prepared as an independent evaluation of the current proposal (1990) within the documented setting. References for data sources are cited within the text. Supplemental studies used to prepare this Chapter are included as appendices to the EIS.

2. PHYSICAL ENVIRONMENT

The Project is located on the southern coast of the island of Lanai. Comprising 139.5 square miles, Lanai was formed by a single shield volcano. The shape of the island has retained the classic shield volcano profile, with its highest point, Lanaihale summit, at 3,370 feet above sea level. The Central Plateau, at an elevation of 1,000 to 2,000 feet, is characteristic of the caldera collapse phase of volcanoes and covers about 20 percent of the island interior. Lanai lies in the lee of the West Maui Mountains, which temper the

influence of the predominant northeastern tradewinds, thus reducing the precipitation reaching the island, especially the southern coast (Armstrong, 1983).

Landownership of the island is concentrated (98%) in a single, public company, Castle & Cooke, Inc.

2.1 Geology, Physiography, Soils and Agricultural Potential

2.1.1 Existing Conditions

2.1.1.1 Geology and Physiography

The project site on the southern coast of Lanai lies west of Hulopoe Bay, and stretches about 1.2 miles from the border of the Manele Bay Hotel Development east to Huawai Bay. The project site is located in portions of the Palawai Ahupuaa and the Kealiaapuni Ahupuaa on the southern coast of the island of Lanai and consists of approximately 458 acres of land situated between the Manele Boat Harbor and Huawai Bay. The Palawai Basin is located approximately three miles to the north of the project site. The natural topography of the site is characterized by rugged slopes varying from approximately 10 to 20 percent, with elevations ranging from 200 feet along the shoreline to approximately 620 feet. Four major gulches on the site drain intermittent surface water and cut the terrain from north to south. The construction of the Manele Bay Hotel has required a portion of the natural topography of the surrounding area to be modified by grading. Access to the project site exists only on the east side from Manele Road and the Manele Bay Hotel area.

The project site is located on the lava flow from the crater remnants that form the headland of the southwest Manele Bay. The site is composed of *aa* lava flows containing tholeiitic basalt, olivine tholeiitic basalt, and picritic tholeiitic basalt, estimated to be between 700,000 and 1.46 million years old (Decker, et al., 1987).

There are no sand beaches on the project site; Hulopoe Beach, fronting the Manele Hotel, is the only sand beach near the project area. Generally, the coastline is formed by low sloping cliffs from 15-20 feet high on the east end of the project to vertical cliffs of over 180 feet from Kahipaa Bay to Huawai Bay. There are some boulder beaches in small coves along the shoreline.

2.1.1.2 Soils and Agricultural Potential

Only a portion of the island of Lanai is suitable for agricultural production. Dole Company, a subsidiary of Castle & Cooke, Inc. (parent company now known as Dole Food Co., Inc.), historically operated a large pineapple plantation. At one time, about 16,000 acres, or 18 percent of the total land area produced pineapple, but commercial production is presently being phased out. There are currently 6,597 acres cultivated and 5,637 acres fallow (Lanai Company, 1990). Within two and one-half years, pineapple production may be reduced to approximately 100 acres (or less than one tenth of one percent of the total land area), and targeted for sale to local markets (Honolulu Advertiser, September 6, 1990).

A diversified agricultural program involving 1,046 acres of land used for egg production, pasturage, forage crops, papaya, and organic produce is active and growing on Lanai. There are also cattle, swine, and poultry operations and the total acreage required for these diverse activities is expected to double by 1992 and continue to grow (personal communication, S. Snow, Director of Diversified Agricultural Program, Castle & Cooke, September 1990).

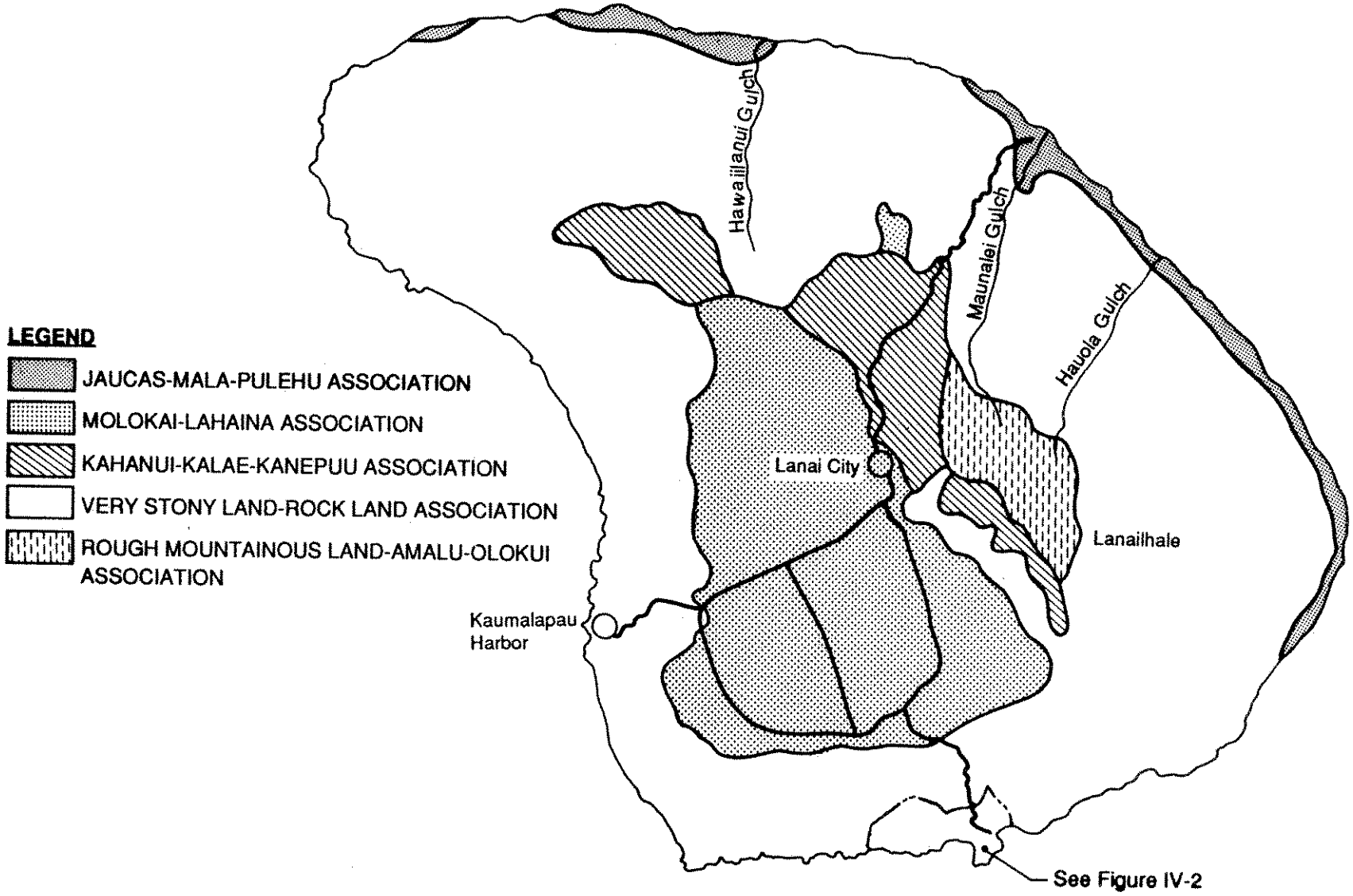
The thinly scattered soil overlay at the project site was created by erosion of volcanic rock along with vegetation encroachment. The Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai and Lanai (Figures IV-1 and IV-2) identifies the soils at the project site as Very Stony Land (rVS) and Rock Land (rRK). The rVS soil association occurs in areas characterized by a surface that is 50 to 90 percent stones and boulders. In general, this land type is found in elevations ranging from sea level to 1,500 feet and where annual rainfall is 10 to 25 inches. On Lanai, the area is underlain by soft, weathered rock and bedrock. A shallow clay-like soil can occur among the stones and boulders in a few places. The rVS land type is often used for homesites, pasture, and wildlife habitat, although pasture improvement is difficult due to the high percentage of stones. The soil capability classification for rVS is VIIs (soils having very severe soil limitations because of unfavorable texture or because they are extremely rocky or stony). Erosion and soil loss is common during storm events. Small portions of soil on the project site are designated Rock Land (rRK), where 25 to 90 percent of the area is exposed rock. Rock Land use is limited to pasture, wildlife habitat, and water supply.

The agricultural potential of the Manele project site is poor; it is unlikely it would ever be used for any of the proposed grazing or cultivation activities under the diversified agriculture program (personal communication, S. Snow, September 1990). The Soil Survey Interpretations (Lanai USDA Report 44) classify the soil in this area as very stony land-rock association overlying weathered volcanic rock. The topsoil layer is 6 to 30 inches thick and composed of dark, reddish-brown soil material containing many stones and boulders. In the gulches, the rock outcrops and stones cover 60 to 90 percent of the surface. The soil is rated E19 and E22 by the Land Study Bureau Detailed Land Classification System (unsuitable for cultivation), and has very poor potential for most agricultural uses, but is suitable for grazing or wildlife habitat (Foote et al., 1972). None of the land within the project site is classified within the Agricultural Lands of Importance to the State of Hawaii (ALISH) system due to its unsuitability for agricultural use.

2.1.2 Probable Impacts

Temporary Impacts

The proposed project is not expected to significantly affect the geology of the project site or area. Grading, excavation, and filling of the project area to prepare for the development of homesites, roadways, infrastructure, and the golf course will alter the natural topography of the site. Since all excavated material will be used on-site, no off-site disposal of excavated material is necessary. Since soils of the project area are extremely rocky and poor quality, gravel (for crushing to sand) and top soil will be imported from elsewhere on the island; thus, the soil quality will be improved and used for turf and landscape plant cultivation. Existing soil erosion activity may be lessened due to increased soil retention caused by additional planting.



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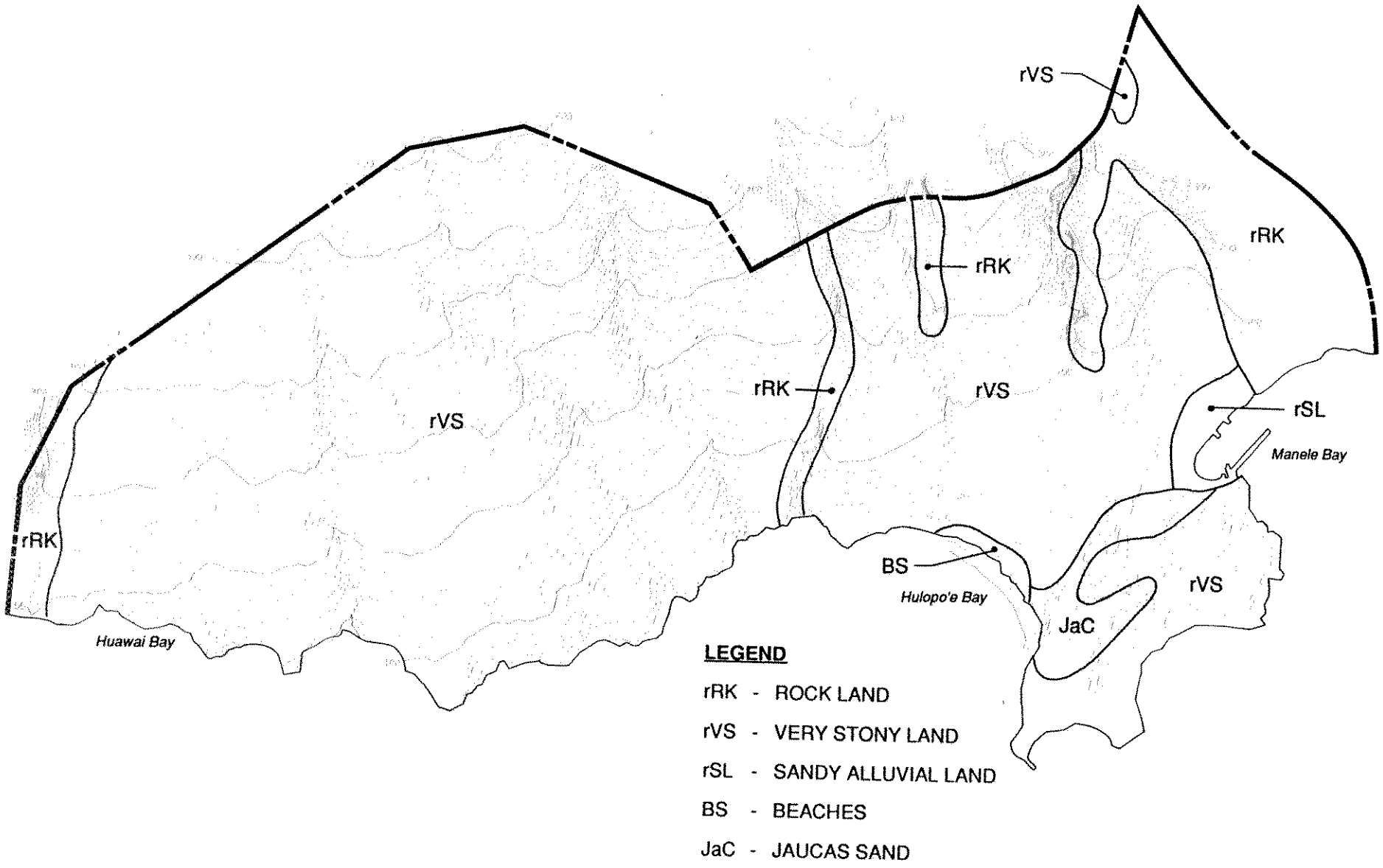
NORTH

0 1 2 3
SCALE IN MILES

FIGURE IV-1
LANAI SOIL DISTRIBUTION



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NORTH

0 400 800 1200
SCALE IN FEET

FIGURE IV-2
SOILS OF THE PROJECT SITE

Long Term Impacts

Development of approximately 458 acres in the amendment area and 170 acres in the Lanai Project District 1-Manele for golf and residential uses would preclude any other use of the land. Given the poor quality of the soil for pasturage or crop production, the impact is not considered to be significant.

2.1.3 Mitigation Measures

Although development of the project is intended to conform to existing contours to avoid site disturbance as well as to take advantage of the mauka-makai view corridor, any clearing and cut and fill activities would be performed in compliance with county, state, and federal design requirements. All soil disposal activities and fill operations would be engineered to assure that stable, buildable sites are created. Appropriate engineering and landscape architecture precautions will be taken with the soils that are excavated and used in other areas within Manele Bay Resort. Also, further archaeological investigation of fill sites will be performed prior to soil disposal.

Potential loss of topsoil through erosion (during construction of the golf course and residential projects) would be mitigated by the following measures:

- Increasing ground cover through landscaping and reforestation of barren areas
- Phasing grading operations to limit amount of soil exposed at one time
- Use of temporary flow and diversion berms when necessary
- Use of sediments basins
- Watering of graded areas during construction
- Dust control by watering and use of proper stockpiling procedures
- Immediate sodding and planting of cut and fill slopes after completion of grading work

2.2 Groundwater and Hydrology

2.2.1 Existing Conditions

Lanai's regional water resources are from two sources: brackish basal groundwater, and water confined by high level dikes, not floating on sea water. Sea water intrusion into the basal lens creates the brackish water reserve. Rainwater collected in high level (to about 1,500 feet) aquifers of east central Lanai is the main source of potable water. This source is composed of many small aquifers, but is treated in this section as a regional aquifer due to hydraulic connections between discrete units.

High Level Aquifer

General assumptions about the amount of water confined in dikes cannot easily be made due to the character of the rainfall in the region and the geologic formations which impact catchment and distribution. However, the high level groundwater underlies an area estimated at approximately 24 square miles (Mink, 1983); this high level water is potable except in the Palawai Basin. The principal recharge zone for high level

groundwater on Lanai is located in a central area of about 4.5 square miles (Figure IV-3). Together with a secondary recharge area of about 9.5 square miles, the recharge area for potable water on the island covers approximately 14 square miles or 11 percent of the total land area. The volume of the system of high level groundwater (prior to development) has been variously estimated at 146 to 100 billion gallons (Mink, 1983; Bowles, 1974). High level groundwater is currently developed on both the windward and leeward sides of the ridge lines of the island. The windward side was first tapped in 1910-1911, while leeward water development occurred after 1945.

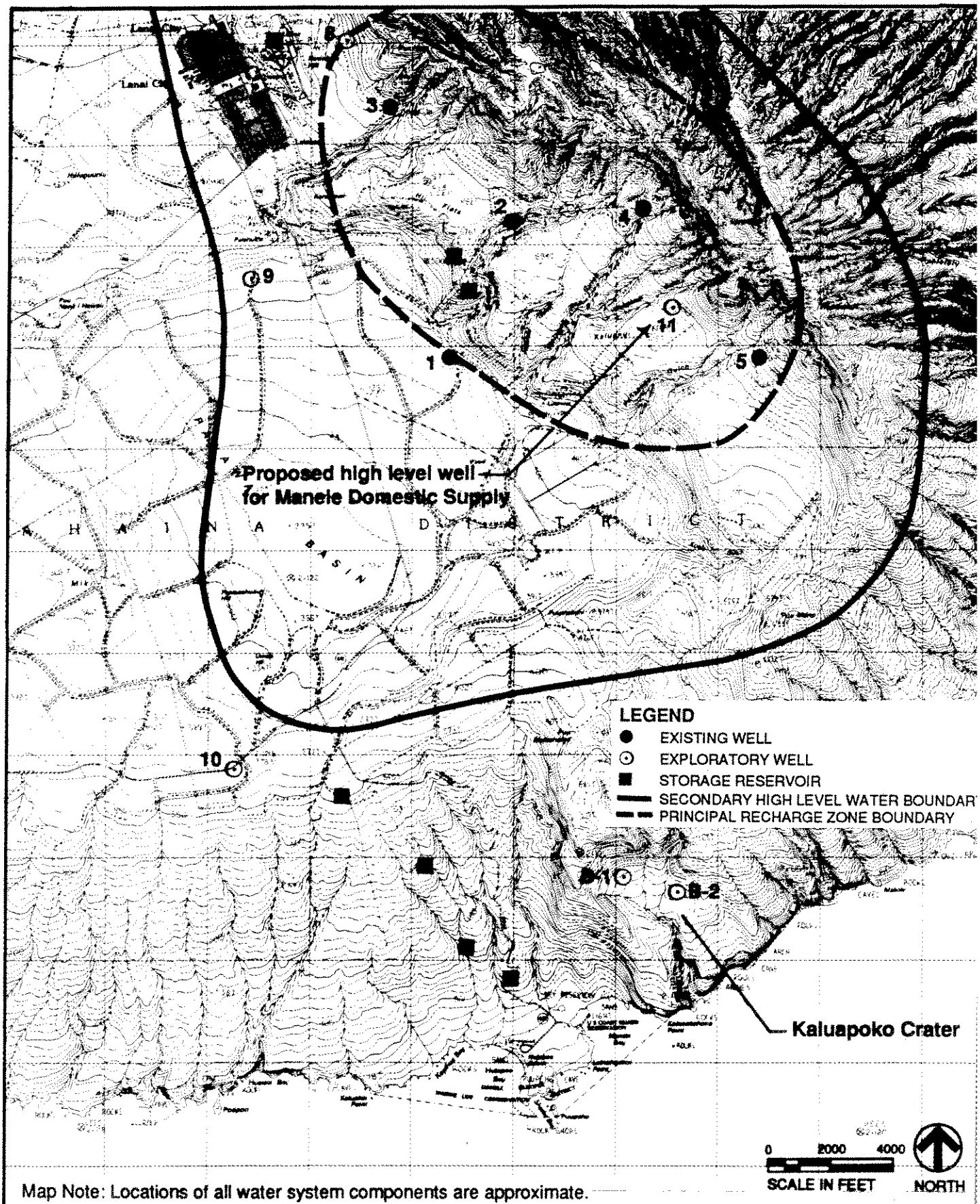
To determine how much water reaches or infiltrates the aquifer requires consideration of rainfall, fog drip, evapotranspiration (water evaporated or used by plants), leakage, and surface runoff. A groundwater recharge rate and recharge area can then be used to estimate sustainable yield, or the island water supply available for human use. Lanai collects about 187 mgd of rain water annually. Of this amount, 124 mgd is estimated to be expended by evapotranspiration, 40 mgd lost in surface runoff, with 23 mgd available for groundwater recharge over the entire island (Armstrong, 1983).

Two comprehensive studies of water resources on Lanai have estimated the sustainable yield at approximately 6 mgd (M & E Pacific, 1989). Using two independent methodologies to arrive at sustainable yield figures, hydrologists Keith Anderson and John Mink arrived at estimates of 6.22 mgd and 6.00, respectively. The complex hydrologic cycles analyzed (recharge area and recharge rate) yielded calculations of the same magnitude and are thus considered reasonable estimates. For purposes of this assessment, 6.00 mgd will be used.

Basal Groundwater

The project site is located over the thin basal lens of brackish water that underlies the coastal perimeter of Lanai. Resistivity analysis suggests that this basal lens is present up to the southwestern edge of the Palawai Basin. Fresh water head is estimated to be less than 1.5 feet above mean sea level. Due to the low head, groundwater pumped within the project site would probably have chloride concentrations which preclude use for any purpose except irrigation of salt tolerant plants. Due to lack of an on-site source of potable water, the increased potable water use created by the project would be met from the high level groundwater source. Cumulative figures for both existing and future requirements for potable water are shown in Table IV-1.

Since the recent works of Mink and Anderson have estimated the sustainable yield for Lanai at approximately 6 mgd, the demand figures in Table IV-1 indicate projected potable water use to be well within estimated sustainable yield. These water demand figures, however, are based on the assumption that no potable water would be used for golf course or landscape irrigation at Manele, that potable water would be required for the diversified agriculture program, and most importantly, that water use for pineapple would cease (any water required for continuation of pineapple is included within the diversified agriculture water demand estimates).



Map Note: Locations of all water system components are approximate.

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FIGURE IV-3
SOUTH LANAI WATER SOURCES- WELLS AND STORAGE

TABLE IV-1

PROJECTED LONG-TERM WATER DEMAND ON LANAI CALCULATED IN 1990

WATER USER	WATER UTILIZATION (mgd) HIGH LEVEL AQUIFER (POTABLE)	ALTERNATIVE SOURCE (NONPOTABLE)
EXISTING:		
Lanai City	0.38	
Dole Plantation	0[1]	.0
IN PROCESS:		
Divers. Agriculture	1.0	
Lalakoa III	0.086	
Koele Hotel	0.04	
Koele Landscaping	0.11	
Lanai City Apts.	0.013	
Lower Wailua	0.072	
Wailua Multi-fam.	0.078	
Other Housing	0.08	
Hulopoe Beach	0.07	
Central Service Facility	0.03	
Comm. Landscaping	0.03	
Koele Golf Course	0.0	0.25
Manele Bay Hotel	0.22	
IN PLANNING:		
Manele Golf Course	0.0	0.80
Manele Club House	0.015	
Commercial	0.05	
Landscaping (Manele)	0.0	0.40
Koele Residential	0.22	
Manele Residential	0.25	
TOTAL	2.74	1.45

Source: Lanai Water Company. Water Management Plan presented to the State Commission on Water Resource Management, November 1990.

[1] Water for pineapple irrigation is included under diversified agriculture.

2.2.2 Probable Impacts

The primary impact of the proposed development is increased water use, mostly for golf course and landscape irrigation. Although development of the proposed project would increase somewhat demand for potable water on the island of Lanai, this new demand appears to be within the present estimated sustainable yield from the high level aquifer providing the existing well system is modified to improve pumpage (see Section 6.4, Water Supply, for more detail). The total estimated potable water use for Manele Golf Course and Golf Residential Project is 0.26 mgd; an additional 1.2 mgd required for golf course and landscape irrigation would be served by alternate sources. Details of the water requirements for the proposed project are shown in Table IV-2. Irrigation water for the golf course does not have to be potable. (The potable water limit for chloride is considered 250 mg\1). With pineapple being phased out as an agricultural land use, it is difficult to quantify the water demand of diversified agriculture. The termination of pineapple as a major crop frees a large portion of the water budget (1.80 mgd) for alternative agricultural uses, and the quantity of variable crop irrigation requirements is presently unknown. However, a conservative estimate of 1.0 mgd is included in this water demand table for estimating purposes (Lanai Water Company, 1990).

Concerns have been raised at the Koele Golf Course about the possibility of leaching of chemical fertilizers or pesticides used on the golf course into the ground water. Several studies have investigated this issue through a number of different methods including simulation experiments (Nicklaus Golf Services, 1990; M & E Pacific, Inc., 1989; Environmental Assessment Company, 1990; Mink, 1983). The possibility of leaching of these materials is slight under the proposed management practices. The maximum application of nitrogen for the proposed golf course is 1 lb. per 1,000 sq. ft. per month. A study evaluating the leaching potential of nitrogen application to sugar crops (about 1/2 pound per month per 1,000 square feet) showed nitrogen leaching resulted in a nitrate concentration in the water of 1.4 mg/l (M & E Pacific, 1990). By direct extrapolation, the potential for leaching at the golf course could be 2.8 mg/l. The actual amount of material leached could be lower because of the ion exchange and nitrogen fixing microflora of the soil as the leachate passes through the soil strata to the basal aquifer. It should be noted that the aquifer beneath the project site is not a potable water aquifer and hence no source of drinking water could be affected. What remains is then the concern about the quality of the groundwater input into clean waters. The amounts of added nitrogen do not point to potential significant impact on offshore waters.

Use of collection sumps, dense turf grass, and soil with proper organic carbon content and particle size distribution influences the leaching process which might contribute to pesticide concentration in the basal lens aquifer. Since these features (along with other surface drainage controls) are part of the proposed golf course design, the impact of pesticides on surface runoff is considered unlikely (see Appendix D, Integrated Management Plan for Manele Golf Course).

The Commission on Water Resource Management, State Department of Land and Natural Resources evaluated the island of Lanai's water resources and decided not to designate it as a water management area. They did instate strict testing and reporting guidelines pursuant to the State Water Code. Under their guidelines, the cumulative effect of current and proposed projects should not exceed 70 percent of the estimated

sustainable yield on the island (i.e., 3.3 mgd). If the water demand begins to approach this value, the Water Commission will re-evaluate their decision.

TABLE IV-2

ESTIMATED WATER DEMAND FOR THE PROPOSED ACTION

PROJECT	WATER DEMAND (mgd) HIGH LEVEL AQUIFER (POTABLE)	ALTERNATIVE SOURCE (NONPOTABLE)
Manele Golf Course	0.0	0.80
Manele Club House	0.015	0.0
Manele Residential	0.25[1]	0.0
Manele Landscaping	0.0	0.40
TOTAL	0.26	1.20

[1] Remains essentially the same with or without the project.

2.2.3 Mitigation Measures

While figures for agricultural water use on Lanai may be uncertain at present, specific actions can be taken to ensure potable water consumption would not exceed projected levels for the Project. Mitigation measures to regulate water demand in the project area include:

- Using alternate water sources for golf course irrigation and other landscape irrigation
- Providing guidelines to homeowners for landscaping features using plants and grasses with low irrigation requirements
- Monitoring consumption, unreasonable use, and leakage from storage and distribution system

2.3 Surface Water and Drainage

2.3.1 Existing Conditions

The project site is covered with aa lava flows characterized by rocky surficial geology and natural, sloping terraces. The project terrain contains a natural mauka-makai drainage system formed by several gulches. Three of these extend about one third of the way up-slope to the Palawai Basin. Two gulches on the east side drain into Kapihaa Bay (which forms a portion of the larger Hulopoe Bay), and the third drains into Kaluakoi

Bay. Just off the west side of the project boundary is a fourth gulch which drains into Huawai Bay. Due to low rainfall and the porous nature of lava with its rapid permeability, surface water drainage is primarily surface runoff. In times of heavy rain, excess water drains through the gulches crossing the property. No perennial streams or surface water supply are found on the island, but the gulches serve as intermittent streambeds on the site.

Some level or gently sloping terraces occur along the slopes and gully edges. Some of these terraces have been modified by early Lanaians for planting in areas where the clay loam exists. These modifications, as well as several habitation sites, are discussed in further detail in Section 4, Archaeology.

Since the annual rainfall on the project site averages 15 inches, high flood events are rare. The U.S. Federal Emergency Management Agency, Federal Insurance Administration has not prepared a flood insurance map of Lanai; therefore, flood hazards are assumed to be low. No floodways or floodzones have been identified or recorded.

2.3.2 Probable Impacts

Temporary Impacts

Temporary impacts affecting surface runoff and drainage are associated with installation of infrastructure and construction of the golf course. Clearing and grubbing, excavation (including blasting), surface grading, and placement of gravel and sand would contribute to increases in soil runoff during heavy rains which may occur before ground cover is adequately established.

Long-Term Impacts

Decreased surface runoff and drainage on the project area due to the establishment of landscaped areas and turf grass surface that are more permeable and with flatter slopes. Some impermeable roadways, rooftops, and driveways would divert surface water runoff into existing drainage facilities or landscaped areas. Surface runoff in these instances could introduce petrochemicals associated with automobiles, as well as chemicals connected to fertilizer and pesticide use, into the basal aquifer or ocean if allowed to percolate through to underlying lava formations. Sumps used for drainage could act as areas where chemicals concentrate. However, any calculations of amount of runoff or chemical percolation or concentration are premature because site layouts and construction schedules have not been finalized. The potential for leaching of pesticides or fertilizers into the groundwater is discussed in Section 3.2, Marine Environment.

2.3.3 Mitigation Measures

As far as possible the natural drainage features of the proposed project area will be maintained, including preservation of swaled runoff and use of culverts across existing ditches and gulches. The contour design plans and internal drainage features of the golf course would increase soil percolation. Some sump drainage is also planned to control drainage. The golf course design includes specific measures for managing surface water and drainage (Nicklaus, 1990). These include:

- Limiting the total number of acres of turf ("target" course)
- Use of more effective irrigation sprinkling heads
- On-site review of the construction process by the designer
- Use of soil types and quantities needed to properly absorb nutrients and water
- Timing the application of fertilizer and pesticides to prevent rainfall and irrigation water from leaching chemicals to underlying bedrock formation
- Golf course has been designed with a "self" (see Nicklaus testimony)

All sites, except those recommended for preservation, will be designed and constructed in full compliance with Maui County Department of Public Works and State Department of Health standards for roadways, drainage and golf course construction. Erosion would be minimized by limiting the soil exposed at any given time, careful design of residential areas, and implementing a comprehensive landscaping program during each stage of development. Management controls such as keeping vehicles on existing access roads and eliminating unnecessary heavy equipment trips, watering, sediment basins, and temporary grassing would also protect the existing soil layer.

Potential adverse impacts from pollutants would be mitigated through use of time release or rapid uptake fertilizers, and the application of EPA- and DOH-approved biocides under the direction of certified applicators. In addition, management practices for the golf course would include use of a sophisticated weather station to control the irrigation system and limit chemical dispersion by closely controlling water requirements.

2.4 Natural Hazards

2.4.1 Existing Conditions

In addition to storms and strong winds, the natural hazards having the greatest potential impact upon the physical character of the proposed site are volcanic eruption, earthquakes, and tsunamis. Flood events in the leeward area are likely to be rare. Flood hazard is discussed in Section 2.3, Surface Water and Drainage.

The Project is located on the southern slope of the Lanai Basalt, midway between two of the three major rift zones on the island. The prehistoric lava flow on which it is situated is estimated to be from 700,000 to 1.46 million years old. There is no evidence of eruptive occurrences during the past 10,000 years (Holocene time). According to information gathered by the United States Geological Survey (USGS) and published in its Professional Paper 1350 (Decker et. al, 1987), the possibility of volcanic eruption is considered minimal due to the age and nature of the shield volcano that formed Lanai.

Earthquakes in the Hawaiian islands are primarily associated with volcanic eruption and magmatic or tectonic movement. Tectonic activity, which causes most earthquakes on continental regions, is not considered frequent in Hawaii, however; the Molokai Fracture Zone, an extension of the fault from the East Pacific Rise in the Gulf of California, intersects the Hawaiian Islands in the area between Molokai and Lanai. This fracture zone is reported to contribute to the seismic activity of the region (Furimoto, 1990). Most major earthquakes are caused by faults, or planes of fracture in rock. When

associated with volcanic activity these faults are called rifts. In the Hawaiian region, some faults are located on volcanos and others lie on the ocean floor near the islands. On the island of Lanai, three major rift zones radiate outward from the center of the collapsed caldera of Palawai Basin.

On February 19, 1871 the epicenter of a major earthquake was located on the island of Lanai. Large portions of cliffs on the western side of the island were reported to have fallen into the sea and rock falls were observed from Manele Bay to Kamaiki Point. However, of the eleven major earthquakes which occurred since 1925, none have originated on Lanai. (Four of these earthquakes originated in ocean faults and seven from faults located on the island of Hawaii). The entire island of Lanai is situated within Seismic Zone 2B, as designated by the International Conference of Building Officials, 1988. This zoning indicates the island is less likely to sustain damage from earthquakes occurring in the area than the island of Hawaii, which is designated as Zone 3. The project site is located three miles south of the Palawai Basin between the southeast and southwest rift zones.

Tsunamis have been observed and recorded on all major islands in the Hawaiian chain. The state of Hawaii is particularly vulnerable to tsunamis originating in the north and southeast Pacific Ocean. The number of tsunamis caused by local earthquakes is small, numbering four in the last one hundred years. The largest of those occurred April 2, 1868, and was reported to have caused a wave runup of 20 meters along the South Puna Coast of the island of Hawaii. Of tsunamis recorded from about 1814 to 1968 only three were reported to have affected Lanai: a May 30, 1924 wave, five meters high, generated by an eruption of Kilauea; an April 1, 1946 wave originating from the Aleutian Islands which swept water inland 15 to 30 meters on the south coast; and a May 22, 1960 wave generated from an earthquake in southern Chile, no recorded height.

2.4.2 Probable Impacts

The Project is not likely to have any impact on natural hazards. However, natural hazards such as volcanic eruptions, earthquakes, and tsunamis could directly impact the project area.

Hazards created by volcanic eruptions can be categorized as lava flows; volcanic ash and rock produced by explosive eruptions; clouds of ash, rock fragments and gas propelled outward during an eruption; and volcanic gases. Since renewed volcanic activity of the Lanai Basalt shield volcano is considered extremely low, it is unlikely the project would be subject to volcanic hazards in the foreseeable future. However, in the event of an eruption in the rift zones closest to the project site, lava could inundate the project area.

Although the probability of the occurrence of an earthquake on Lanai is considered lower than that of the island of Hawaii, in the event of any seismic activity of sufficient magnitude (5 or more on the Richter Scale), buildings, roadways, sewer and water lines or other infrastructure could be damaged. Landslides caused by earthquakes are unlikely, due to the surficial geology and the slope of the site. Substantial areas of fill could be more vulnerable to instability.

Because the project site is 200 to 620 feet above sea level, the elevation safeguards the site from impacts of tsunamis. (The highest recorded tsunami was about 66 feet).

2.4.3 Mitigation Measures

Volcanic activities which could potentially impact the project site can only be mitigated by evacuating persons or relocating structures to another area. Protection of property from lava inundation has not been effective on a regional scale. Mitigation measures, therefore, are limited to the civil defense warning system and provision of adequate means of evacuation. Although Lanai has a radio-activated, single siren located in Lanai City, a portable system would be used to cover areas such as hotel sites in outer areas.

Mitigation of hazards associated with earthquakes include design and construction of buildings and infrastructure in compliance with applicable building codes and standards. Using large volumes of fill to create level building sites, or construction near unstable cliff areas should be avoided.

2.5 Visual Attributes

2.5.1 Existing Conditions

Manele Golf Course and Golf Residential Project is situated on over 750 acres which slope evenly and rise in elevation from about 200 feet above mean sea level (msl) to 620 feet msl. Overlooking the ocean on southern Lanai, the project site lies above sea cliffs ranging from 20 to 180 feet in height along the coast. The project area is covered with scrub vegetation and lava rock, similar to much of the coastline of Lanai. A portion of the site can be seen in the vista west from Hulopoe Beach Park, the only public viewshed with a sight line in the Manele area. No portion of the proposed project site can be seen from Manele Road until the road descends to the Manele Bay Hotel area. The site is also screened from the Manele Boat Harbor by the ridge that divides Manele Bay from Hulopoe Bay.

The Manele Bay Hotel, located on the beachfront to the east of the project site, presents a landscaped entrance to the project site. With low rise form and design, the Manele Bay Hotel was constructed to blend in with the surrounding area without overwhelming the existing environment.

2.5.2 Probable Impacts

Impacts During Construction

Short term impacts include disturbance of scrub vegetation by construction, on-site location of temporary buildings to house personnel and supplies which encroach on the landscape, and exposed irrigation pipes, drainage culverts, rocks, and soil prior to landscaping.

Long-Term Impacts

The proposed construction of the Manele Golf Course and Golf Residential Project will have long-term impact on various visual attributes of the site. The addition of low-rise and low-density residential areas and a golf course would increase the extent of landscaped area and construction on the south shore of Lanai. Within a large portion of the public viewshed from Hulopoe Beach Park, however, various natural features and topography would remain within the Project's planned open space. Natural features of the site that would be retained include:

- Cliffs and rocky coastline for the entire length of the project
- All existing conditions and features within a 50-foot setback from the cliffs
- Archaeological features, which preserve open space and topography
- Drainage paths which conform to existing contours
- The shoreline cliff trail

The western viewshed from Hulopoe Bay Beach Park would change from a horizon dominated by scrub vegetation and lava above the sea cliffs, to a vista containing a manicured golf course, some residential construction, and various natural features already present on the site.

2.5.3 Mitigation Measures

In the short term, mitigation measures involve limiting the time rock and bare soils are exposed to erosion, placing sod as soon as practicable, and planting vegetation on developed sites that complements the natural environment. In the long term, the primary mitigation measure that will be employed to minimize potential adverse visual impacts will be the use of extensive landscaping in and around the residential areas. Residents will be encouraged to choose plantings that are associated with a "natural" look from a suggested plant list. In addition, the buildings and homes will be designed to blend in with the natural environment of the area. The golf course would be a "target golf" concept which minimizes the extent of the turf area required and allows for maximum natural vegetation to remain.

3. NATURAL ENVIRONMENT

3.1 Terrestrial Flora and Fauna

3.1.1 Existing Conditions

3.1.1.1 Flora

The vegetation of the project area was surveyed in March 1988 and the area was surveyed again specifically for the purpose of reassessing the sensitive plant species and surveying the lands designated agricultural in the proposed project district expansion area. Please refer to Appendix A for the scientific names of the floral species and details on the methods used in the surveys.

The project site presently consists of three general vegetation cover types: (1) scrub vegetation and (2) kiawe-ilima forest and (3) strand. The scrub vegetation is further divided into kiawe-ilima scrub and koa-haole scrub (Figure IV-4). The surveys indicate that the vegetation of the plant cover types is as described below.

The kiawe-ilima scrub vegetation is the most common within the project area and it is generally interspersed with the kiawe forested area. The kiawe-ilima scrub is characterized by widely scattered kiawe trees (less than 50% canopy cover) generally 2-5 meters tall and a well-developed shrub layer of ilima 0.3-1 meter tall. This vegetation type is discontinuous exhibiting many areas of rocky outcrop and extremely stony soils nearly devoid of vegetation. The shrub layer also contains ilima (up to 50-100%) and a subcomponent of uhalo and hoary abutilon. Herb layer is primarily pili grass with sub-elements of feather fingergrass, buffelgrass, and hairy merremia. Less than 40 species of flowering plants were found within this vegetation type (see Appendix B).

In ravines and gulches and wherever the soils are deeper and/or moisture is more readily available, the scrub community grades into the kiawe-ilima forest. This type differs from the scrub type only in the canopy cover and stature of the kiawe. Generally, the trees are 3-9 meters tall and the canopy exceeds 50%. Ilima is the dominant shrub and other common components include: hoary abutilon, pili grass, and feather fingergrass. Less than 30 plant species were found in this community.

Toward the western end of the project area, the kiawe yields to koa-haole which gradually supplants it as the dominant species. Koa-haole scrub is characterized by widely scattered, but mostly dead or necrotic koa-haole shrubs 2-4 meters tall, and a well developed shrub layer of ilima and hoary abutilon. Approximately 19 flowering plants species were recorded from this vegetation type.

The strand vegetation is not well developed and pau-o-hiiaka is the only species commonly associated with coastal strand habitat that is found in any significant numbers. Many of the plant species common to the coastal strand including beach naupaka, ahinhinaku-kahakai, nehe, pohinahina, and the prostrate form of ilima are <u>not present</u> on this site.

<u>Endangered Plant Species</u>

The biological survey investigated several plants that were either restricted to the Manele-Hulopoe Region or have been listed as endangered or deemed extant (see Appendix A). A large population of <u>Canavalia lanaiensis</u> was found in 1987 in the gully east and mauka of the Manele Hotel site. A second population was discovered in the strand zone on the seaward edge of an extensive boulder field approximately 450 meters from the east boundary of the present project site. This plant is considered rare and endangered and it was previously listed as endangered in the early Smithsonian Institution listing of sensitive species (1974). It was proposed for listing by the U.S. Fish and Wildlife Service as an endangered status in 1976, withdrawn in 1979, and relisted in 1980 as an endangered species.

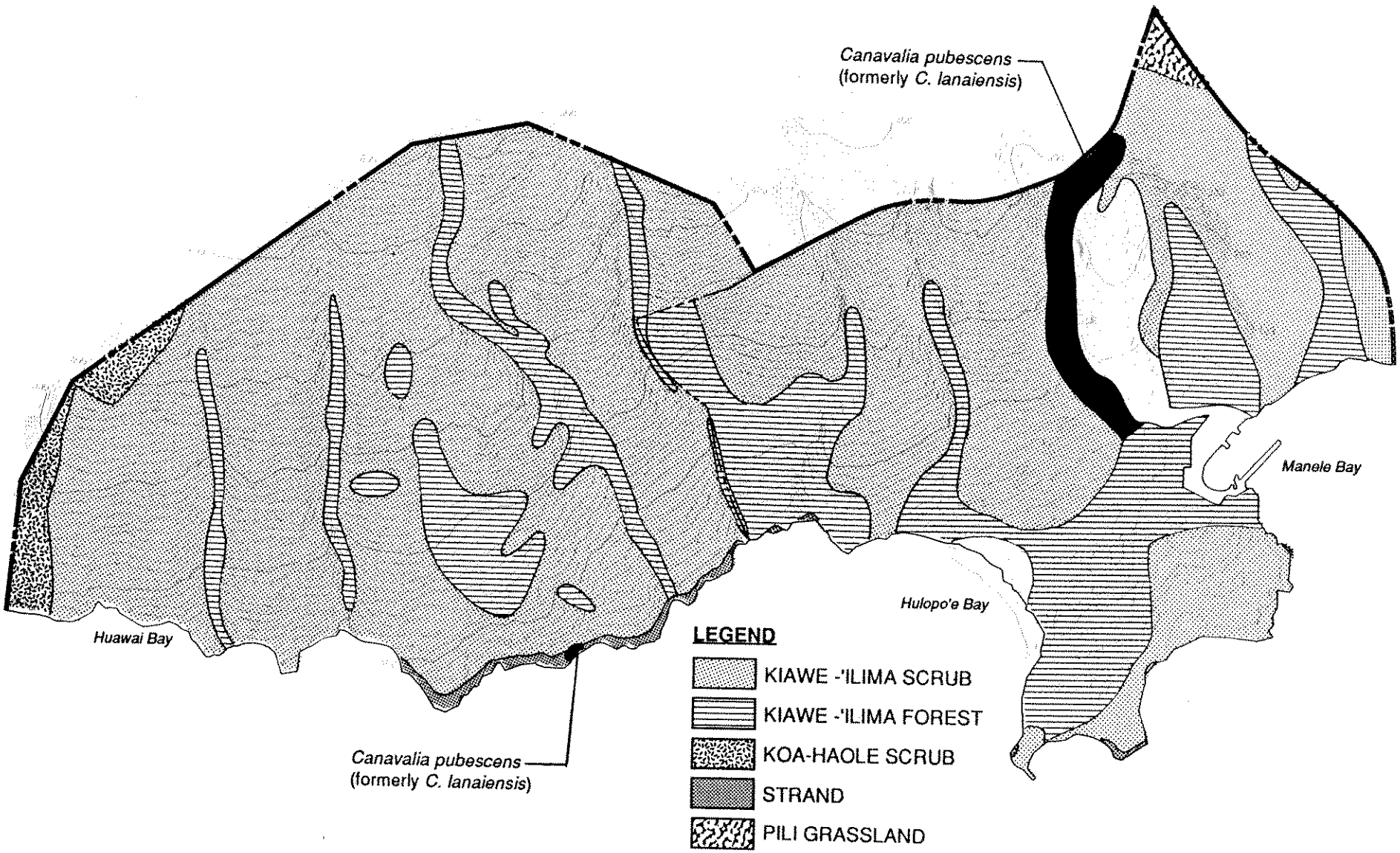

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FIGURE IV-4
VEGETATION MAP

Recent taxonomic work on the Canavalia genus has shown that it is not sufficiently distinct from the similar species on Kauai, Niihau or Maui to warrant a separate species; therefore, it's proper name should be (C. pubescens). Consequently, the U.S. Fish and Wildlife Service (USFWS) has reevaluated the status of the species and has listed it as a Category II plant. Category II describes the class of plants proposed for listing as threatened or endangered that the USFWS does not have sufficient information to warrant listing as an endangered species. Additional information is required about the species prior to determining if the plant should be listed or should be dropped from the endangered listing consideration.

3.1.1.2 Fauna

The following common urban and field birds have been recorded in the Manele-Hulopoe area: common mynah (Acridotheres tristis), house sparrow (Passer domesticus), Kentucky cardinal (Richmondena cardinalis), red-crested cardinal (Paroaria coronata), barred dove (Geopelia striata), and lace-necked dove (Streptopelia chinensis). In addition, two game birds, the Indian gray francolin (Francolinus pondiderianus) and the turkey (Meleagris gallopavo) were also observed in the region.

Two seabirds were observed in the nearshore waters, although these species are believed to be transient rather than resident species.

The only mammal observed in the project area was the axis deer (Axis axis) which is abundant throughout the region.

3.1.2 Probable Impacts

3.1.2.1 Flora

The vegetation of the project site is dominated largely by introduced (or alien) species such as kiawe and buffelgrass, although in places the native ilima, hoary abutilon, and pili grass may be common. Of a total of 44 species recorded during the botanical survey for the proposed project (Appendix A), six species (13%) were indigenous and six were endemic (13%) to the Hawaiian islands. The others were introduced (74%).

One species found in the strand vegetation was previously considered endangered by the U.S. Fish and Wildlife Service. Through recent taxonomic work, the rare Canavalis lanaiensis plant was determined to be the same species as a species that exists in a wider distribution on Hawaii. The specific epithet was dropped and the plant was renamed C. pubescens. C. pubescens, although present on East Maui, Niihau, and now Lanai, is considered a Category II candidate endangered species whereby additional information on the species is required prior to officially listing the plant or removing it from further consideration.

Extensive earthwork and excavation have occurred on the site as a result of the hotel development and additional clearing, excavation, and site grading will likely occur for most of the project site in order to construct the residences and the golf course. Portions of the site will be left intact where feasible, especially along the shoreline. Potential impacts to the vegetation of the site will be significant in that much of the

existing vegetation will be lost. However, as noted below, the potential adverse impacts will be largely mitigated.

3.1.2.2 Fauna

Development of the proposed golf course and house lots is not expected to adversely affect the bird or mammal species found within the project area. Newly landscaped areas could provide more habitat for the common introduced species. Populations of species such as the common mynah, barred dove, cardinals, lace-necked dove, and house sparrow may increase with development of the project site.

3.1.3 Mitigation Measures

3.1.3.1 Flora

To mitigate the loss of both native and introduced species, much of the site will remain in open space used as a public park. The areas around the archaeological sites preserve will remain in natural vegetation for aesthetics and to retain any native plants as part of the historical record. A present population of Canavalia pubescens is located within the archaeological preserve and thus it too will be preserved. Where possible, the ilima-uhaloa-pili grass association will be preserved in the golf course rough and in other areas within the residential landscaping. The landscaped areas will include native species wherever appropriate and aesthetically pleasing.

To protect rare native species, the biological reports in Appendix A suggest various measures. These include realignment of the golf tees and fairways to avoid disturbance of the Canavalia populations, channeling surface runoff away from the Canavalia colony, and preventing construction rubble and runoff from spilling into Manele Gulch.

To mitigate the loss of naturally occurring vegetation, natural landscape elements, including endemic species, would be used in landscaping plans for the golf course and house lots, particularly along the coastline. Individual owners of house lots will be encouraged to use native and naturally occurring plant species to the maximum extent possible in their landscape plans.

3.1.3.2 Fauna

Given the lack of expected significant adverse impacts that might result from the Project, specific mitigation measures for fauna are not warranted. As indicated above, newly landscaped areas will provide habitat for introduced and some native species.

3.2 Marine Environment

The marine waters and biota were surveyed and sampled by Environmental Assessment Company for the purpose of identifying baseline conditions of the area as the first step in developing a comprehensive management plan to protect the resources of Hulopoe and environs (Brock, 1990). The objectives of the study were:

- to provide a quantitative description of the marine macroinvertebrate biota and water quality conditions in the waters affronting the Manele Bay Resort

- to serve as the first phase of the comprehensive management plan to protect marine resources in the Hulopoe Bay area

The following section summarizes the results of the marine assessment, please refer to Appendix B for a detailed description of the study design, sampling methods, raw data, discussion and limitations of the study.

3.2.1 Coastal Environment Biotopes

The exceptional quality of marine communities within the Manele and Hulopoe bays has been acknowledged through the State of Hawaii's designation of the area as the Manele-Hulopoe Marine Life Conservation District (MLCD). As such, the waters are managed by the State Department of Land and Natural Resources and a comprehensive management plan is being developed to guide current and proposed development in and around the MLCD. The first phase of the management plan was a quantitative survey of the biota and water quality conducted by Environmental Assessment Company in December 1989.

The Hulopoe Bay and environs (95 surface acres), from shoreline seaward for 2,132 feet (650 meters) and between Sharks Bay at Puupehe Point on the east to Kaluakoi Point in the west, was surveyed and four biotopes were recognized. Biotopes are life zones delimited by physical characteristics including water depths, relative exposure to wave and current action, and the major structural components present in the benthic communities. The four major biotopes, named for distinctive physical features, include: low channels, grooves and low coral cover, sand, and shallow high coral cover (Figure IV-5). The relative location, depth, cover, and biomass for each biotope is shown in Table IV-3 and described in Sections 3.2.1.1 through 3.2.1.5.

3.2.1.1 Biotope of Low Channels

The substratum of these low channels is comprised of sand, rubble, and live coral. The coral occurs in low elongate mounds that are up to 3.3 feet (1 meter) in height and spaced from 3.3 to 26 feet (1 to 8 meters) apart and perpendicular to the shore. This configuration provides local cover for fishes and macroinvertebrates. Coral species have a mean cover of 38 percent in this biotope and the most common cover type is the coral species (Porites compressa).

The most common macroinvertebrates were the starfish (Linckia multiflora) and the black sea urchin (Tripneustes gratilla). Thirty-three fish species (over 300 individuals) were observed through 25-meter transect surveys. The most abundant species were kole (Ctenochaetus strigosus), maiko (Acanthrus nigroris), lauipala (Zebrasoma flavescens), hinalea lauwili (Thalassoma duperrey), and damselfishes (Chromis hanui and C. agilis).

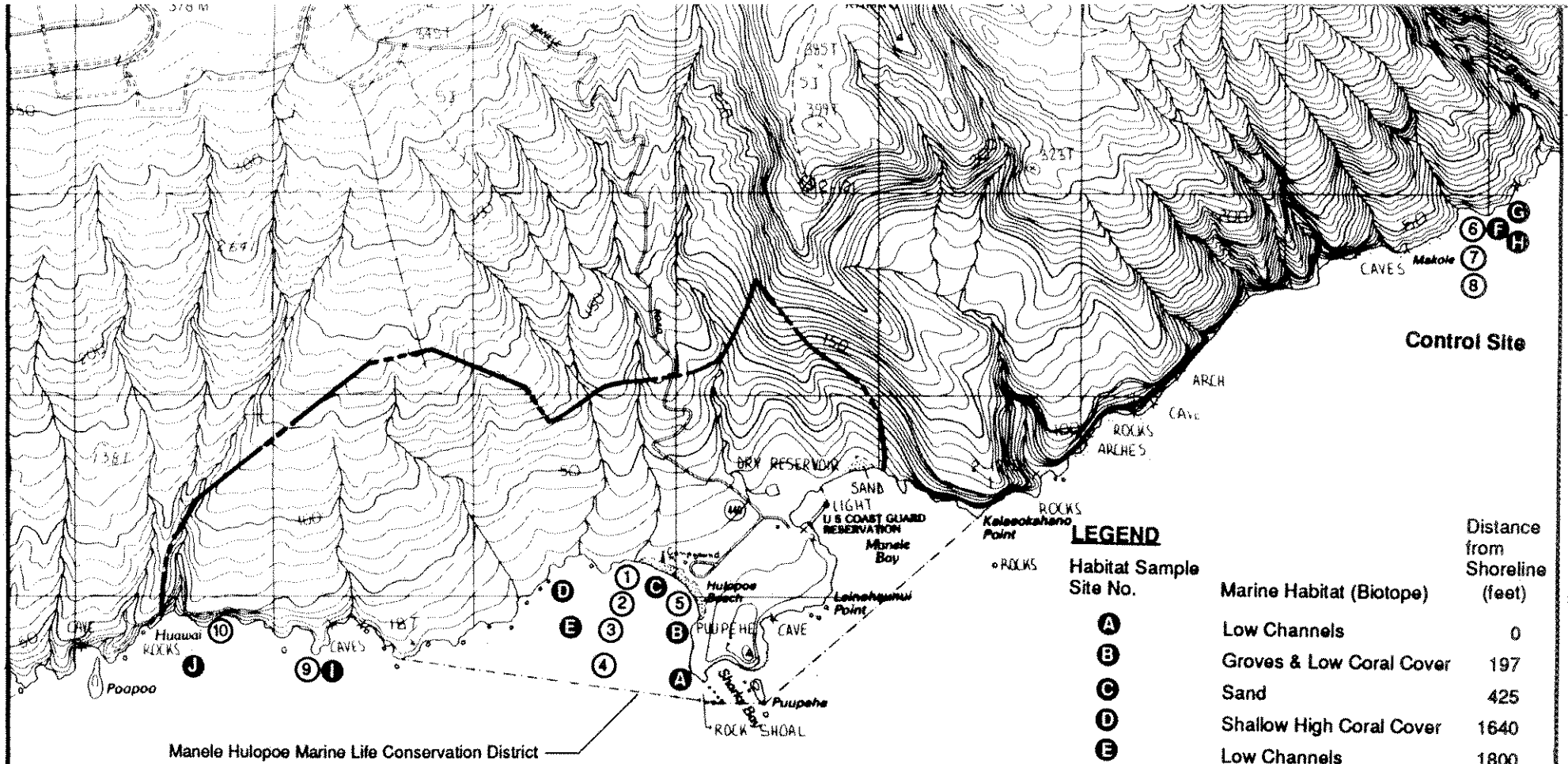

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FIGURE IV-5

MARINE ENVIRONMENT AND LOCATION OF WATER SAMPLING STATIONS

TABLE IV-3

SUMMARY OF QUANTITATIVE MARINE BIOLOGICAL OBSERVATIONS

	Station No.	Depth (m)	No. Coral Spp.	Mean Cover (%)	No. Fish Spp.	Biomass (g/m^2)
Biotope of Low Channels	1	20	4	41	33	84
	5	15	4	22	18	17
	6	11	9	38	39	101
	Means	15	6	34	30	67
Biotope of Grooves and Low Coral Cover	2	8	5	9	37	159
	9	12	6	15	38	147
	10	8	4	4	32	149
	Means	9	5	9	36	152
Biotope of Sand	3	8	-	-	1	2
	7	13	-	-	-	-
	Means	11	-	-	-	1
Biotope of Shallow High Coral Cover	4	6	10	49	30	139
	8	7	8	32	42	243
	Means	7	9	41	36	191

3.2.1.2 Biotope of Sand

This biotope extends in a fan shape from the shore well out into the bay. Sand is the dominant substratum. Sand provides little cover or solid substratum; therefore, the fish and macroinvertebrates are limited (Table IV-3).

The benthic and fish community development is lowest in this biotope. A single fish, a garden eel, was observed at one of the two sampling sites. There was no coral cover and only three invertebrate species were observed during the census. Several small kona crabs (Rania rania), an auger (Terebra crenulata), and one juvenile nabeta (Hemipteronotus) were observed in the vicinity of Hulopoe Bay as well.

3.2.1.3 Biotope of Grooves and Low Coral Cover

Hulopoe Bay

The biotope of grooves and low coral cover is a shoreward extension of the low channels and it is found on the eastern shore of Hulopoe Bay. It is dominated by hard substratum with channels cut through it that run roughly perpendicular to the shore. These channels and ridges create a spur and groove formation which is characteristic of coral reef communities that experience occasional wave energy. This biotope is characterized by a variety of coral species growing over a solid substrate.

Because of the high wave action, coral cover is not high (i.e., less than 10 percent); the dominant species are (Porites lobata) and (Pocillopora meandrina). Macroinvertebrates and fish have sufficient cover to be abundant and diverse. The most common invertebrate is the green urchin (Echinometra mathaei). The most common fishes include: the maiii, kole, hinalea lauwili, moano, uhu, and damselfish.

Kaluakoi Point to Huawai Bay

This area, sampled at stations 9 and 10, is characterized by grooves comprised of basalt/limestone ridges oriented perpendicular to the shore with intervening sand channels. Station 9 is located 98.4 feet (30 meters) from shore and station 10 is located 328 feet (100 meters) from shore. Coral cover is greater nearshore than offshore and the cover mean is 9 percent (Table IV-3).

The most common macroinvertebrate is the starfish and fish are abundant. The most common fish is maiii, kole, lauipala, hinalea lauwili, moano, and damselfish (Appendix B).

A small amount of the alga Amansia glomerata which is the common food of sea turtles, was found in the offshore sampling site.

3.2.1.4 Biotope of Shallow High Coral Cover

The biotope of shallow high coral cover occurs in areas that have appreciable amounts of hard and stable substratum and that are somewhat protected from occasional storm surf. It is usually found adjacent to the shoreline (i.e., within 300 feet) both in and

adjacent to Hulopoe Bay. The substratum is bisected by channels and corals are usually found on the ridges as well as in the channels.

The benthic and fish community development is greatest in this biotope (Table IV-3). The dominant coral species is (Porites lobata) and mean coverage is 41%. The cover is dense with macrothaloid algae, soft corals, and smaller amounts of numerous other coral species. Macroinvertebrates are present including echinoderms and molluscs; the most frequently encountered species is the starfish (Linckia multiflora). The fish are abundant (over 200 individuals) and diverse (over 30 species); the most common species being kole (Ctenochaetus strigosus), maiii (Acanthurus nigrofuscus), manini (A. triostegus), pakuikui (A. achilles), and lauipala (Zebrasoma flavescens), hinalea lauwili (Thalassoma duperrey), damselfishes (Chromis spp.), and the mamo (Abudefduf abdominalis).

3.2.1.5 Endangered and Threatened Species Occurrence

The endangered green turtle (Chelonia mydas) was sighted three times during the marine survey. One occurrence was about 196 feet (60 meters) offshore of Puupehe Rock; another was approximately 250 feet (75 meters) offshore of Kaluakoi Point; and a third was found about 328 feet (100 meters) offshore along the eastern side of Kawaiu Gulch. Each of the turtles occurred in areas of considerable cover; however, food sources for these animals (i.e., algal forage) were limited in all the areas sampled during the field survey. The investigators surmised that any existing algal mats were probably heavily grazed by the sea urchins because they were found in abundance. Therefore, food for green turtles is limited within the study area.

3.2.2 Water Quality

3.2.2.1 Sampling Sites and Methods

Water quality parameters were measured at ten sites, seven within the project site and three control (Figure IV-5), during three separate trials in December 1989. Samples were taken two days after heavy rainfall (i.e., 1 to 2 inches as measured at the rain gauge at Lanai Airport). Water quality parameters that were evaluated are specific criteria designated for "open coastal waters" in Title 11, Chapter 54, Amended Administrative Rules for Water Quality Standards. These criteria include ammonia nitrogen, nitrate + nitrite nitrogen, total nitrogen, orthophosphate phosphorus, total phosphorus, chlorophyll-a and nephelometric turbidity. Also collected were samples for the non-specific criteria including oxygen, temperature, pH and salinity as well as the nutrient, silica, at each station. Refer to Appendix B for a description of the State Department of Health water quality standards and the "wet" and "dry" criteria application.

3.2.2.2 Existing Water Quality

Locations sampled within Hulopoe Bay were chosen to represent biotopes of low channels (Stations 1 and 5), the grooves and low coral cover (Station 2), sand (Station 3), and shallow high coral cover (Station 4). Samples 1 through 4 were affronting an intermittent stream just west of the Manele Bay Hotel. Two sampling locations, site 9 and 10, were along the west end of the golf course near shoreline holes 12, 16, and 17. These

sampling sites represented the groove biotope and were taken at distances of 197 feet (60 meters) and 230 feet (70 meters) from shore, respectively (Figure IV-5). Three sites were chosen near Makole as a control location similar to the project site representing the biotopes of sand, grooves, and low channels. Water quality sampling stations 6, 7, and 8 represented the low channels, the sand, and the high coral cover biotopes, respectively. These sites were also located close to an intermittent stream about 1,640 feet (500 meters) west of Kawaiu Gulch as were the project area station sites.

The waters of the project site are classified as open coastal waters Class AA by the State of Hawaii, Department of Health (Title 11, Chapter 54). Standards are shown in Appendix B. The results of the sampling showed several trends (Table IV-4):

1) the concentrations of dissolved nutrients (orthophosphate, nitrite + nitrate, ammonium and silicate) decrease with distance from shore,

2) salinity shows a weak increase with distance from shore, and

3) the geometric means for nitrate + nitrite nitrogen, ammonia nitrogen, turbidity and chlorophyll-a all exceed state water quality standards for "dry" coastlines.

Dry coastlines are those receiving less than three million gallons of freshwater discharge per shoreline mile. The gradients are probably related to unusually heavy rainfall and runoff for two days preceding the water quality sampling and/or the possible diffuse input of groundwater along the shoreline. Both silica and nitrate-nitrite nitrogen usually exist in high concentration in groundwater owing to metabolism of organic material and mineral dissolution. These ions are in low concentration in open ocean waters and hence, they, along with salinity, may serve as tracers for freshwater (groundwater or stream) input into oceanic settings.

The high concentrations of chlorophyll-a, a measure of phytoplankton biomass, is common for two or three days after a rainfall because the runoff delivers inorganic nutrients into the water and the phytoplankton begin to respond to the fresh food supply with a bloom.

None of the water quality parameters exceeded values specified by DOH as "not to exceed the given value more than 10% of the time" and only the geometric mean for chlorophyll-a exceeded the "wet" criteria (Table IV-4).

It should be noted that State standards for open coastal waters are frequently exceeded irrespective of the presence of nearby coastal developments. Brock and Kam (1989) found that under dry conditions nitrate + nitrite nitrogen concentrations are equal to "dry" criteria for waters affronting Lahaina, Maui and that chlorophyll-a exceeded the "wet" criteria; following a heavy rain (3.38 inches over a 24-hour period) nitrate + nitrite nitrogen, turbidity and chlorophyll-a and ammonia nitrogen exceeded DOH "dry" standards (Marine Research Consultants, 1989; Brock, 1990). Even in Keahole, Kona on the island of Hawaii, in waters that are considered to be pristine, the long term mean for ammonia nitrogen exceeds the State "dry" standards. This suggests that the DOH standards for ammonia nitrogen may be too stringent.

TABLE IV-4

SUMMARY OF THE WATER QUALITY PARAMETERS

Station	Nitrate N	Ammonia N	Total N	Ortho-P	Total P	Silicate
1	11.43	3.03	73.50	6.61	8.99	196.26
2	8.96	2.75	74.20	5.99	9.92	84.28
3	8.45	3.64	76.86	5.79	9.92	95.48
4	0.70	0.89	57.68	3.19	8.68	22.40
5	6.16	3.03	71.82	5.27	9.92	28.00
6	10.41	2.80	67.62	4.34	8.99	185.36
7	3.59	2.01	58.10	4.03	8.68	28.00
8	1.59	1.35	59.78	3.41	8.68	33.60
9	3.78	2.42	59.78	4.24	9.61	28.00
10	3.08	3.03	59.50	4.44	8.68	39.20
GEOMETRIC MEAN	4.27	2.32	65.49	4.61	9.19	53.44

Station	Turbidity (NTU)	Chlorophyll a (ug/l)	Salinity (‰)	Temp (°C)	Oxygen (& Sat)	pH
1	0.81	1.20	33.0	25.5	100	8.0
2	0.35	0.58	33.4	25.7	102	8.0
3	0.47	0.41	33.5	25.7	99	8.1
4	0.11	0.27	33.5	25.6	100	8.1
5	0.22	0.27	33.2	25.6	101	8.1
6	4.10	0.56	33.0	25.4	97	8.0
7	0.12	0.51	33.2	25.5	100	8.1
8	0.21	0.55	33.4	25.6	101	8.1
9	0.13	0.47	32.5	25.7	100	8.1
10	0.18	0.25	33.0	25.7	101	8.1
GEOMETRIC MEAN	0.31	0.46	33.2	25.6	100	8.1

Note: As measured at 110 sites in the study. In the body of the table concentrations of dissolved nutrients given in U/L. Geometric means given for each species measured; single underlined values exceed "dry" Department of Health water quality standards and double underlined values are in excess of the "wet" standards.

3.2.3 Potential Impacts to Marine Communities

The biomass estimates for stations within the Hulopoe Marine Life Conservation District (Stations 1 through 5) are not high, suggesting that the habitat is not capable of supporting a greater biomass, the protected area is insufficient in size, or that ongoing fishing is retarding population growth. The only fishing allowed in the MLCD, however, is by hook and line.

Further, occasional sedimentation and turbidity result from storm water runoff. Turbidity data collected by Environmental Assessment Company suggest that considerable sediment can be washed into the open waters following heavy rains. Lowered photosynthesis due to turbidity and sedimentation are the major environmental threats to the benthic community under the existing setting. Therefore, with the increased potential for terrigenous inputs to the water system because of earth disturbance and erosion or from pesticide or fertilizer application, there is a resultant increase in the potential for adverse impact to the marine water quality and biota.

3.2.3.1 Construction Impacts

The proposed development may increase the potential for runoff during the construction phase when extensive earthwork is being performed. Runoff will be greatest during the limited rainy season; however, soil erosion may be assisted by mechanical shifting of soils or disturbance by feral animals.

3.2.3.2 Operational Impacts

The marine communities may be changed by the long term low volume (chronic) input of inorganic nutrients, pesticides, and sediments due to the golf course operation and maintenance. The Integrated Management Plan, Appendix D, describes the fertilizer and pesticide applications proposed for the Manele Golf Course and provides simulation results from studies that modelled the leaching time for nitrogenous fertilizers and for the common insecticides, fungicides, and herbicides that would be used. In many dry coastal Hawaiian resorts, golf courses are irrigated by a combination of brackish groundwater and treated resort sewage effluent. Dry fertilizers, pesticides and herbicides are applied on a regular basis. The nutrient subsidy from fertilizers and sewage as well as the pesticides and herbicides placed on these golf courses could migrate downward into the groundwater table and move laterally in the low salinity water table towards the shoreline. However, the residual amount that actually enters the marine water after passing through the soil to the groundwater and into the marine waters would be extremely low and it would depend on the physical characteristics of both the leachate, the soil, and the aquifer.

Long term monitoring studies at Waikaloa Resorts in the Kohala District, Hawaii, a resort with several similarities to the Manele site (see Appendix B), has shown that coastal golf courses may increase the concentration of inorganic nutrients in the underlying groundwater but that these changes are neither chemically detectable outside of 328 feet (100 meters) from the shore nor do they manifest any discernible change in the aquatic communities. The soil near the Hulopoe Bay is of much greater thickness and the golf course lies at greater elevation from the shoreline than the Waikaloa example. Therefore, the opportunity for leaching of materials to the water table at Manele is less than at

Waikoloa. If leaching were to occur, a greater period of time would elapse prior to detection.

Environmental Assessment Company's data suggest that over a long period of time, there would be an increase in the concentration of inorganic nutrients in the underlying water table, but that the increases will be less than seen in some natural systems in Hawaii. It is unlikely that any discernible change on the nearshore marine communities affronting the project site would result from the long term changes in nutrient chemistry.

3.2.4 Mitigation Measures

3.2.4.1 Protection Measures During Construction

During construction, the erosion potential would be decreased by following prudent construction practices including uncovering a small area of soil at any one time before reseeding and building temporary catchment and settling basins. The reseeding for the golf course and the landscaping for the residential area would most likely be more complete erosion protection than the existing setting, where deeply eroded gullies and exposed soil areas are common. It is possible that after construction is completed on the site, less sediment will enter the sea by way of storm runoff than under the natural conditions.

3.2.4.2 Monitoring Strategy for Assessment of Long-term Impacts

The sampling program summarized in Appendix B was the first step in the development of the comprehensive management program for the Manele-Hulopoe Marine Life Conservation District. The strategy used in this program is to conduct a comparative analysis of quantitative data for marine communities (e.g., water quality parameters, benthic composition, biomass) directly affronting the project site and at selected sites well removed to serve as controls. Sites at each location will be sampled at a number of points in time, thus assuring both a spatial and temporal dimension in each comparison.

3.2.4.3 Long-term Monitoring and Management Procedures

The initial survey took place in December 1989; this data (Appendix B) represents the benchmark upon which all further observations are measured. For comparison, additional sampling and observations will be made according to the following schedule throughout construction and operation of the Manele Bay Resort and Golf Course to assure that water quality standards are met and marine communities are not adversely affected.

A suggested sampling schedule is every three months during the construction of the golf course and every nine months for post-construction surveys to determine equilibrium. The marine resource consultants, Environmental Assessment Co., has an agreement with the Lanai Company to continue the monitoring program as proposed for the project during the approval, construction, and operation. Environmental Assessment Co. will work with the Lanai Company and the resource agencies in the State of Hawaii to determine the actual monitoring program schedule and procedures.

4. HISTORICAL AND ARCHAEOLOGICAL RESOURCES

The historical and archaeological resources of the Manele-Hulopoe Bay Region have been investigated for the Manele Bay Hotel and for the petition lands (Athens, J.S. and M.W. Kaschko, 1987; Cultural Surveys Hawaii, 1989 and 1990). As a result of these investigations, and the Lanai Company's desire to preserve and protect the cultural resources of the resort area, many of the archaeological sites will be preserved and several interpretive displays will be established. It is the Lanai Company's policy to preserve and protect these resources.

4.1 Existing Conditions

An archaeological inventory survey of the Hulopoe Bay and Manele Bay Areas was conducted for the Manele Project District and Hotel Development in 1987. The 422-acre study area included most of the Manele Project District and documented a total of 183 features grouped among 33 archaeological sites (J.S. Athens and M.W. Kaschko, 1987).[1] A feature can generally be defined as a non-portable and relatively discrete archaeological entity. Data recovery excavations were performed on five of these sites prior to constructing the hotel. The archaeological data recovery work included all sites and features that would have been within the hotel excavation, grading and landscaping area. The other 28 sites discovered through that survey will be considered in this EIS.

In 1989, Cultural Surveys Hawaii inventoried the petition lands (300-acre rural lands and 173-acre agricultural parcel) specifically for this environmental impact statement (Appendix C). The objectives of the survey were to (a) identify all sites and site complexes present within the project area, including relocating and evaluating previously recorded sites; (b) evaluate the potential significance of all identified archaeological remains; (c) determine possible impacts of any proposed development upon the identified remains; and (d) recommend sites for preservation and define the general scope of any subsequent archaeological work that might be deemed necessary or appropriate.

4.1.1 Overview of Site Types and Features

Fifty-four sites, including over 150 individual features, have been identified within the project area. Twenty-five sites are within the existing project district boundary and 29 sites are within the petition lands. The sites can generally be classified in six types, each with varying quantities and qualities of features: 1) permanent habitation, 2) temporary habitation, 3) religious, 4) burials, 5) quarries, and 6) agricultural. Formal feature types present at the sites include surface habitation features such as enclosures, short linear wall segments, platforms, terraces, walls and cupboards, *abu*, koa, fishing shrines, a petroglyph, flake scatter, and an historic stone wall. Functional types present include permanent and temporary habitation, quarries and adze manufacture, religious, agricultural, and livestock management activities. The location, description, and significance of each of the sites and many of the individual features are shown in Figure IV-6 and Table IV-5.

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[1] Copies of the report are available from the State Department of Land and Natural Resources or International Archaeological Research Institute.

Habitation Sites

Permanent habitation sites generally occur along the shorelines and in major drainages. At Manele, the major coastal and permanent habitation complexes (i.e., 1514, 157, 78, 1525, 12, 18, 19, 20) contain more than 80 features densely scattered across the eastern side and the central portion of the project area (Figure IV-6). Most of the candidates for permanent habitation structures are located in these sites, as are most of the features that were described as possible burials. Many of the features are in excellent condition and are significant to the prehistoric record. Two sites (157 and 1525) have clear indication that they were occupied well into the historic period.

Temporary habitation sites are characterized by small terraces, small platforms, shelter enclosures and a few cave shelters and flaking areas. These sites usually contain sparse midden and artifacts, as well as a limited variety of midden and range of artifacts. Two excellent examples of fishing shelters are located at Sites 12 and 22. In addition, Sites 3, 4, and 8 are examples of temporary habitation sites. The shoreline locations would have been used for fishing while the mauka sites would probably have served as shelters for the agricultural activities.

Religious Sites

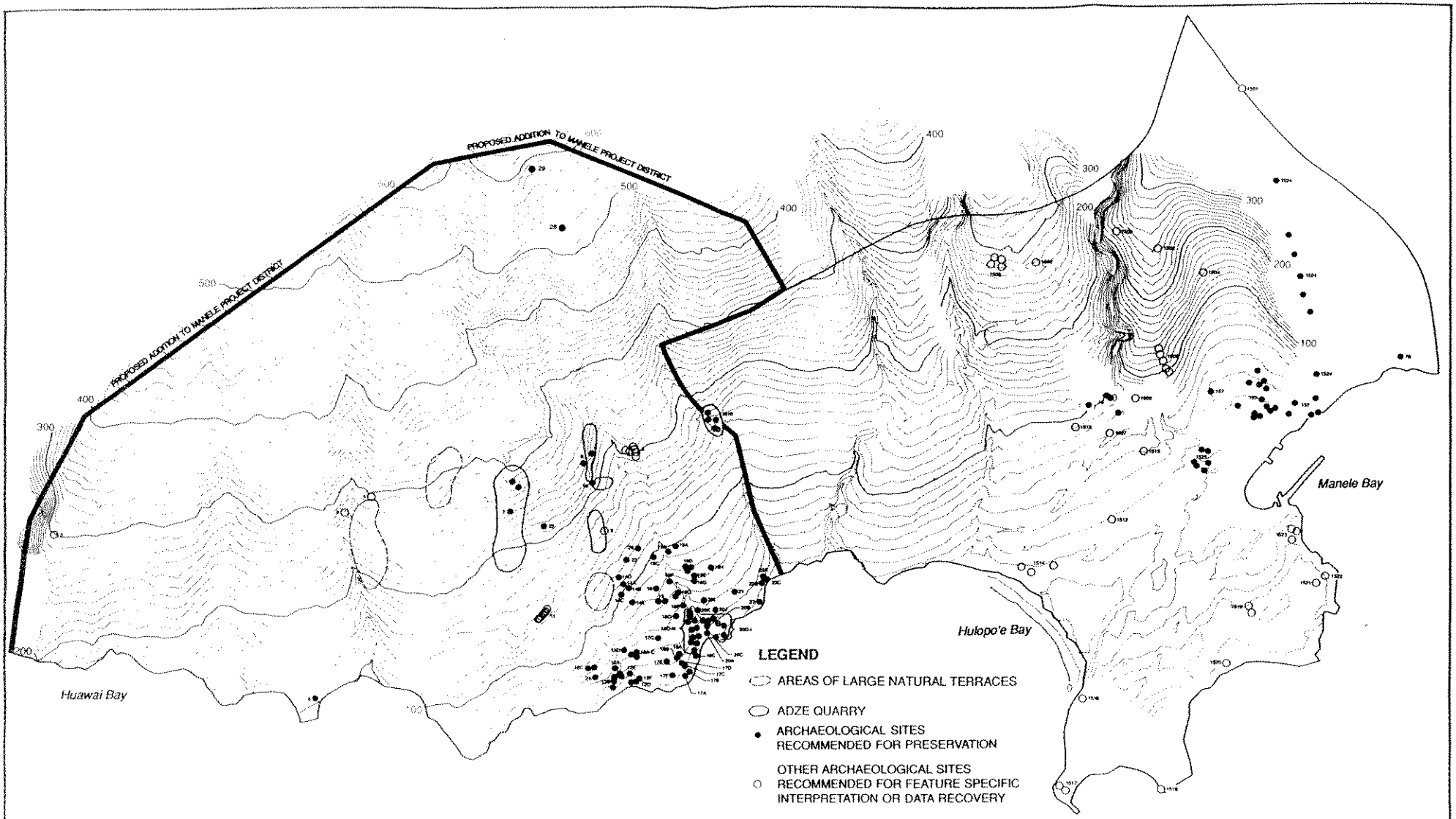
Religious sites include *heiau* (temples of the ancient Hawaiians), large shrines, and *ahu* (small shrines). Religious features often occur within the permanent habitation sites. Sites 78, 157, and 19C contain possible burials, while 12A, 14D and 20E are most likely shrines. The most easily distinguished kind of small shrine is a simple *ahu* supporting an upright slab, often collapsed. Other religious sites include a *heiau* (Site 14) and a possible *heiau* at Site 157.

Burials

Burials are not common in the project area. Only two were positively identified during the site surveys. Mauka of Site 20 there are two monument burial platforms. Burials sometimes occur within the permanent habitation sites. It was not uncommon for prehistoric Hawaiians to bury their dead under or adjacent to house sites. Sites 78, 157, and 19C contain possible burials and excavation could yield additional burials.

Quarries

Eight sites had functions directly related to the manufacture of flaked basalt artifacts (Table IV-5). These functions were located generally mauka and between Kaluakoi and the Manele Hotel site. The location of the quarries, as observed through flaking stations, is determined by the dike outcroppings that occur on this site either along the gullies or in level areas. Site 1 (referred to as 1510 in S. Athens, 1987, Archaeological Inventory Survey of the Hulopoe Bay and Manele Bay Areas) is a basalt quarry and workshop that may well have served as the major local source of dense basalt for this immediate area, especially the coastal habitation sites. Sites 6, portions of 7, and 10, were tested and discovered to be excellent examples of this type of site, thus recommended for preservation (Cultural Surveys Hawaii, 1990).



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SCALE IN FEET

NORTH

FIGURE IV-6
ARCHAEOLOGICAL SITES AND FEATURES

TABLE IV-5

SUMMARY OF ARCHAEOLOGICAL SITES, SIGNIFICANCE AND MITIGATION RECOMMENDATION

Site No.	Site Type and Features	Significance[1]	Recommendation	Proposed Land Use
1	Small Basalt Quarry/Utilizing Exposed dyke (prehistoric) (probably Athens Site 1510) (Feature D)	C, D	Test, Surface Collection, Preserve	Golf Course Driving Range
2	Ahu/possible trail marker	NLS	None	Residential
3	Terrace/Probable Habitation Site; Visible Midden	D	Test	Open Space
4	Rock Shelter/Probable habitation site, Visible Midden with possible agricultural features	D	Test	Residential
5	Habitation Site/Enclosure, terrace cupboard; Midden and artifacts observed.	D	Test	Open Space
6	Terrace and quarry/Possible habitation terrace; quarry utilizing exposed dyke	D	Preserve	Open Space
7	Quarry/Large Surface Quarry with associated scatter of flakes	D	Test, Surface Collection, Preserve a portion of it	Open Space
8	Shelter and Quarry/Probable habitation shelter, few artifacts & midden observed	D	Test	Open Space
9	Quarry, Ahu/Utilizes exposed dyke; Ahu associated with quarry	D	Test, Surface	Open Space
10	Quarry, Terrace/Soil Terrace, Probable "workshop" with adze preforms present	D	Test Preserve	Open Space

Site No.	Site Type and Features	Significance[1]	Recommendation	Proposed Land Use
11	Quarry, Ahu (7) on bedrock bluff with quarry, on downslope side with midden observed	D, E	Test	Open Space
12	Habitation Complex/Fishing related; consists of ko'a, platform, shelter, enclosure	C, D, E	Preserve	Open Space
12A	Ko'a Plentiful coral	C, E	Preserve	Open Space
12B	Overhand Shelter/Habitational Feature Midden observed	C, D, E?	Test Preserve?	Open Space
12C	Upright Cupboard	E?	Preserve	Open Space
12D	Enclosure and terraces/Habitational feature, midden and artifacts observed	C, D	Test	Open Space
12E	Platform/Midden, artifacts observed	C, D	Test Preserve?	Open Space
12F	Platform, enclosure	A?, D	Test	Open Space
13	Habitation Platform and flake scatter. Probably associated with Site 12 Features	D	Preserve	Open Space
13A	Platform (A), Adjoining Terraces (B, C) B,C/Probable hearth on platform, midden and artifacts observed	D	Preserve	Open Space
13D	Flake Scatter	D	Preserve	Open Space
14A	Platform (A), Adjoining Terraces (B, C, E) and ahu (D)/Possible heiau, and associated features; midden, artifacts observed	D, E	Preserve Test	Open Space

Site No.	Site Type and Features	Significance[1]	Recommendation	Proposed Land Use
15	Enclosure and Adjoining Terrace/ Probable habitation site, midden and artifacts observed	D	Preserve	Open Space
16	Enclosure/Probable habitation site; midden, artifacts observed	D	Preserve	Open Space
17	Complex/habitation and religious midden features	D	Preserve	Open Space
17A	Habitation shelter/Level area between bedrock boulders shell, midden and historics, prehistoric with modern use	D	Preserve	Open Space
17B	Two small adjoining platforms/possible shrines, prehistoric	D, E	Preserve	Open Space
17C	Small platform/possible shrine, prehistoric	D, E	Preserve	Open Space
17D	Enclosure/habitation enclosure with makai boulder terrace, midden, basalt flakes, prehistoric	D	Preserve	Open Space
17E	Terrace/Possible habitation, no visible midden, prehistoric	D	Preserve	Open Space
17F	Oval alignment/possible habitation, no midden observed, prehistoric	D	Preserve	Open Space
17G	Wall and cupboard/short wall section and cupboard on bluff, pieces of branch coral adjacent, possible habitation shelter, prehistoric	D	Preserve	Open Space

Site No.	Site Type and Features	Significance[1]	Recommendation	Proposed Land Use
18	Habitation & Religious Complex, 17 closely associated features, ko'a, housesites, terraces, platforms, prehistoric	A, C, D	Preserve	Open Space
18A	Coral paved terraces/probable shrine prehistoric	D, E	Preserve	Open Space
18B	Terrace/habitation terrace, midden, flakes, prehistoric	D	Preserve	Open Space
18C	Terrace/habitation terrace with coral midden, flakes, adjacent to ko'a	D	Preserve	Open Space
18D	Fishing Shrine, Ko'a well-constructed, 6' max. height, has branch coral	C, D, E	Preserve	Open Space
18E	Circular enclosures/prehistoric with evidence of modern use	D	Preserve	Open Space
18F	Habitation, enclosures and terrace/ enclosure wall w/uprights, enclosure and adjoining terrace, plentiful midden, flakes, and volcanic glass, stone-lined hearth, 2 more terrace levels makai	C, D	Preserve	Open Space
18G	Habitation/Partially walled soil deposits plentiful midden, flakes, coral	C, D	Preserve	Open Space
18H	Habitation terrace/on gulch edge, plantiful midden, flakes possible burial platform on makai side	C, D, E	Preserve	Open Space
18I	Small enclosure/Associated with Horticulture	D	Preserve	Open Space

Site No.	Site Type and Features	Significance[1]	Recommendation	Proposed Land Use
18J	Habitational Terrace/Adjacent to H & K, plentiful midden, coral, flakes	C, D	Preserve	Open Space
18K	3 Adjoining Habitation Terraces/plentiful midden, coral, flakes	C, D	Preserve	Open Space
18L	2-Level Platform and habitation terrace/habitation platform	C, D	Preserve	Open Space
18M	Habitation terrace and adjoining platform	C, D	Preserve	Open Space
18N	Platform/depression in center, possible shrine	C, D, E?	Preserve	Open Space
18O	Habitation terrace/plentiful basalt flakes, poorly defined alignments	D	Preserve	Open Space
18P	3-Level Habitation terrace/Plentiful flakes, coral, midden, one coral file observed	D	Preserve	Open Space
18Q	Ahu and habitation terrace/terrace has plentiful basalt flakes	D	Preserve	Open Space
19	Complex/shelters, burials, cave	D	Preserve	Open Space
19A	Ahu and fence alignment/depression in center	D	Preserve	Open Space
19B	Burial platform/probable burial next to gulch	C, D, E	Preserve	Open Space
19C	Ahu/possible shrine (fallen upright) or burial (on west side of gulch)	D	Preserve	Open Space
19D	Habitation shelters and terrace/plentiful basalt flakes, 2 adjoining enclosures	D	Preserve	Open Space

Site No.	Site Type and Features	Significance[1]	Recommendation	Proposed Land Use
19E	Burial platform/rectangular with branch coral, cobble pebble paving	C, D, E	Preserve	Open Space
19F	Habitation cave and terraces/cave has plentiful cultural material, cut into Hulopoe gravel, terrace on east side of gulch has midden, flakes coral	C, D	Preserve	Open Space
19G	Piled boulders/some midden, flake in SE corner	D	Preserve	Open Space
19H	Flake scatter/flaking station	D	Preserve	Open Space
20	Complex/Habitation	D	Preserve	Open Space
20A	Habitation terrace/next to gully, possible pavement, evidence of recent use	D	Preserve	Open Space
20B	Overhang shelter/cut into Hulopoe gravel, good excavation potential	D	Preserve	Open Space
20C	Overhand shelters/Along sea cliff, 4 adjacent overhangs in soft gravel, some collapse	D	Preserve	Open Space
20D	Linear mounds/parallel linear mounds possible fish or net drying areas, on bedrock shelf	C, D	Preserve	Open Space
20E	Small Enclosure/possible shrine, has branch coral	D, E	Preserve	Open Space
20F	Small Enclosure and terraces/possible shrine with habitation terraces on mauka side, midden present	D, E	Preserve	Open Space

Site No.	Site Type and Features	Significance[1]	Recommendation	Proposed Land Use
20G	Enclosure and habitation terraces plentiful midden, flakes	C, D	Preserve	Open Space
20H	Adjoining habitation terraces/2 main adjoining terraces, plentiful midden, flakes	C, D	Preserve	Open Space
20I	Habitation platform/level soil area with hearth, paved area to east, possibly main house site	C, D	Preserve	Open Space
20J	Enclosure/probable planting area	C, D	Preserve	Open Space
20K	Habitation Terraces/small features	D	Preserve	Open Space
20L	2 Semi-circular enclosures/low walls heavy basalt flake scatter	D	Preserve	Open Space
21	Isolated Petroglyph/may be modern	D	Move feature to a preserve area	Residential
22	Small Complex of shoreline shelters/ 3 features	D	Preserve	Open Space
22A	Enclosure/Small shelter associated terraces	D	Preserve	Open Space
22B	Enclosure/Soil floor, possible cupboard built in	D	Preserve	Open Space
22C	2 Enclosures/both are 5.5 feet in diameter, enclosure but partially bulldozed	D	Preserve	Open Space
23	Temporary habitation shelter	D	Test	Open Space
24	Ahu	NLS	None	Open Space

Site No.	Site Type and Features	Significance[1]	Recommendation	Proposed Land Use
25	Quarry	D	Map/Test	Open Space
26	Ahu	D	Map	Open Space
27	Habitation Site	D	Preserve	Open Space
28	Circular Enclosure and Adjoining C-Shape	D	Preserve	Residential
29	Historic Wall and Fence Line	D	Preserve	Residential
98-16	Complex with possible burial	D, E	Preserve	Residential
98-78	Coastal Habitation Complex with possible burial and religious features	C, D, E	Preserve	Park
98-157	Coastal Habitation Complex with 30 features including possible burial and religious structures	C, D, E	Preserve	Residential
98-1007	Old Boiler	D	Additional Mitigation Work Needed	Residential
98-1500	Historic Wall	D	Additional Mitigation Work Needed	Residential
98-1501	Surface Midden Scatter	D	Additional Mitigation Work Needed	Open Space
98-1502	Small Complex	D, E	Additional Mitigation Work Needed	Residential
98-1503	Two Associated C-shapes	D	Additional Mitigation Work Needed	Residential

Site No.	Site Type and Features	Significance[1]	Recommendation	Proposed Land Use
98-1504	Small Complex	D	Additional Mitigation Work Needed	Residential
98-1505	Complex	D	Additional Mitigation Work Needed	Residential
98-1509	Small Complex	D	Additional Mitigation Work Needed	Residential
98-1512	Historic Well	D	Additional Work Needed	Park
98-1513	Small Complex, 3 Features	D	Additional Work Needed	Residential
98-1514	Complex with 3 Features	D	Additional Work Needed	Park
98-1515	Rectangular Walled Structure	D	Additional Work Needed	Park
98-1516	Cultural Deposit	D	Additional Work Needed	Park
98-1517	Complex with possible religious structure	D, E	Additional Work Needed	Park
98-1518	Small Complex with 3 Features	D	Additional Work Needed	Park
98-1519	Complex with 3 Features	D	Additional Work Needed	Residential
98-1520	Small Complex with 3 Features	D	Additional Work Needed	Park
98-1521	Paved Area with Midden	D	Additional Work Needed	Residential
98-1522	Old Cattle Chute	C, D	Preserve if possible	Shoreline Park
98-1523	Complex with 6 Features	D	Additional Mitigation Work Needed	Commercial

Site No.	Site Type and Features	Significance[1]	Recommendation	Proposed Land Use
98-1524	Trail Route with Shelters and possible burial present	C, D, E	Preserve	Park
98-1525	Coastal Habitation Complex with 6 Features	C, D	Preserve on data recovery	Commercial
	Historic Roadways and Trails with 4 Features	C, D	Preserve areas on detailed recording and data recovery	

[1] Codes for Criteria for Site Significance Evaluations

NS	Not Significant
NLS	No Longer Significant
A	Site reflects major trends or events in the history of the state or nation
B	Site is associated with the lives of persons significant in our past
C	Site is an excellent example of a site type
D	Site may be likely to yield information important in prehistory or history
E	Site has cultural significance; probable religious structures (shrines, heiau) and/or burials present

Source: National Historic Register and State Register of Historic Places Significance Criteria and Department of Land and Natural Resources Historic Sites Section

Other quarry sites (i.e., Sites 8, 9, 11, 25) that yielded flake scatter, *abu*, and other artifacts were recommended for testing.

Agricultural Features

Only one feature was definitely identified as agricultural (i.e., Site No. 20J). It is on the east side of Kapihaa Gulch and is a walled rectangular enclosure with a soil filled interior. There are distinct areas that suggest possible planting terraces; however, the areas appear to have been modified by human hands. Separate site numbers were not given to these areas and further examination would be required prior to assessing their role in the cultural record.

4.2 Probable Impacts

4.2.1 Significance Assessment

The significance of individual sites and features has been evaluated based on the definitions derived from the National Register of Historic Places criteria for evaluation (Table IV-5). The Hawaii State Historic Preservation Office also uses these criteria for evaluating cultural resources.

Most of these sites are potentially significant as they may be likely to yield information about prehistory or history if investigated further (Table IV-5). Sites given this rating are common in the area and information regarding construction, age range, or function could arise from excavation and closer examination of the buried deposits. Some have greater significance in that they are excellent examples of the site type and/or they have cultural significance (i.e., contain burials or religious structures).

4.2.2 Direct Impacts

Direct impacts to the features found within the project boundaries would essentially be a loss of the features due to excavation and/or construction of the planned facilities. At this time, no known archaeological sites or cultural resources are located within the disposal area.

Most of the potential direct impacts have been avoided through modification of the project design following the initial archaeology inventory. If any of the sites recommended for preservation cannot be incorporated in the project design (and wholly protected), a data recovery plan and proper mitigation will be required.

4.2.3 Indirect Impacts

Indirect impacts would occur on many of the features from the increased access to the area to many more people than in the past. Indirect impacts must be considered significant, for they can be just as destructive as bulldozing in that they often occur at a relatively slow rate, or as isolated instances not easily controlled. Vandalism, scavenging, and trampling of features is common in areas where public access is uncontrolled and interpretive displays and caution signs are not implemented.

4.3 Mitigation Measures

The cultural heritage of the prehistoric and settled Lanaians is one of the objectives of the proposed project. Numerous studies, committee meetings, and mitigation planning discussions have occurred to date for this project. The following is a summary of the steps that have been taken and have been planned to mitigate potential impacts on archaeological and cultural resources of the Manele Project area. For a detailed description of the data recovery plan, refer to Appendix C, Archaeological Resources Inventory and Mitigation Plan.

Of the 54 identified sites, all but one have been assessed as significant for information content. Site 2, an Ahu or possible trail marker, is considered no longer significant. The remainder of the sites are recommended for either preservation or data recovery. The majority of the known sites will be preserved and interpretive signage or displays will be used where appropriate to encourage the public to respect the resources. The remaining sites not recommended for preservation will be tested and data recovery will be performed if the excavation or construction activities occur in or adjacent to the site (Figure IV-6).

In addition, as an overall mitigation measure, the Lanai Co. will abide by the terms of the October 10, 1990 MOA, specifically those of Section IIIB. Archaeological and Cultural Resources Agreement.

4.3.1 Preservation and Interpretation

Consistent with the recommendations made by Cultural Surveys Hawaii (see Appendix C) and subsequent community and agency input, major habitation and religious sites which form an almost contiguous complex on both sides of Kapihaa Gulch will be preserved as open space in the Manele Golf Course and Golf Residential Development Plan (Figures II-3 and IV-6). Other clusters of sites in the eastern portion of the project mauka of Manele Small Boat Harbor will be preserved in place as well, unless they cannot be avoided because of excavation for residential lots.

Because many of the significant historical and archaeological resources were incorporated into the design of the golf course and residential lot plan, the impact to the site has been avoided. If, however, substantive changes are made in the proposed action that affect the location of the golf fairways and tees or the residences, suitable measures must be taken to protect the valuable archaeological remains and data from the potential adverse impact.

4.3.2 Data Recovery

Sites outside of the designated preserve areas (Figure IV-6) could be adversely affected in the future construction activities. Therefore, it is recommended that data recovery be conducted on the significant features of the following sites:

- Permanent Habitation Sites - Site 5
- Temporary Habitation Sites - Site 3, 4, 8
- Quarry Sites - Sites 8, 9, 10, 11, 7 (surface testing only, site will be preserved)
- Agricultural Features - Sites 4, 5, 14
- Site 21, possible petroglyph, may be relocated

Eighteen sites have the potential for being affected during construction. The method for excavation and documentation of the data recovery for these sites involves a sequence of excavation techniques followed by laboratory identification and cataloguing and dating procedures. All findings would be documented in a report that would be reviewed by the State Historic Preservation Office, the Maui County Planning Department, and the Lanai Historic Preservation Committee prior to finalizing the report and distributing it to reviewing agencies.

Should any additional sites be uncovered during construction, work will stop and the appropriate State and County officials notified. Work will resume upon approval of the State Preservation Officer and the Maui County Planning Department.

5. SOCIOECONOMIC AND SOCIO-CULTURAL FACTORS

This chapter was prepared by Community Resources, Inc. (CRI), a research consultancy specializing in socioeconomic impact assessment. Contributing subcontractors to CRI include John R.K. Clark (recreational impacts) and Dr. Wes Shera (socio-cultural impacts). Please refer to Appendix J for additional tables not presented here. The tables in Appendix J are referenced with the prefix "J-."

5.1 Overview of Lanai Socio-Economic Conditions

5.1.1 History and Economy Through the 1980s

The Early Population of Lanai: Ancient Hawaiians believed Lanai was inhabited by wandering evil spirits who would kill anyone attempting to visit the island. The first known human inhabitant of Lanai was a young chief banished to Lanai for disobedience in about 1400 A.D. Hawaiians eventually settled on Lanai and by 1778 (the arrival of Captain James Cook) Lanai had a population of approximately 3,000 people (Matsuoka and Shera, 1990). Once Westerners began to arrive in the Hawaiian islands, there was a dramatic decline in the Hawaiian population due to foreign diseases. By 1902, the population of Lanai dwindled to approximately 100 people (Gay, 1965).

Economic Activity and Land Tenure: From the 1860s to the early 1900s the island was used for sheep and goat ranching, a sugar plantation, and a cattle ranch (Matsuoka and Shera, 1990). In 1924, James Drummond Dole gained complete ownership of Lanai and began to develop a pineapple plantation. Cattle ranching continued on a smaller scale and was discontinued in 1950. However, even while ranching activity still existed pineapple was the island's primary economic activity (Ashford, 1974).

Landownership on Lanai has long been highly concentrated. Before the Great Mahele in 1849, the island of Lanai was divided into 13 *ahupua`a*, each with its own chief. During the Great Mahele most of the island's land was awarded to the government and chiefs. Only 65 *kuleanas* were registered for commoners (Emory, 1922).

Unionism: Lanai pineapple workers became members of the International Labor Workers Union (ILWU) in 1947. In 1950, the Lanai pineapple workers engaged in a 210-day strike and forced plantation management to negotiate with the workers on

their terms. The results of this strike contributed significantly to efforts to establish labor unions at pineapple plantations in Hawaii.

Settlement and Population: Lanai City, the only settlement on the island, was constructed in the 1920s by field hands, who also planted the first pineapple crops. A new harbor and roads were built at the same time.

U.S. Census data indicate Lanai's modern population peaked around 1940, when the population reached 3,720. It subsequently declined to 2,115 by 1960 and has remained fairly stable since. According to estimates by the State Department of Business, Economic Development, and Tourism, the 1989 population was about 2,200. The 1980 U.S. Census indicated about 98% of Lanai's population lived in Lanai City.

Similar to many plantation communities in Hawaii, Lanai's population is heavily Filipino, including many residents born in the Philippines. According to the 1980 Census, Lanai's population was 51% Filipino (Table J-1, "Total Population and Demographic Breakdowns, 1980"), although a study headed by University of Hawaii Social Work researchers (Matsuoka and Shera, 1990) indicates the Filipino proportion in the late 1980s may have been from 60% to 70% of the population. Immigrants continue to arrive from the Philippines; in 1980, 10% of the population had lived in a foreign country five years previously.

5.1.2 Current Transition from Agricultural to Tourism Economy

Castle & Cooke first announced resort development plans for Lanai in 1970, submitting a proposal to Maui County in 1971. Subsequent debates about the nature and extent of that development have involved numerous formal public hearings and informal discussions with various Lanai community groups.

The 1981 Lanai Community Plan (part of the Maui General Plan) specified economic diversification as a major objective for Lanai, to help counteract the outmigration of Lanai's young people. It recommended maintaining pineapple as the primary economic activity, while promoting the visitor industry as a secondary economic activity.

When current Chairman David Murdock assumed control of Castle & Cooke in 1985, the company intensified resort planning and development efforts. In 1986-87, Maui County development ordinances were passed to establish separate resort "project districts" at Koele (adjacent to Lanai City) and Manele. Both project districts include approvals for a single hotel each (although with permitted later expansion), single-family resort residences, and multi-family residences. A golf course was permitted at Koele and commercial shopping development at Manele.

Construction began in early 1988 on both new hotels, The Lodge at Koele (102 initial units) and Manele Bay Hotel (250 initial units). The Lodge at Koele had its preliminary or "soft" opening in January 1990, with final or "hard" opening in April. The Koele golf course was completed in January 1991 and opens for play in May 1991. The Manele Bay Hotel was also opened in May 1991. The two hotels will generally charge non-kamaaina room rates in excess of $300 per night, making them among Hawaii's most "upscale" resorts.

However, company executives have said the "entire island of Lanai," not just the two project districts, will serve as a visitor draw (Wood, 1990). The Lanai Company hopes to renovate portions of Lanai City, maintaining the pineapple plantation community motif. Tours and recreational activities throughout much of the rest of the island are also planned.

In early September 1990, David Murdock and ILWU officials jointly announced a pineapple "phase down" which would end pineapple operations by late 1992 or 1993. Mr. Murdock stated that Dole could not continue to compete with low foreign labor costs. He announced that all Dole workers who wished would be offered jobs in the new resort industry, which would include components such as an expanded diversified agriculture program to serve the hotels and residential population. Castle & Cooke initiated programs to retrain workers. Subsequently, as discussed later in this report, a number of government agencies have announced preliminary plans for helping to ease the economic and social transition on Lanai.

Previously, the Lanai Company (Castle & Cooke Properties' subsidiary) initiated applications for a Manele project district amendment to (1) construct an 18-hole golf course and clubhouse, and (2) redistribute the planned 425 Manele resort residential units (versus 416 under the current approvals) so that many would be single-family parcels fronting on the golf course.

The company has sought approvals from the State Land Use Commission (LUC) and Maui County. A community group which intervened at the LUC, Lanaians for Sensible Growth (LSG), eventually reached agreement with Castle & Cooke on a number of points of contention. One of those agreements was that Castle & Cooke would prepare a "cumulative EIS" which would incorporate social impact analysis.

5.1.3 Lanai Future Without Project: Conceptual Overview

Socioeconomic (and socio-cultural) "impacts" do not consist simply of expected changes from existing social conditions. Rather, social and economic conditions are constantly changing, with or without a proposed development such as the Manele Bay Golf Course and Golf Residential Project. Therefore, socioeconomic impact assessment requires consideration of:

- Existing conditions;
- Expected future without project approval and implementation;
- Expected future with the project.

The "impact" is the difference between the future without the project and the future with the project.

On Lanai, resort development is already well under way. Castle & Cooke executives and consultants have testified that the project will make a great difference to the success of that development. Accordingly, the difference between the future with the project and the future without the project goes beyond the Manele golf course and residential area.

Table IV-6 summarizes implications of the project. The project affects hotel occupancy levels and future construction plans at both Manele and Koele. The mix of resort visitors and residents depends on whether the project is implemented. Employment both at the resort areas and elsewhere on Lanai would be affected. The project is expected to be crucial to the success of the Manele and Koele resort areas. Without the project, a sluggish economy is projected, in which Dole Food Co., Inc. would have limited funds available for community contributions.

For this analysis, it will be assumed that the "without project" future means no hotel expansions at either Koele or Manele. At the present time, this seems the most likely outcome if no second resort golf course is permitted on Lanai. However, other possibilities would include much delayed expansion and/or expansion projects which target a less upscale class of visitor. (In reality, under the "without-project" scenario, Dole Food Co., Inc. would have to conduct a completely new evaluation of how to use its resources in the most economically feasible manner. However, the assumption of no hotel expansion produces the greatest possible differences between the "without-project" and "with-project futures" -- hence, the most conservative or maximal impact conditions.)

Other detailed assumptions concerning the two futures have been worked out on the basis of market studies (KPMG Peat Marwick, 1989; Lesser, 1990), input from Castle & Cooke and RockResorts executives, and CRI's studies of Hawaii resorts. These assumptions are indicated where appropriate in the following sections.

The most critical assumptions for both the "with-project" and "without-project" future scenarios are those relating to the project's impacts on hotel occupancies (and consequent staffing requirements) and whether or not the hotel expansions will occur; these assumptions were provided by Castle & Cooke.

5.2 Visitor Population and Characteristics

5.2.1 Existing Conditions

The Manele Bay Hotel opened on May 1. Two other hotels are operating on Lanai, the 102-room Koele Lodge and the 10-room Hotel Lanai. The Lodge opened last year, and initial occupancies have generally been low, although they have exceeded 50% at various times, such as Christmas. The Hotel Lanai is usually nearly full, as it provides rooms for those on Lanai for business or personal affairs, not the upscale visitor clientele for which the Lodge was designed. Until recently with only one major hotel and with no resort golf course, Lanai is not yet attracting target visitors in large numbers.

5.2.2 Future Without Project

Without a golf course available near the coast and playable 360 days a year, the Lanai resort hotels will have significantly lower occupancies, according to RockResorts management. At the Manele Bay Hotel, projected occupancy levels would be 25 to 30 percentage points lower than with the project. At Koele, lack of a second Lanai golf course is expected to lower occupancies by 10 to 15 percentage points.

TABLE IV-6

FUTURE WITH AND WITHOUT PROJECT -- BASELINE DESIGN AND SOCIOECONOMIC FACTORS

FUTURE WITH PROJECT	
• Construction and Design:	Manele Golf Course opens 1992; Manele housing on 408 acres; Manele Bay Hotel expanded (150 additional units), 1996; Koele Lodge expanded (148 additional units), 1995.
• Appeal to Visitors & Resort Residents:	Hotels are upscale with mostly independent travellers; more residential units occupied full-time (or a substantial portion of the year).
• Employment:	About 2,000 new direct jobs (including hotels); more diversification and hence support jobs on Lanai; hotel jobs more stable.
FUTURE WITHOUT PROJECT	
• Construction and Design:	No Manele Golf Course; Manele housing on 151 acres; no Manele Bay Hotel expansion; no Koele Lodge expansion.[1]
• Appeal to Visitors & Resort Residents:	Hotels upscale, but more groups and lower occupancy; more residential units in visitor pool.
• Employment:	About 1,300 new direct jobs (including hotels); less diversification; hotels jobs less stable.

[1] This is a simplifying assumption; see discussion on following page.

Since the hotels would have fairly low occupancies, there would be no need for planned expansions of total rooms in later years (although, as mentioned earlier, a revised, more mass-market concept could be adopted). The without-project future would also mean reducing staff and the ability to make additional commitments or contributions to the community, according to Castle & Cooke Properties executives.

The Manele area housing without the project would be confined to the existing project district. It would consist of 342 single-family and 74 multi-family units. With smaller lots, less impressive views, and fewer nearby amenities than with the project, about 25 single-family and 12 multi-family residential units could be marketed annually. These units would command lower prices than with the project, although they still would be in the luxury category. The number of units in visitor pools would increase, and the number of visitors staying in the Manele area could double to over 100 by 2010. However, with or without the project, full-time residents would constitute the majority of the population.

The residential development planned for Koele would not be affected by the project.

The average visitor population staying at the two resort areas is projected as shown in Table J-2a, "Manele Bay Average Daily On-Site Population" and Table J-2b, "Koele Lodge Average Daily On-Site Population."

With or without the project, Castle & Cooke plans to develop the Lanai resorts for an upscale clientele. With low occupancies, however, the operator would likely need to realize savings on amenities and level of service, including the number of employees and community subsidies or contributions. Indirect and induced employment, including new business opportunities, would also be affected.

5.2.3 Project Impacts

The project is expected to attract appreciably more visitors and resort residents to Lanai -- a total resort population of about 1,800 people, on average, at the two resort areas in 2001. This is about twice as many as would come to Lanai without the project. The project's impact consists of:

- Higher hotel occupancies (reaching an estimated 70%) at Koele Lodge, and 80% at the Manele Bay Hotel);

- Demand for additional hotel rooms at both Koele and Manele, leading to construction of 298 more rooms;

- Buildout and sale of resort residential units in both resort project districts during the coming decade (versus construction continuing until 2007 without the project -- if in fact there is a sufficient market to achieve buildout without the project);

- Purchase of residential units by upscale buyers, of whom the large majority would be full- or part-time residents -- for example, about 25% of Manele

single-family units would be bought by full-time residents and 65% by part-time residents, versus 20% and 50% without the project (estimates provided by Castle & Cooke Properties executives).

The golf course would both attract more visitors and draw some of them away from areas now shared with Lanai residents, such as Hulopoe Beach. (The increase in resort population, however, is greater than the number of golfers expected to use the course at any one time.)

5.3 Labor Demand Versus Supply

Economists normally identify three categories of jobs created by new expenditures:

- Direct jobs -- those created by direct expenditure of funds for construction or from visitor expenditures (e.g., jobs on-site at resorts or off-site from visitor spending at airports, gift shops, etc.).

- Indirect jobs -- created when businesses supported by direct expenditures purchase goods or services from other businesses.

- Induced jobs -- created when workers in the first two categories make purchases in the local economy or pay taxes for government services.

Calculation of indirect and induced employment (the "spin-off" business effect) on Lanai itself is problematic. Standard multipliers developed by the Department of Business, Economic Development, and Tourism provide fairly reliable estimates of indirect and induced employment on a statewide basis. However, there have been few studies which indicate the likely impacts on individual islands.

Additionally, Lanai is now an atypical Hawaiian island because of its heavy concentration of landownership and the lack of currently zoned commercial areas. Although the island has seen a heavy influx of construction workers in the past several years, there has been no significant increase in the number of local businesses serving the transient workers. Finally, many of Lanai's current jobs supporting the pineapple industry will become support jobs for tourism.

In preparing the following estimates of labor demand, CRI has assumed that all parties involved are working toward full development of Lanai's potential to be a prosperous island economy. This means that Lanai's share of the statewide indirect/induced jobs from resort development would likely grow over time, as more commercial space is developed. Estimates of retail and indirect/induced jobs in 1991 may point to demand that will not be fully met on-island in that year. In later years, however, no such unmet demand is expected.

The assumed ratio of total new Lanai jobs to new direct jobs (about 1.25) is comparable with ratios estimated on Kauai in the early 1970s (Anderson, 1974) and estimated for other Hawaiian islands in resort EIS's over the past decade. It is also close to the ratio of total Lanai jobs in 1980 to direct pineapple jobs (U.S. Census, 1981b).

5.3.1 Construction Impacts

5.3.1.1 Existing Conditions

The construction of the Koele and Manele Bay hotels has brought hundreds of construction workers to Lanai over the past three years. With 500 or more construction workers on island at the high point, this workforce was as large or larger than Dole's workforce.

As of October 1990, about 375 construction workers are present (based on meal orders). The majority of the workers are union employees brought in from other islands. Based on conversations with two major contractors, CRI estimates a maximum of 80 to 100 construction workers are long-term Lanai residents.

5.3.1.2 Future Demand Without Project

When the Manele Bay Hotel is completed, the number of construction workers needed on Lanai will drop considerably. However, other construction projects would include work on resort employee housing in Lanai City, infrastructural development for the resort residential areas at Manele and Koele, and construction of single-family and multifamily homes in those areas.

Without the project, the average number of direct resort-related construction worker jobs on Lanai is estimated as varying from about 70 in 1992 to about 130 in 1996, then falling to about 30 per year in 2001 to 2006.

(This analysis assumes that no hotel additions would be built without the project. However, it is possible that additions might be built, for a different market than currently projected for the Lanai resort areas, and at lower cost than projected.)

5.3.1.3 Project Impacts

The total amount of construction with the project would be appreciably greater with the project, but the duration of the construction period would be shorter, due to higher demand for the resort residential units.

Major construction projects that would occur with the project, but not otherwise, include:

- The Manele golf course and clubhouse (opening in 1992); and
- The Manele Bay and Koele hotel additions, projected as under construction in 1995-1997.

Costs and employment for residential development would be higher with the project, both because the residential area needing infrastructure at Manele would be much larger and also because many housing units, on lots of 30,000 square feet or more, would be larger than the average house built at Manele without the project.

Average direct construction employment is projected as:

	1991	1996	2001	2006
With Project	149	358	0	0
Without Project	69	134	30	23

Indirect and induced jobs on Lanai derived from construction are estimated as:

	1991	1996	2001	2006
With Project	51	120	0	0
Without Project	26	47	11	8

With a large, prosperous resort, the amount of construction needed to supply employee housing and off-resort commercial or service establishments would likely increase over the without-project scenario. The above estimates of construction employment allow for the resort employee housing that Castle & Cooke has agreed to build, but not further off-resort construction.

5.3.2 Operational Impacts

5.3.2.1 Existing Conditions

(NOTE: Existing socio-conditions have been changing rapidly on Lanai and are continuing to change. Unless a specific notation to the contrary appears, the following text describes "Existing Conditions" as of fall 1990, when the Draft EIS was prepared.)

Pineapple cultivation has been the employment base for Lanai residents for decades. Lanai's economy is now changing from pineapple production to resort operations, with some diversified agriculture and other support activities. By 1992, the visitor industry will be the main source of employment for Lanai residents.

In 1979, Dole had 14,000 acres on Lanai planted in pineapple. By 1989, only 9,000 acres were in pineapple. The transition from an agricultural economy to a new economy was already under way before the first resort hotel opened on Lanai.

As of 1980, the civilian labor force of 1,024 was heavily concentrated in agriculture and related activities (see Table J-3, "Labor Force Size and Characteristics--Lanai Island, Maui County, and State of Hawaii, 1980"). In the mid-1980s, the civilian labor force averaged 1,050 (Hawaii State Department of Labor and Industrial Relations, 1990). By August 1990 -- following the opening of The Lodge at Koele -- there were an estimated 1,212 people in the Lanai civilian labor force (personal communication, Manuel Fragante, Hawaii State Department of Labor and Industrial Relations, October 4, 1990).

The three main employers on Lanai are Dole, the Lanai Co., and RockResorts. (NOTE: RockResorts is the hotel operator, with day-to-day supervisory authority over employees. Technically, however, hotel workers are on the payroll of the hotel owner,

Lanai Resort Partners, which, like Dole and the Lanai Company, is a Dole Food Co., Inc. entity. Overall management responsibility rests with Castle & Cooke Properties, Inc.)

As of fall 1990, Dole was the largest employer with about 411 employees, 10% of whom are in salaried administrative and supervisory positions. This was a decrease from 567 employees in 1987. Dole employment is expected to decrease further to about 340 jobs by the end of 1990. By late 1992, all but 20 to 30 Dole jobs on Lanai will be eliminated; these will end in 1993. [Note: As of March 1991, Dole was no longer the largest employer since many of its employees transferred to work with the hotels or Lanai Company.]

Dole employees wishing alternative employment are being offered job opportunities by the Lanai Company and Lanai Resort Partners, beginning immediately. Dole will import migrant agricultural workers to fill vacancies during the next several years.

The Lanai Company has grown from a staff of 29 employees in 1985 to about 260 workers at present (personal communication, Henry Oliva, Lanai Company, September 20, 1990). The increase is due largely to construction activities and support services in preparation for resort and residential development on the island. Many Lanai Company employees had been non-regular Dole workers. The company's workers tend to be younger than the Dole workforce.

Lanai Resort Partners opened The Lodge at Koele in early 1990. As of fall 1990, the company employed 212 workers on Lanai, around 75% of whom are estimated by RockResorts management to be longterm Lanai residents.

Recent figures show that more than a third of the Rockresorts management staff are Lanai residents, as are one-fifth of the Lanai Company management staff.

(NOTE: As of April 2, 1991, Lanai Resort Partners had filled 159 of a total 197 positions needed to open the Manele Bay Hotel in early May 1991. This 159 job count includes both full- and part-time positions. However, the great majority are full-time; RockResorts estimates the 159 total positions equal about 145 full-time equivalent positions.

(The source of labor for the 159 positions filled to date included the following:

(Longtime Lanai Residents	124	[78%]
-- from Dole Co.	-- 68	
-- longtime Lanai residents transferring from Koele or RockResorts Central Services	-- 16	
-- other current Lanai residents	-- 35	
-- returning off-island Lanai residents	-- 5	
(Other Hawaii Residents	20	[6%]
(Direct Mainland Arrivals	10	[7%]

(Recent Lanai Arrivals from Outside Hawaii Now
Transferring from Koele/Central Services 13 [8%])

5.3.2.2 Future Demand Without Project

The Manele Bay Hotel opened in May 1991. Without the project, it is expected to attract relatively few guests, to reach 50% occupancy by around 1996, and to have about 50% occupancy afterwards. With low occupancies expected at both hotels for the foreseeable future, the Manele Bay Hotel would employ fewer workers than has been announced -- an ultimate maximum of only about 330 full-time equivalent workers, rather than 430 -- after an initial start-up of about 200 total positions. The number of jobs at Koele Lodge would also be reduced from current levels (personal communication, Thomas Leppert, President, Castle & Cooke Properties, October 25, 1990).

(NOTE: In reality, because of the timeframe for the approval process for this project, initial staffing for the Manele Bay Hotel will probably be based on the assumption of project approval. Actual differences in staffing levels due to lack of a golf course would probably not materialize until about 1992. However, for purposes of this analysis, 1991 will be used as a baseline year. This means the 1991 "without-project" staffing levels are estimated on the assumption that management anticipates project disapproval and low occupancies, rather than approval.)

The Koele Golf Course, opening in mid-1991, will provide jobs for groundskeepers, food and beverage workers, and golf staff. In addition to these jobs, a few direct jobs will be generated in the resort residential areas. (These include cleaning, security, and management positions.)

Finally, visitor spending will support retail jobs. In light of the limited retail space on Lanai and the visitor market expected to visit the island, the number of retail jobs generated by visitor spending on-island is expected to be about half the statewide average. (The number of retail jobs for the resort market depends on availability of retail space. In the present analysis, it is expected that additional space will be created somewhere on Lanai in response to demand. It is, however, quite possible that the creation of retail space and jobs could lag behind resort development.)

Table IV-7 identifies the projected direct operational jobs generated by resort operations without the project. It also shows indirect and induced jobs associated with resort development. A few points about Table IV-7 (and the later corresponding Table IV-8 showing the "with-project" future situation) bear explaining:

- Construction employment is also included on the table and in the totals, since construction is a factor in the subsequent labor supply analysis.

- Direct operational jobs are categorized not by location (e.g., at the hotel or elsewhere) but rather by sector of the economy, since different sectors have different multipliers for calculating indirect and induced employment effects. Most direct operational jobs would be located at the hotels, golf course, or clubhouse, but some retail and personal service jobs could be generated by direct visitor spending in Lanai City or elsewhere on Lanai.

TABLE IV-7

DIRECT, INDIRECT, AND INDUCED EMPLOYMENT WITH LANAI RESORT DEVELOPMENT -- WITHOUT PROJECT

Jobs by Industry	Multipliers	1991	1996	2001	2006
Hotel/Commercial/ Infrastructure/Construction					
Direct		0	52	9	9
Indirect, Induced, State	1.76	0	91	16	16
Indirect, Induced, Lanai	0.314	0	16	3	3
Housing Construction					
Direct		69	82	21	14
Indirect, Induced, State	2.17	149	177	46	30
Indirect, Induced, Lanai	0.377	26	31	8	5
Retail					
Direct[1]		49	147	194	209
Indirect, Induced, State	0.57	28	84	111	119
Indirect, Induced, Lanai	0.1905	9	28	37	40
Eating/Drinking (on- or off-resort)					
Direct		171	196	196	196
Indirect, Induced, State	0.81	138	159	159	159
Indirect, Induced, Lanai	0.3065	52	60	60	60
Hotel (except Eating/Drinking)					
Direct		304	353	353	350
Indirect, Induced, State	0.9	274	318	318	315
Indirect, Induced, Lanai	0.232	71	82	82	81
Services for Resort Residents					
Direct		0	16	34	41
Indirect, Induced, State	0.82	0	13	28	34
Indirect, Induced, Lanai	0.248	0	4	8	10
Amusement Services					
Direct		33	49	49	49
Indirect, Induced, State	0.49	16	24	24	24
Indirect, Induced, Lanai	0.128	4	6	6	6
Total Direct		626	894	856	868
Total Indirect, Induced, State		605	865	701	697
Total Indirect, Induced, Lanai		162	227	205	206
Total Lanai Direct, Indirect, Induced Jobs		789	1,121	1,061	1,074
Total Civilian Labor on Lanai		812	1,154	1,093	1,107
Unemployment[2]		24	33	32	33

NOTES:

Jobs are arranged to correspond with industries defined in the State's Input/Output Model. Lanai indirect and induced employment multipliers are based on the following assumptions:

Indirect: 10% of Statewide indirect employment associated with Construction jobs remains on Lanai, 15% of Retail, and 25% of Eating and Drinking jobs;

Induced: 20% of induced jobs associated with Construction employment, and 40% of induced jobs associated with Operational jobs stay on-island.

1 Based on visitor spending: 1.75 jobs per $1 million estimated total visitor spending (midrange estimate from later fiscal analysis).

2 Unemployment calculated on assumption of constant 3% unemployment, not including in-migrant construction workers.

TABLE IV-8

DIRECT, INDIRECT, AND INDUCED EMPLOYMENT ASSOCIATED WITH LANAI RESORT DEVELOPMENT -- WITH PROJECT

Jobs by Industry	Multipliers	1991	1996	2001	2006
Hotel/Commercial/ Infrastructure/Construction					
Direct		80	235	0	0
Indirect, Induced, State	1.76	141	414	0	0
Indirect, Induced, Lanai	0.314	25	74	0	0
Housing Construction					
Direct		69	123	0	0
Indirect, Induced, State	2.17	149	266	0	0
Indirect, Induced, Lanai	0.377	26	46	0	0
Retail					
Direct[1]		100	202	389	386
Indirect, Induced, State	0.57	57	115	222	220
Indirect, Induced, Lanai	0.1905	19	39	74	73
Eating/Drinking (on- or off-resort)					
Direct		193	269	402	402
Indirect, Induced, State	0.81	156	218	326	326
Indirect, Induced, Lanai	0.3065	59	83	123	123
Hotel (except Eating/Drinking)					
Direct		346	438	691	691
Indirect, Induced, State	0.9	312	394	622	622
Indirect, Induced, Lanai	0.232	80	102	160	160
Services for Resort Residents					
Direct		0	25	63	64
Indirect, Induced, State	0.82	0	21	51	52
Indirect, Induced, Lanai	0.248	0	6	16	16
Amusement Services					
Direct		33	94	94	94
Indirect, Induced, State	0.49	16	46	46	46
Indirect, Induced, Lanai	0.128	4	12	12	12
Total Direct		821	1,386	1,638	1,636
Total Indirect, Induced, State		831	1,474	1,266	1,266
Total Indirect, Induced, Lanai		214	361	385	385
Total Direct, Indirect, Induced, Lanai		1,035	1,747	2,023	2,021
Total Civilian Labor Force		1,065	1,793	2,086	2,084
Unemployment[2]		30	46	63	63

NOTES:

Jobs are arranged to correspond with industries defined in the State's Input/Output Model. Lanai indirect and induced employment multipliers are based on the following assumptions:

Indirect: 10% of Statewide indirect employment associated with Construction jobs remains on Lanai, 15% of Retail, and 25% of Eating and Drinking jobs;

Induced: 20% of induced jobs associated with Construction employment, and 40% of induced jobs associated with Operational jobs stay on-island.

[1] Based on visitor spending: 1.75 jobs per $1 million estimated total visitor spending (midrange estimate from later fiscal analysis).

[2] Unemployment calculated on assumption of constant 3% unemployment, not including in-migrant construction workers.

Except for diversified agriculture, few indirect jobs (created by the purchase of goods and services by resort enterprises) are likely to be generated on Lanai. Induced employment (created by worker expenditures and tax revenues) will play a greater role on the island.

The Lanai Company's diversified agriculture operation is expected to grow in the coming years. It would be stimulated by resort development, since resort visitors are the immediate market for specialty produce grown by the company. Similarly, the rock and concrete op\erations of the Lanai Company count as employment indirectly stimulated by recent and projected construction on Lanai.

Induced jobs would include commercial and professional jobs. Many of these already exist. For example, the storekeeper whose customers are Dole Company employees will retain customers as they go to work for the Lanai Company or RockResorts (i.e., Lanai Resort Partners), yet analytically this job will become a resort-induced job rather than one induced by plantation operations.

Indirect and induced jobs due to both pineapple cultivation and resort development in 1991 are projected as roughly equal to the number of such jobs supported by the plantation in the early 1980s. Over time, non-resort jobs on Lanai supported by the resort economy would increase to about 225 jobs, then stabilize at 200 jobs. These figures indicate that, without the project, the resort would support slightly fewer jobs than were supported by pineapple cultivation in the early 1980s.

CRI has calculated the longterm Lanaian labor force as 1,050 in 1990, based on averages from the mid-1980s. Historically, the size of the labor force supported by pineapple was fairly constant. In projecting future labor supply, CRI has treated the long-term resident labor supply as shrinking before mid-1991 due to retirements, then as constant at 1,000 persons. In mid-1991, 125 persons are treated as working for Dole or in jobs related to the pineapple economy, leaving 875 persons available for resort-related work. Afterwards, 1,000 Lanaians are treated as available for resort-related jobs.

(These labor force figures exclude in-migrants now working resort and resort-related jobs. They are used to estimate the impact of resort operations on the labor supply. They presume that few young Lanaians join the baseline labor force, since only about 10% of high school graduates stayed on-island in recent years [Matsuoka and Shera, 1990]. In the future, more young people could well stay on Lanai, but their continued residence must be treated as an impact of the new economy.)

Without the project, the number of resort-related jobs -- including indirect and induced jobs -- is estimated as smaller in 1991 than the available Lanai workforce (i.e., the civilian labor force, not including plantation and plantation-induced jobs, and not including Lanaians who return from other islands because of new opportunities). In other words, the resort would not provide enough jobs to employ the available Lanai-born workforce, much less in-migrants who are already on Lanai. By 1996, the resort economy would support a workforce roughly equal in size to the long-term Lanai labor force and the in-migrant workers already on Lanai. However, it is unlikely that long-term residents would have enough jobs, due to the composition of the workforce. A slight decline in jobs is forecast after 1996.

If there were no problems of fit between jobs and available workers, the available Lanaian workforce would account for about the following percentages of resort-related and construction jobs on Lanai:

1991	1996	2001	2006
110%*	90%	95%	95%

* In other words, the workforce would be larger than the jobs created in 1991 in the without-project future.

This analysis projects no in-migration. However, the assumption that longterm Lanai residents would find acceptable jobs in the resort economy is problematic in the without-project future, since few job opportunities would exist. Without the project, it is quite possible that longterm residents would leave the island job pool, whether through retirement, unemployment, or emigration, and a few more in-migrants would come to Lanai than indicated here.

5.3.2.3 Project Impacts

Resort operations with the project would generate about 275 additional jobs on Lanai in 1991 than would be the case in the without-project scenario (see Tables IV-7 and IV-8). Many of the additional jobs would be due to construction of the golf course (discussed below under "Job Characteristics"), but most would be resort direct jobs and the induced jobs associated with them. By 1996, the Lanai resorts would generate almost 675 more jobs with the project than without it. In 2001 and afterwards, the resort would support about 950 more jobs with the project than it would otherwise.

In the near term, the greater number of jobs would follow from higher occupancy levels at the hotels with the project as compared to the without-project future. With higher occupancy, additions to the two hotels would be built, and yet more direct jobs would be created at the resort areas. (It is assumed that 1.3 direct jobs are created per hotel room in the hotel expansions. Nearly 400 direct resort jobs shown for 2001 and 2006 in Table IV-8 are attributable to the hotel expansions. The number of jobs could be even higher, since the 1.3 multiplier presumes that few facilities other than hotel rooms will be built.)

New direct jobs created with the project include work at the Manele golf course, at the Manele Bay and Koele hotel additions, and a few additional jobs in the Manele resort residential area.

Employment impacts of the project involve higher numbers of jobs, both on the resort and elsewhere on Lanai, as a simple function of increased numbers of visitors. However, two complex issues deserve mention:

- With a substantial on-island market for specialty crops, the diversified agricultural operations on Lanai could be introduced, then marketed elsewhere (personal communication, Steve Snow, Lanai Company, 9/18/90). The resort would thus be a catalyst for further growth of these operations.

- The larger Lanai resident population will support expanded commercial, service, professional, and government activities on Lanai.

The figures in Table IV-8, along with CRI's estimates of future available native Lanaian labor force, indicate that the available Lanai-born workforce could fill about the following percentages of resort-related jobs:

1991	1996	2001	2006
85%	55%	50%	50%

The drop in 1996 is largely due to an assumed influx of off-island workers for construction of hotel expansions; smaller proportions in subsequent years reflect the need for in-migrants to fill operational jobs in the expansions. Again, the definition of "in-migrant" is conservative, in that it could actually include returning Lanaians or prevented out-migrants.

(NOTE: Both Tables IV-7 and IV-8 omit one type of labor demand: commercial support jobs from expenditures of affluent full-time resort residents. No current reliable multipliers exist for modeling this employment impact. Furthermore, the extent of such employment would be highly dependent on future development of Lanai commercial space, since affluent residents would find it easy to do much of their shopping and weekend entertainment on Oahu. Based on 1980 Census figures indicating ratio of commercial jobs to population for affluent bedroom communities such as Hawaii Kai, CRI estimates that such jobs on Lanai would amount to 10% of the full-time resort residential population, as a maximum. This would mean about 50 additional jobs without the golf course/residential project; 60, with it.)

5.3.2.4 Labor Supply and Sources

Although they will not be able to fill all new jobs, the most important potential source of labor supply for the next several years will be current Dole workers.

As of October 8, 1990, according to Dole personnel officials (personal communication, Tim Ho, October 17, 1990), the Dole pineapple workforce on Lanai consisted of:

40	salaried (35 managers, five clerical);
142	hourly year-round "regulars";
112	"non-regulars" (carried on payroll year-round, but only work when field operations going on);
66	"covered seasonals" (seasonal workers covered by union contract);
32	non-covered or "pure seasonals" (figure excludes 19 "guest" seasonals who are not Lanai residents).
392	RESIDENT TOTAL (including 98 resident seasonals)

(It should be noted that the Dole workforce constantly fluctuates, and these figures may vary slightly from other published estimates due to such fluctuations and to the exclusions noted above. Also, about ten Dole workers had already transferred to new jobs at the Lanai Company in the period between the phase-down announcement and October 8, 1990.)

In late September and early October, Dole and the ILWU surveyed almost all Dole workers (except for some of the non-covered seasonals) to determine future plans, preferences, and interest in training for new jobs at RockResorts (Lanai Resort Partners) or the Lanai Co.

As of this writing (mid-October 1990), survey results were not yet finalized. The figures in Table J-4, "Potential Availability, Dole Workers Living on Lanai," prepared by CRI, are based on preliminary results, estimates from people involved in conducting the surveys, and CRI extrapolations to the few non-surveyed workers. Factors which may impact the actual availability of Dole workers include worker preferences and "fit" with resort jobs (discussed later) and the age structure of the Dole workforce.

(NOTE: The survey mentioned in the above paragraphs was superceded by a later State Employment Service series of in-depth interviews with Dole employees, preparatory to a retraining program. This 1991 training effort is described in the following Section 5.3.2.7. As described in an earlier NOTE for the Final EIS in Section 5.3.2.1, 78% of the Manele Bay Hotel positions filled as of April 2, 1991 had been filled by Lanai residents – the majority of them former Dole workers.)

The Dole workforce is relatively old. Among non-salaried workers, 17 are currently 65 or older, and more than 60 others will reach age 65 within six years. The median age of employees is over 50, and very few are under 30 years old. These figures might indicate that Dole workers would fill resort-related jobs only temporarily, so that the need for in-migrant workers would be delayed only a few years. However, many male employees married late and have young families to support. Others are immigrants who must work additional years to qualify for Social Security.

Therefore, CRI tentatively concludes that there would <u>not</u> be a sudden, major wave of former Dole employees leaving the future Lanai workforce within a few years due to retirement-age considerations alone.

In order of likelihood, other potential labor sources include:

Lanai Youth: The current enrollment at Lanai High and Elementary School averages about 37 students per class. Only about 10% enter the Lanai workforce immediately (Matsuoka and Shera, 1990). However, only some 15%-20% go on to a four-year college, with the remainder going to community colleges, business schools, or the military. It is reasonable to suppose that a much higher proportion of Lanai-born young people will eventually return to Lanai under an expanding economy than was the case under the former pineapple economy.

In late 1990, the State DLIR's Maui County "School to Work Transition Center" surveyed 38 Lanai High School seniors and 23 juniors on future plans. Among the seniors, the top areas of career interest included:

- Tourism and hotel management (9 mentions)
- Cosmetology (7)
- Business Administration/Management (5)

- Electronics (4)
- Hotel (unspecified) (3)
- Business (3).

The great majority (34 out of 38) intended to continue education after high school, although the majority of schools mentioned were Hawaii business or community colleges; only two students indicated an interest in four-year Mainland schools. About half the students also indicated an interest in military service. (In general, results for the junior class were similar, although more juniors were interested in skilled occupations such as carpentry, nursing, or automotive mechanics.)

The survey -- which will be repeated in May 1991 to track any changes in plans -- may or may not accurately predict future behavior, and it did not specifically ask about long-term plans to remain on (or eventually return to) Lanai. However, it does indicate that career interests for many students appear at least as compatible with a resort economy as with the previous agricultural economy.

Returning Lanaians and Family Members: About one-fourth of the Lanai Company's current workforce consists of returning former Lanaians (personal communication, Henry Oliva, Lanai Company, September 20, 1990).

Additionally, RockResorts maintains a list of about 500 former Lanaians, developed from high school records and contacts with ex-Lanai people now living on the West Coast. The company maintains communication with them through a newsletter and family members still on Lanai. RockResorts offers relocation assistance of $1,000 to returning Lanaians, payable after one year of continuous service.

Other Hawaii Residents: Before turning to any other non-Lanai sources, RockResorts intends to target residents of other Hawaiian islands who may wish to move to Lanai for "lifestyle reasons" -- i.e., slower pace of life and, for supervisory personnel, subsidized housing (personal communication, George Lidicker, RockResorts Inc., September 20, 1990).

Remainder: Any remaining needed workers would have to be imported from the Mainland, although there will also probably be some continuing immigration from the Philippines to join family members already on Lanai. Some supervisors and managers needed to open the Manele Bay Hotel were expected to be brought in from off-island, although the intention is to train local residents to replace as many of them as possible.

5.3.2.5 Job Types and Characteristics

Jobs associated with resort residential units are relatively few and mostly involve building or grounds maintenance, property management, or housekeeping. Most of these will probably be associated with divisions of the Lanai Company.

Golf course jobs are generally divided into four divisions: golf services, grounds maintenance, clubhouse administration, and clubhouse food service. The director of golf, superintendent, club manager, and food and beverage manager serve as division

heads for each respective division. The director of golf is also the head administrator of the total golf course. Clubhouse jobs may be under RockResorts (Lanai Resort Partners); other golf course jobs, under the Lanai Company.

Table J-5, "Summary of Manele Golf Course Jobs/Characteristics," lists probable number of jobs (approximately 80), types of jobs, and starting annual salaries expected at the Manele Bay golf course. Jobs and salaries were estimated by David A. Hein, Lanai Company golf course superintendent. Wages would likely increase as staff gain in experience. Wages do not include tips or fringe benefits.

Responsibilities of the director of golf and superintendent include duties at Koele Golf Course. A superintendent for the Koele and Manele golf courses and a director of golf have been hired. A director of golf has not been hired yet. Some clubhouse food service jobs, such as waithelp, bartender, cook, and steward may be part-time positions.

A sense of the types of jobs available at the Manele Bay Hotel (and of the general impact which could be attributed to golf course development through effect on occupancies) is given in Table J-6. Figures apply to the initial 250 units only.

5.3.2.6 Other Issues Relating to Employment

"Fit" of Jobs to Lanai Resident Background: Golf course jobs (at least those involving golf services and grounds maintenance) are similar to pineapple jobs in that they are outdoors and often involve horticulture or equipment maintenance. In areas such as Kohala, many senior golf course employees are former sugar plantation workers. On Lanai, a September 1990 posting for a few golf course jobs drew more than 180 applications from Dole workers. This partly reflected concern over the recent pineapple phase-down announcement, but also reflected interest in the higher wages, benefits, and opportunities for advancement in golf course jobs. An earlier posting drew three applicants for every available position (personal communication, David A. Hein, Lanai Company, September 21, 1990).

Less clear is the "fit" between the backgrounds and preferences of pineapple workers and the requirements of direct service jobs in upscale hotels. A few hotel workers interviewed by CRI reported some discomfort with the formal atmosphere, uniforms, and hours, but the majority did not. These interviews were not systematic, and no reliable quantitative information exists on the issue at this point.

The current Lanai resort workforce is relatively young. It is probable that older agricultural workers making the transition from Dole will need more training or assistance to learn basic social and communication skills for service work. The amount of needed assistance will vary, since many resort jobs are located in the "back of the house" where there is limited contact with guests.

Preliminary results of the September 1990 survey of non-salaried Dole workers indicate that:

- The single most preferred type of future job was "landscaping" (39%).

- Some 85 employees have 20 or more years of service with Dole and are expected to transfer to the approximately 80-100 Lanai Company jobs expected to be available in the next year. This means more than 200 would need to seek employment in resort settings or their own businesses.

- There was significant interest in "back of the house" resort jobs (e.g., housekeeping), but very little interest in jobs with significant amounts of public contact (particularly food and beverage jobs). The consultant for the survey attributed this lack of interest to illiteracy and lack of language communication skills. Literacy training for Dole, Lanai Company, and Lanai Resort Partners employees is already underway.

Among salaried Dole workers, interest was highest for "agriculture-related" future jobs (38%), followed by "office/accounting/computer" (28%), "engineering/mechanical" (19%), and "other supervisory" (16%). Thus, former Dole managers and supervisors may face a more difficult "fit" into the resort economy than do non-salaried workers.

(NOTE: The foregoing paragraphs appeared in the Draft EIS and are unaltered here. However, the Dole worker retraining program described in the following Section 5.3.2.7 has provided good preliminary indications that concerns about "fit" for former agricultural workers in upscale hotels have been addressed for at least some former pineapple workers. Among at least one group of Dole workers, concerns about language barriers and fears of being treated by guests with disrespect or condescension were directly addressed in the training effort. The ultimate success of this program, however, cannot be determined until the hotel has been operating and the trainees deal with the real-life work situation.)

Worker Satisfaction: Some social critics (e.g., Kent, 1975) have alleged that a "servant mentality" inherent in resort work damages employee self-esteem. However, there has been no published data supporting this contention, and CRI interviews with resort personnel officers, union officials, and independent social workers around the state in the last decade have turned up few references to this as a serious mental health problem.

The 1988 Statewide Tourism Impact Core Survey (Community Resources Inc., 1989) found that self-described "visitor industry" workers had reported job satisfaction levels essentially identical to statewide averages (Table IV-9). By comparison, for all 1988 Lanai workers, job satisfaction was more polarized (i.e., a little higher and a little lower, less in the middle), while a 1989 University of Hawaii Social Work survey (Matsuoka and Shera, 1990), indicated even greater Lanai job satisfaction.

TABLE IV-9
JOB SATISFACTION DATA, 1988

	Lanai Workers*	Workers Statewide*	Visitor Industry
Very Satisfied	67%	57%	55%
Fairly Satisfied	18%	30%	31%
Little Dissatisfied	10%	8%	7%
Very Dissatisfied	4%	3%	3%
Not Sure/Refused	2%	3%	3%

* all industries

Source: Community Resources, Inc., 1989.

A 1986 statewide survey of unionized hotel workers (summarized in Belt Collins and Associates, 1987, p. V-63) explored worker job satisfaction in more detail. Large majorities of hotel workers said they liked their jobs and felt pride in their work. Smaller majorities said they were satisfied with their pay. However, pluralities or majorities said not enough Hawaii residents were promoted to high managerial positions and that "Supervisors who are not from Hawaii don't understand the needs of employees who are."

5.3.2.7 Mitigation Measures

(NOTE: The following section has been substantially rewritten for the Final EIS, in order to describe the recent Dole worker retraining program.)

The most basic mitigation involves agreements made by both the Lanai Company and RockResorts (Lanai Resort Partners) with the ILWU. These agreements stipulate that qualified Dole employees will be given preference over all other employees (except those already in the employ of the respective companies) for new positions posted after September 7, 1990. Related additional mitigation strategies include (1) training Lanai residents (particularly current Dole workers), and (2) programs to further improve "fit" with Lanai residents' backgrounds after they are actually on the ground.

Many direct golf course jobs, as well as building and grounds maintenance for resort residential properties, would be under the Lanai Company. Such jobs would require skills similar to those currently required for Dole employees. Additional training would be relatively minimal and could be accomplished through on-the-job experience. Thus, the major training needs would be associated more with service jobs (primarily under Lanai Resort Partners) at the golf clubhouse and the Manele Bay Hotel.

Following the September 1990 announcement of the pineapple phase-down, initial steps to re-direct Dole workers into the tourism workforce were taken by Castle & Cooke and the ILWU. Castle & Cooke hired a social work consultant to work with the ILWU to survey Dole workers about training needs. The scope of the consultant's

contract included subsequent work related to individual career counseling and provision of appropriate training. Also involved was an organization known as Hawaii Human Development (described at more length later), which had already been involved in literacy programs for Lanai residents.

These efforts were gradually folded into an even larger program spearheaded by the State of Hawaii. Governor John Waihee announced that the State Department of Labor and Industrial Relations (DLIR) would coordinate the effort. Based on a Canadian model for dealing with plant closings, DLIR created a "Labor-Management-Government Committee" (LMGC), with representation from Castle & Cooke, the ILWU and a wide variety of government agencies. It began meeting in mid-September.

The LMGC created four sub-committees:

(1) Survey Committee -- This began with the previously discussed effort by the ILWU and Dole to survey all workers, in order to determine skills, preferences, and training needs. Subsequently, the State Employment Service also conducted independent assessments of individual Dole worker career goals and training needs.

(2) Counseling Committee -- This has focused on psychological aspects of job transition, as well as more practical concerns such as finances and housing. The "committee" in fact did not so much attempt to initiate new programs as to exchange information and make sure that already-involved agencies (e.g., social workers, the ILWU, etc.) were actually meeting needs.

(3) Communications Committee -- The major purpose of this group was to assure that Dole workers were kept informed of developments. The ILWU played a major role. The union took steps such as bringing Maui hotel workers to Lanai to describe hotel work conditions to their fellow union members.

(4) Training Committee -- Maui Community College, the State Employment Service, Hawaii Human Development, and Lanai Resort Partners were primarily responsible for planning and carrying out training programs for Dole workers.

The training effort proved to be the LMGC's principal focus. Following publication of the Draft EIS for this project, the LMGC obtained a preliminary $110,000 grant from the U.S. Department of Labor for retraining Dole workers interested in resort jobs.

In late January 1991, the State Employment Service attempted to interview all such workers in order to develop personalized training plans. Thus, the Employment Service essentially served in a case management function. According to Maui County Branch Manager Alvin Tanaka (personal communication, February 8, 1991), many Dole workers at that time appeared strongly interested in the retraining program, although most also appeared hesitant to work full-time at the new hotel for fear of losing

severance pay from the Dole Co. However, many were tentatively interested in part-time work.

Throughout early 1991, CRI interviewed various parties involved in the training program. Virtually all of them said that the major concern expressed by Dole workers involved their limited English abilities and a consequent fear of "being laughed at" or looked down upon by visitors. Consequently, there was a strong psychological aversion to any "front of the house" job which would involve much direct interaction with visitors. Reportedly, only one Dole worker expressed any interest in dining room positions as of February 1991.

Therefore, the training effort was custom-designed not only to provide an initial exposure to hotel jobs, but also to deal directly with issues of language and general anxiety about the new work setting.

The actual training curriculum was designed by Maui Community College's Visitor Training and Education Center (VITEC), in cooperation with Hawaii Human Development. Also involved in the overall process were the Catholic Immigration Services and Castle & Cooke's social work consultant; along with Hawaii Human Development, they split the tasks of outreach (contacting people not seen by the Employment Service) liaison between clients and the Employment Service, following up on individual absences, and reporting problems to case managers.

Classes were held in March 1991, when most pineapple workers were on furlough due to cannery maintenance. (Another round of courses will be held in the next few months.) It was repeatedly stressed that participation would not necessarily lead to immediate jobs (in part because the hotel will be staffing up slowly in response to occupancy levels). Only three absences were permitted.

The classes extended for 19 days, four hours per day, Mondays through Fridays. The structure was as follows:

Topic 1 (5 days) -- **Hotel Job Exploration: General Overview**

Topic 2 (3 days) -- **Guest Service Attitudes**

Topic 3 (5 days) -- **Specific Job Exploration** (choice of one module: clerical/ computer, housekeeping, food service preparation, guest relations, dining room service)

Topic 4 (5 days) -- **Specific Job Exploration** (choice of one module: bartending, housekeeping, food service preparation, guest relations, dining room service)

Topic 5 (1 day) -- **"Where Do I Go From Here?"** and **Graduation: Certificates Awarded**.

(NOTE: After the main classes began, there was a demand to accommodate some workers who were not furloughed -- e.g., harbor, trucking, or clerical workers.

Night classes were arranged for these people, and the job exploration time was more limited. However, night students did have the opportunity for job shadowing at Koele.)

Some of the critical elements of the VITEC courses included:

- Two intensive days of "training the trainers," with very strong emphasis on cultural learning styles, language factors, and specific fears/concerns of Lanai residents, as well as the actual content of the courses.

- Of the 12 trainers, a few were off-island specialists (e.g., from VITEC or Hawaii Human Development), but most were from Lanai and/or RockResorts itself. The decision to involve RockResorts mid-management and supervisors was considered a calculated risk, because it was possible that participants could have made a bad impression on them, jeopardizing their chances of being hired. However, their involvement proved to be beneficial, because they could discuss the potential work setting in specific detail and because they ultimately became advocates within the organization for hiring many of "their" students.

- Teaching techniques which minimized "classroom-style" lectures and tests in favor of hands-on activities, role-playing, flash cards, and frequent praise and encouragement. All participants were exposed to actual hotel work settings for at least part of the time.

- The strong concerns about language and "being laughed at" were addressed head-on, and instructors provided specific techniques which people could use to help guests understand them or to deal with situations where people did not understand them well.

The long-term success of the courses cannot be determined until after the hotel has opened and been in operation. However, some indications of preliminary success included these:

(1) Both the conclusions of individual teaching modules and the final graduation ceremony were reportedly jubilant affairs, with many people bringing gifts for the instructors and thanking them for helping to boost their self-confidence.

(2) Despite Lanai workers' strong initial aversion to food and beverage service jobs, 100% of the Manele Bay Hotel's initial dining and banquet jobs will be filled by Lanai residents, many of them graduates of the March training program.

(3) Of the 178 workers who completed the course (only four dropped out), 157 were assessed as to their eligibility for resort employment. (The 21 night course graduates were not assessed because Dole Co. will not phase out their jobs in the near future. Therefore, there are issues of severance pay if they resign now. However, some are interested in part-time jobs in the near future, and RockResorts is exploring how many of the remaining job openings could be converted to part-time work.)

The assessment was essentially based on language and communication skills. Of the 157 who were assessed, 101 were rated as having skills eligible for employment. The remaining 56 will be offered free night training classes in language skills by Hawaii Human Development.

Of the 101 eligible workers, 68 had been offered immediate jobs as of April 2, 1991, and 33 were classified eligible for subsequent hiring as more resort jobs open up. Of the 68 offered immediate jobs, 64 had definitely accepted as of April 2; three had conditionally accepted (pending resolution of questions about severance pay from Dole); and one declined (because the job transfer would have affected his eligibility for Dole Company housing).

While the initial retaining program has generally been considered very successful, interviews with various participants suggest there are still a number of questions and/or needed improvements:

(1) RockResorts and the Dole Co. are still in the process of ironing out the logistics of employee transfers while Dole remains in business. Some of the unresolved issues may put certain employees in difficult positions:

- Severance pay -- Dole workers whose jobs are being phased out immediately will receive severance pay if they go to work now at the hotels, but those whose jobs are considered crucial to ongoing operations would not receive severance pay if they quit now.

- Housing -- While most Dole workers in company housing would keep their housing if they transfer to resort work, some might not. The one Dole worker who declined a resort job offer is currently a supervisor who would have lost supervisory-level housing if he had taken the hourly job offered at Manele Bay Hotel.

(2) There is a sense of optimism that the March training program made significant progress in dealing with community concerns about "front of the house" jobs. At the same time, those involved (e.g., resort personnel officers, VITEC trainers, the State Employment Service) do not believe that all community apprehensions have been totally cleared up.

It is possible that male workers continue to have a greater sense of reserve about "front of the house" jobs than do females. Fewer males than females signed up for the March training course, and some of the positions which RockResorts has not yet been able to fill (bellman, shuttle driver) are traditionally more appealing to men than to women.

(3) Several people involved in the training felt that more time and attention is needed -- both more training time for other people taking the course in the future, and also more post-employment attention to those Lanai residents who completed the course and have been placed at the hotel.

The March training was one of the longest "pre-employment" courses which has bee offered in Hawaii, and people selected for work are continuing to receive on-the-job training from RockResorts. However, some trainers felt Lanai residents could have used even more time to deal with their concerns about "fit" and self-image, as well as ongoing "job retention" counseling after the hotel opens. These issues were to be discussed at the next LMGC meeting.

Other Mitigation Efforts

In addition to the LMGC initiatives, a number of other public or private programs have been initiated or proposed to address training and education concerns:

Maui County Task Force on Lanai: Former Maui Mayor Hannibal Tavares responded to the pineapple phase-down by announcing appointment of a task force to focus on ways to continue agriculture on Lanai and to ease transition problems. The task force would be similar to a County task force formed in the early 1980s when Molokai pineapple operations were phased out.

The task force held an initial meeting in November 1990. Chaired by Lanai resident Shiro Hokama, it tentatively consists of 11 Lanai residents -- representing Castle & Cooke, private businesses, and community organizations -- as well as nine ex-officio representatives from various State and County agencies. However, as of early April 1991, further meetings of the task force were pending membership approval and discussion with the new mayor of Maui County.

Transition Center: In conjunction with the Department of Education, DLIR operates "transition centers" in selected high schools throughout the state. The transition centers assist students in making the transition from academic to practical employment settings.

Following the pineapple phase-down announcement, a Maui counselor has begun visiting Lanai twice monthly to meet with students both individually and in groups. Workshops conducted thus far include career decision making, self assessment, and job interviewing techniques. Services will be provided through the semester and will continue after summer break.

Hawaii Human Development (HHD): HHD is the Hawaii arm of a nonprofit organization also operating on the West Coast. Prior to the formation of the LMGC, it was already involved in a workplace literacy project with Dole workers, utilizing federal funds and working in partnership with the ILWU and Castle & Cooke.

HHD received a $150,000 "Rural Community Assistance Program" grant from the 1990 Hawaii State Legislature, allowing it to leverage a minimum of $350,000 in new federal funding. The State grant (used to provide support for basic administrative personnel) is intended to assure the existence of an organization focusing on aid to traditional plantation towns undergoing transition to service economies -- specifically including Lanai City, Waialua, Ewa, Hilo, Ka'u, and Hamakua.

The organization can then expand to use additional future funding as appropriate for dealing with actual transitions such as now being experienced on Lanai. In coordination with the ILWU, HHD is to act as a "catalyst and general resource" to develop services such as workplace literacy, job training, and technical assistance for small business development. Such capabilities closely match the preliminary results of the Dole non-salaried worker survey, which suggest that illiteracy and lack of confidence in language skills may present barriers to many Lanaians taking resort jobs with substantial amounts of public contact.

(NOTE: Since the Draft EIS was completed, HHD has continued to work with the ILWU and various State agencies to plan and develop job training programs. It is currently assisting the State in proposing for possible additional federal funding, which may be granted if the State has used federally allocated funds for displaced workers in Hawaii.)

Po`okela Program: The Po'okela Program was developed by the nonprofit Waiaha Foundation to promote Hawaiian values in the resort industry. Matching State funds are available for workshops on topics such as Hawaiiana, the history of the area surrounding the resort, and "Aloha Service" delivery. Activities include program planning and discussions by committees which put hotel general managers and gardeners on an equal status.

On Lanai, RockResorts (Lanai Resort Partners) contracted for workshops delivered to all employees of The Lodge at Koele, many of which were also taken by Lanai Company employees. These will also be given to all future employees at the Manele Bay Hotel. Additionally, ongoing workshops on basic Hawaiiana and the history of Lanai will be offered every two months, to assure that new Lanai Resort Partners employees (or other interested community members) has received the training (personal communication, Barbara Mills, Waiaha Foundation, September 26, 1990). The component focusing on the history of Lanai also addresses cultural factors such as ethnic histories of various Lanai groups and the practical implications of living in small, close-knit communities such as Lanai City.

5.4 Resident Population and Housing Impacts

5.4.1 Construction

(NOTE: The following description was accurate as of the writing of the Draft EIS. Since that time, the number of construction workers has continued to drop, and the Camp Manele construction housing quarters have been closed.)

Of the 375 construction workers now on the island, around 80 to 100 are from Lanai; 240 are housed in company-provided dormitories; and the rest rent from individual homeowners (absorbing some 10 to 20 Lanai City units). Their lengths of stay vary, but on the average, those who stay in the dormitories are in Lanai for six to eight months. Very few bring dependents with them. Construction workers with dependents rent from individual homeowners. (This information is based on discussions with the Lanai Company's dormitory administrator, as well as estimates provided by construction contractors for the Manele Bay Hotel and Koele Golf Course.)

The dormitories consist of log cabins, *hales*, and trailers in Lanai City and Manele Bay. These can hold around 460 workers. The majority of the 240 workers stay in Camp Manele and the log cabins in Lanai City. A few of the *hales* are used for 36 migrant agricultural workers who arrived in September for a three-month stay.

While the Manele construction worker quarters will be taken down by April 1991, use of the Lanai City dormitories after the major construction projects are completed is not clearly defined at this time. They could house other types of workers, such as young newcomer hotel workers or, during the pineapple phasedown, migrant agricultural workers. However, it may be anticipated that they could help house many of the 300 or so construction workers expected to return to Lanai in the mid-1990s for construction of hotel expansions and resort residential units (Section 5.3.1), if planned new apartment rentals are not yet on line or do not have enough vacancies.

5.4.2 Operational Phase

5.4.2.1 Existing Conditions

(NOTE: Unless a specific notation to the contrary appears, the following text describes "Existing Conditions" as of fall 1990, when the Draft EIS was prepared.)

Since mid-1989, when the resident population was estimated by State statisticians as 2,200, labor force statistics suggest that resort development has brought an increase of about 200 persons to Lanai. Housing unit administrator estimates are lower, at 100 in-migrants or less (excluding construction workers).

Most of the housing stock is old -- some 630 units were built before 1950 (M&E Pacific, Inc., 1989) -- and prices have risen sharply in the past year for housing not controlled by Castle & Cooke.

Nonetheless, the housing situation on Lanai has been among the best in the state in various respects. Costs are still low compared to other areas; home ownership rates were close to statewide averages in 1980 (and would be higher now, due to the Lalakoa housing addition), and Castle & Cooke has heavily subsidized new housing development. Most of the income data presented later (Section 5.7.3) suggest that housing sales costs for recently provided new units have been very affordable for most Lanaians.

Before resort development, Lanai's housing market was extremely limited. It reflected the plantation economy and society:

- Housing costs were lower than in any other district of Hawaii (Community Resources, Inc., 1989). The 1980 data in Table J-7, "Housing Stock and Characteristics, 1980," show that rents were especially low. Today, most plantation homes rented by Castle & Cooke to employees remain in the $130 to $150 range.

- A single company owned much of the available housing, and housing rarely came on the market. However, allocation of Castle & Cooke rental units is controlled by a "Housing Committee" -- comprised of ILWU and resident

representatives -- which awards units according to a system of job seniority, size of family, and amount of time on the waiting list.

- The housing inventory consisted mainly of older single-family homes. In 1980, three-quarters of the housing stock was at least 40 years old.

Prior to resort development, there was limited demand for additional housing. In a 1989 survey (Matsuoka and Shera, 1990):

- Three-quarters (74%) of respondents were satisfied with their current accommodations;

- The average household size was 3.17, and only 24% of the households surveyed included more than two adults over 18;

- Only about five percent of occupied households had any "doubled-up" households.

In early 1990, Castle & Cooke prepared an analysis of unmet housing demand from Lanaians. At that time:

- Just 17 households had been unable to purchase units at Castle & Cooke's new "Lalakoa III" housing project.

- Some 29 families and 25 single individuals were housed with other households and were on the waiting lists for company-owned rental units or other home purchases. Based on incomes, just five of the families and none of the individuals would qualify for housing purchases in the $100,000 range, suggesting the principal demand was for rental units.

However, as noted in Section 5.4.1, construction workers are now occupying rental units and space in residents' homes (although housing demand from construction workers is already abating and will sharply drop off following completion of the Manele hotel). They have been willing to pay rents of $1,500 or more for a furnished house -- more than twice the rents charged in 1987. Sales of homes and lots for $12 per square foot, or more, have been recorded. This represents an increase of over 100% from prices in the early 1980s, although it should be noted that increases have been even greater on other islands.

According to Castle & Cooke's housing assistant on Lanai (personal communication, Diane Rubican, October 11, 1990), there are 903 housing units on the island. This includes 144 units at Lalakoa III, although a few of the rental units there are not yet occupied. The Lalakoa project was subsidized by Castle & Cooke as part of a 1987 Housing Agreement with Maui County, and 112 units were sold for an average $81,000 each in 1989. Of the remaining 32 Lalakoa units, 13 are temporarily being rented to RockResorts management and supervisory workers but will be sold later at original sales prices. The remaining 19 are HUD low-income family rentals.

The remainder of Castle & Cooke's 1987 housing commitments will be met by the 24-unit Lanai City Apartments, of which 19 will be HUD rentals and the other five market rentals. These are due to be open for occupancy in early November 1990, but are not included in the 903 total figure given above. (Note: See Table J-9 for additional units coming on line in late 1990 or early 1991.)

Additionally, according to the Lanai housing assistant, Castle & Cooke has 278 plantation homes, rented as follows:

- 195 to employees of Dole and/or Lanai Company (some of whom may have since switched to hotel jobs) at rentals ranging from $100 to $250 per month;
- 48 to company retirees, who have the option of remaining indefinitely with no rent increases, at $27 to $200 per month; and
- 35 to RockResorts staff (the only units not under the control of the previously described Housing Committee).

Thus, of Lanai's current housing stock, a little under one-third is currently owned by Castle & Cooke and rented to workers or retirees of Dole, the Lanai Company, or RockResorts (Lanai Resort Partners).

5.4.2.2 Future Without Project

Resort development has already brought newcomers and returnees, who would likely not have come back to the island without resort jobs. More are expected, to staff the Manele Bay Hotel. Thus far, few have brought dependents to Lanai. It is normal in Hawaii for new resort workers to live together, with few non-workers in the household. Over time, however, it is normal for many resort workers to establish separate households, supporting their own families.

The population supported by the resort would vary greatly depending on the housing available for in-migrant workers and their families, and on employment policies that would favor retention of workers, and hence the likelihood that new workers will settle down and have families on Lanai. Lanai has had little housing available, making in-migration unattractive for workers with families but no home on the island. With much new housing built or planned, the housing crunch is expected to lessen considerably. Consequently, in-migrant resort workers can be expected to bring or find families on Lanai.

It is not certain how quickly in-migrant workers would settle down and find families, or whether in-migrants coming after 1996 would be likely to settle down and become long-term Lanai residents. Also, new workers could form their own households more quickly in the without-project future that in the with-project future, due to the greater availability of housing suitable to families. To allow for these contingencies, two separate "scenarios" have been used to model population and housing impacts (as shown in Table J-8), representing the two ends of a range of projections.

As the terms "immediate" and "ultimate" indicate, the workforce at any Hawaii resort is expected, if conditions permit, to fit the immediate impact scenario at first, and then later approximate the ultimate impact scenario. Conditions affecting the likelihood of either scenario include hiring patterns and housing availability. Since it cannot be predicted when most in-migrant workers would form settled families on Lanai, the two scenarios are used to calculate a range of population and housing impacts for the entire period studied.

The two scenarios involve the following distinct assumptions and potential impacts:

- Immediate Impact Scenario: These assumptions (based on a 1987 CRI study of newcomers in the Kohala luxury resort workforce) fit a young resort workforce with few and/or small families. The newcomers to South Kohala whose households followed this pattern already faced a housing shortage at that time.

  While the total population supported by in-migrant workers would be modest, many in-migrants would be new to Hawaii or Lanai, since turnover would be higher with such a young labor force.

- Ultimate Impact Scenario: Over time, resort workers are expected to settle down and form families, if housing is available. Projected statewide averages were used to estimate household characteristics of a future settled population supported by workers who would not have come to Lanai without the resort.

  This scenario forecasts a larger population than the immediate impact scenario, but implies a maturing workforce which is settled in the community.

Population: Without the project, the in-migrant workforce would grow to about 100 by 1996. These resort employees would have as few as 50 dependents (if the immediate impact scenario still approximated the Lanai situation) or as many as 150 (ultimate impact). No appreciable change in the in-migrant population is expected in the without-project future.

Including the resort visitor and residential populations estimated in Table J-2a, the total population growth would be:

Immediate Scenario	1996	2001	2006
Full-time residential (in-migrant construction and operational workers, plus their families, plus full-time resort residents)	335	534	597
De facto (above, plus part-time residents and visitors)	819	1,174	1,287

Ultimate Scenario (eventual effects from in-migration in stated years)

	1996	2001	2006
Full-time residential (in-migrant construction and operational workers, plus their families, plus full-time resort residents)	408	592	664
De facto (above, plus part-time residents and visitors)	892	1,232	1,354

(1991 figures are omitted, since the projected negative number for in-migrant workers and their families cannot be treated as realistic.)

Housing: Housing demand in the non-resort areas of Lanai will depend on demand for housing from in-migrants, pent-up demand, new demand created as younger Lanaians seek to have their own homes, and housing supply.

Without the project, working in-migrant housing demand -- estimated as less than 120 for all years from 1991 to 2010 -- will actually be significantly less than the 400-plus housing units Castle & Cooke has built recently or planned to build in the near future. Table J-9 summarizes Castle & Cooke's residential housing commitments.

NOTE: In addition to the projects listed in Table J-9, Castle & Cooke has made a verbal commitment to the State of Hawaii to donate land for a possible future State housing project. The company is now waiting to hear from the State regarding desired acreage, timing, and potential number of units. However, it is doubtful that there will be need for such a State project under the "without-project" scenario.")

Property Values and Taxes: Some Lanai residents are concerned that the cumulative resort development of Lanai will raise property taxes, causing financial harm to homeowners and long-term lessees. The cumulative impact of resort development, including the project, is an increase in property values, much of which has already been experienced. (Current values are likely to be reflected in property tax assessments by 1992.)

The resorts and resort residential housing will have no direct impact on assessments in areas such as Lanai City. Tax assessors do not use sales data from resort areas to estimate the value of existing neighborhoods. Rather, the impact on Lanai neighborhoods is indirect -- in-migrant workers will increase demand for housing in the Lanai City area. The size of that impact depends on the amount of new housing built, since value is a function of both demand and supply.

Property values have risen sharply in the last year or two, as construction workers and some in-migrants compete with residents for space (personal communication, Jerry Madriago, Maui County Department of Finance, October 2, 1990). In future, price and tax increases will be limited by four factors:

- New housing is being sold at prices comparable to sales of older homes, indicating that prices will likely stabilize.

- Sales of homes in new subdivisions are subject to 10-year buyback clauses. Such homes could amount to nearly 40% of the non-resort housing stock by 1995, and will likely establish pricing trends. As a result, future increases in value are likely to be close to the 7% annual increase used to estimate reasonable appreciation for the buyback clauses for the Waialua single-family housing.

- Demand for housing from off-island construction workers can be expected to decline, so long as the Lanai Company maintains dormitory space for such workers.

- Changes in the laws governing Maui County real property taxes offer homeowners protection from major tax increases, subject to eventual payment of deferred taxes. However, few homeowners have thus far signed up for the new homeowner's dedication program.

5.4.2.3 Project Impacts

Population: With the project, increased hotel occupancies will lead to a demand for additional workers to support a larger visitor population. Increases in the number of hotel units will fuel the creation of additional hotel jobs. As Table J-8 indicates, the number of workers on Lanai with project, over and above the baseline Lanaian workforce, would rise in time to about 1,000 more workers than in the without-project future.

The population supported by in-migrant workers would rise from over 200 in 1991 (according to the immediate impact scenario) to a peak that could exceed 2,200 by 2001 (according to the ultimate impact scenario). In-migrants and their dependents could grow from about 20% of Lanai's population to half the population. These "in-migrants" would likely include some returned Lanaians and, if the resort attracts a stable workforce, people who will have lived on Lanai for many years.

The ultimate impact scenario indicates substantial population growth with the project. Much of that growth would occur in the next five years. After 1996, the rate of growth would decline and many of the "newcomers" could become established members of Lanai's community.

Including the resort visitor and residential populations estimated in Table J-2b, the total population growth would be:

	1996	2001	2006
Immediate Scenario			
Full-time residential (in-migrant construction and operational workers, plus their families, plus full-time resort residents)	1,035	2,089	2,072
De facto (above, plus part-time residents and visitors)	1,702	3,370	3,343
Ultimate Scenario (eventual effects from in-migration in stated years)			
Full-time residential (in-migrant construction and operational workers, plus their families, plus full-time resort residents)	1,398	2,774	2,755
De facto (above, plus part-time residents and visitors)	2,065	4,055	4,026

Project impacts would then be the difference between these growth figures and the growth figures given previously for the estimated future without the project -- i.e.,:

	1996	2001	2006
Immediate Impacts			
Full-time residential (in-migrant construction and operational workers, plus their families, plus full-time resort residents)	701	1,556	1,476
De facto (above, plus part-time residents and visitors)	884	2,197	2,057
Ultimate Impacts (eventual effects from in-migration in stated years)			
Full-time residential (in-migrant construction and operational workers, plus their families, plus full-time resort residents)	989	2,182	2,091
De facto (above, plus part-time residents and visitors)	1,172	2,823	2,672

Again, much of the 1996 impacts are due to construction assumed to be occurring on new hotel expansions at that time under the "with-project" future scenario, while later impacts are primarily due to operations of those expansions.

Housing: Housing demand from working in-migrants would be much greater with the project than otherwise. Castle & Cooke housing initiatives will be sufficient to accommodate this demand through the mid-1990s. Thereafter, major hotel expansions will generate additional in-migration and housing need.

Under the immediate impact scenario, workers who would not otherwise be on Lanai would have fewer than 400 households in 2001. Castle & Cooke and Maui County are expected to provide about 400 units in addition to the current supply in the near term (as shown in Table J-9). The additional housing demand generated by the project can be met within the framework of planned housing.

However, under the ultimate impact scenario, workers not in the baseline Lanaian labor force would support about 800 households in 2001 -- down from a high of 886 in 1999. It is likely that demand for housing would rise to exceed the available supply, if new workers on Lanai are encouraged to settle down and have families. This demand would then justify construction of additional housing in locations already designated in the Lanai Master Plan.

Property Values and Taxes: The resort residential development itself would have little impact on the value of residents' property with the project. However, worker demand for homes in non-resort areas, which could be strong, would expectably lead to increased rents and sales prices, and hence to increased assessments for housing not subject to rent controls or buybacks. (That housing will amount to under half the housing stock.)

5.4.2.4 Mitigation Measures

The population increase forecast with resort operations will create needs for public services discussed in Section 6 of this EIS. The impacts of the project which could become adverse, and call for mitigation, have to do with housing and increases in property values due to strong demand for non-resort housing.

Two general approaches to the mitigation of impacts are possible. In-migrants could be encouraged to come with few dependents, minimizing housing demand but risking high turnover and, it is likely, little integration with the Lanai community. Alternatively, in-migrants could be encouraged to live settled family lives through the provision of housing and through actions to integrate them with the existing community, as discussed in Section 5.7. The two approaches could be combined, to a limited extent, if some in-migrants can be identified as likely short-term residents.

Mitigation measures implemented or planned by Castle & Cooke include:

- The various housing commitments specified in Table J-9. Additionally, Castle & Cooke's verbal commitment to the State of Hawaii for additional land contributions will presumably provide the mechanism for addressing

additional housing needs associated with possible hotel expansions in the late 1990s or early 2000s.

- Provision of dormitory housing for construction workers, and perhaps also some young in-migrant resort employees, in order to lessen demand for homes in the Lanai City area.

- Assurances to older workers or retirees that their rentals are guaranteed at controlled rates. Such guarantees are now given to Dole Company retirees. According to Castle & Cooke Properties President Thomas Leppert (personal communication, October 27, 1990), guarantees will be extended to residents retiring from Lanai Company and Koele or Manele hotel jobs, so long as they meet the company's minimum level of prior service (measured as total service with any Castle & Cooke entity, including Lanai Resort Partners).

As noted above, both assessment practices and recent changes in Maui County's property tax laws protect longterm non-resort residents from the property tax increases that some fear.

5.5 Fiscal Impacts

The fiscal impact analysis for the project involves considering the difference in revenues and costs generated with the project over revenues and costs generated without the project. The analysis is not, then, an estimate of the total impact on government finances of resort development on Lanai.

Government revenues have been estimated by identifying several major cash flows associated with resort development, and calculating government income accruing from such flows in Hawaii (based on the State's Input/Output model and records of recent State and County revenues). All figures are converted to 1990 dollars.

The actual costs to the County and State of resort development on Lanai are hard to predict. The developer will provide or contribute to much of the infrastructure needed within new inhabited areas and by the larger population. However, the County and State will provide government services and some off-resort capital improvements. For this Environmental Impact Statement, an average cost method was used to estimate those costs, rather than a calculation of value of services and improvements attributable to the project. The average cost method assumes that government costs will increase in proportion with increases in population. Since this procedure ignores economies of scale, this is a conservative approach, likely to overestimate government costs.

Where cash flows depend on variables that cannot be definitively established--the average level of visitor spending and the in-migrant population attributable to resort development -- alternate calculations are made to estimate the range of likely revenues and costs involved.

(Note: All calculations in this section are in 1990 dollars.)

5.5.1 County Revenues and Costs

Table J-10, "Difference in Revenues Accruing to Maui County -- With Project Future as Opposed to Without-Project Future," summarizes revenues accruing to Maui County for selected years. The figures shown are the difference between with-project and without-project revenue flows. County revenues attributable to resort development include:

- **Revenues from building and planning permits**: The cumulative impact of the larger construction expected with-project is increased revenues from this source. After 2000, the table shows negative values because planned construction with-project would be finished at that time, while construction would likely continue until 2006 without the project.

- **Real property taxes**: The project involves not only additional improvements but much increased land values due to (a) larger lots for Manele resort residences, and above all (b) a much stronger market demand for the resorts.

- **The County's share of transient accommodations tax revenues**: According to statute, Maui County receives 21.66% of transient accommodations tax (TAT) revenues. Tax revenues for hotel rooms and housing units in the visitor pool were estimated. With higher occupancy rates, the project would yield additional funds for the County from this source.

- **County revenues from fees, fines, permits, and departmental income sensitive to increased population**: About 19% of Maui County's revenues are derived from sources such as motor vehicle permits, which increase with increased population (Tax Foundation of Hawaii 1989; Maui County, 1990). A conservative estimate of these revenues can be derived by treating them as increasing in line with resident population increases. These are estimated for the Immediate Impact and Ultimate Impact scenarios.

Total County revenues from the Lanai resort would be higher with the project than without the project for all years until 2010. The cumulative increase in revenues is estimated as about $50 million over the 20-year period from 1991 to 2010.

County costs are estimated on the basis of increases in county resident and de facto population. The calculation of average costs per person is shown in Table J-11, "Per Capita Allocation of Maui County Government Expenditures," while the calculation of costs for increase in the number of residents and visitors to Lanai with the project, over the without-project future, is shown in Table J-12, "Difference in Costs for Maui County -- With-Project Future as Opposed to Without-Project Future."

The net impact of the project on Maui County finances is estimates as being positive for all years from 1991 to 2010. The net additional revenues would be over $1 million annually after 1996. The cumulative impact would be a estimated gain for the County of nearly $25 to $28 million (as shown in Table J-13, "Difference in Costs and

Benefits Accruing to Maui County -- With-Project Future as Opposed to Without-Project Future").

5.5.2 State Revenues and Costs

State revenues associated with resort development are estimated in Table J-14, "Difference in Revenues Accruing to the State of Hawaii -- With-Project Future as Opposed to Without-Project Future." Sources for State revenues include:

- **Construction-derived revenues**: Construction will generate revenues due to corporate taxes (6.4% of taxable income, with 10% of construction value assumed to be taxable), excise tax (calculated for total construction cost), and construction workers' income taxes (3.41% of personal income, on average, with 32.5% of construction spending allocated to labor costs [Hawaii State Department of Business and Economic Development, 1989]).

- **Resort resident income taxes**: Full-time residents of the resort are assumed to have taxable Hawaii incomes amounting to 40% of the sales price of their homes, and to pay 14.5% of taxable income in taxes. (Income taxes paid by non-resort residents are estimated on the basis of the cash flow from visitor spending, described below.)

- **State share of the transient accommodations tax**: Five percent of TAT revenues is retained by the State.

- **Revenues derived from visitor spending**: Visitor spending in Hawaii generates various tax revenues, including excise taxes, income taxes for corporations and persons whose jobs derive from visitor spending. The State's Input/Output Model of the economy can be used to estimate the relation between visitor spending and State tax revenues. In 1986, total government revenues from visitor spending amounted to 10.8% of total visitor spending. The State's share of those revenues was 89%. (In 1986, the TAT was not collected. This benchmark year is used to avoid double-counting.)

For this calculation, both visitors and part-time residents are considered visitors. To estimate the average level of visitor spending under different conditions, three ranges were used:

(A) Average spending of $400 per visitor. Given projected Lanai room rates and housing prices, this range predicts that spending on lodging would amount to about 40% of total spending (as opposed to the State average of 30%). This range would be appropriate if few retail and off-resort spending outlets were available, or if hotel rates were well below the levels projected by Castle & Cooke and RockResorts executives. It is hence an intentionally low range.

(B) An intermediate range, of $475 average spending per visitor per day. This level was used as a basis for estimating the creation of retail jobs in the analysis of employment impacts.

(C) The highest range of $550 assumes that Lanai visitors pay the same proportion of their cash for lodging as do visitors statewide. It could become more appropriate than lower figures if Lanai evolves toward an economy with a variety of retail and entertainment options.

The (B) range seems most appropriate, over the long term, in modeling visitor spending on Lanai with the project. Without the project, visitor spending would likely be lower, and the (A) range would then provide a more realistic estimate of visitor spending.

Revenues derived from visitor spending account for most of the State revenues from the resort. Again, this category accounts for most of the increased revenues in the with-project future, as compared to the without-project future.

With the project, State revenues from resort development on Lanai would be nearly $4 million to $5 million higher than without the project in 1991. The with-project increase in State revenues would stabilize at a level estimated at $10 million to $15 million annually. The cumulative increase in revenues is estimated at about $210 million between 1991 and 2010.

State costs are estimated on the basis of increases in the Statewide resident and defacto populations. The calculation of average State expenditures per person is shown in Table J-15, "Per Capita Allocation of State of Hawaii Government Expenditures." The calculation of State expenditures associated with higher numbers of visitors on Lanai and State residents due to resort development is shown in Table J-16, "Difference in Costs for the State of Hawaii -- With-Project Future as Opposed to Without-Project Future."

The net impact of the project on State finances is estimated as positive for all years from 1991 to 2010. The balance of State revenues over expenditures attributable to the project would reach the $3 million to $5 million range by 1996. Annual net revenues would reach somewhat higher levels in later years. The cumulative impact from 1991 to 2010 would be an increase in State revenues estimated at a minimum of $50 million, and possibly amounting to more than $100 million. See Table J-17, "Difference in Costs and Benefits Accruing to the State of Hawaii -- With-Project Future as Opposed to Without-Project Future."

5.6 Recreational Impacts

Information for this section was gathered by John Clark, an ocean recreation specialist. He reviewed existing studies and resource materials; conducted a field survey of the project site on September 22-24, 1990; and conducted interviews with Lanai residents and other informants during September 1990 and February 1991. The following informants were selected because they afforded a wide variety of information about the project site:

Constance Agliam, Concierge at The Lodge
Jim Coon, Owner, Trilogy Excursions
Edean and Swede Desha, Lanai residents since 1946
Martha Evans, Lanaians for Sensible Growth
Jason Fujie, Na Ala Hele
Frank Hashii, Lanai Fire Department
Kathy Kapalka, Hulopoe Beach attendant for The Lodge
Derwin Kwon, Fish and Wildlife Agent, DLNR
Miller Maioho, Lanai Fire Department
Ron McOmber, Lanaians for Sensible Growth
Sherry Menze, Harbor Agent, Lanai Small Boat Harbor, DOT
Albert Morita, Fish and Wildlife Agent, DLNR
Melia Obado, Concierge at The Lodge
Gary Onuma, Koele Co. Ranger
Anne Orcutt, Consultant for Club Lanai
Wayne Souza, State Parks Planner, DLNR
Lt. Paul Winters, Police Commander

5.6.1 Project Site

5.6.1.1 Existing Conditions

The project site begins at a small gulch at the western end of Hulopoe Beach and follows the shoreline for approximately 1.2 miles to a deep gulch in Huawai Bay. The small gulch at the western end of Hulopoe Beach marks the end of Hulopoe's calcareous sand beach. The sand beach narrows into a boulder beach which in turn transitions into a lava terrace with splash pools backed by low sea cliffs. The cliffs average 25 feet in elevation. The low cliffs continue west along Kapihaa Bay and increase in elevation beyond the bay to approximately 100 feet at Huawai Bay. At Kapihaa Bay the sea cliffs are dissected by two small gulches. The gulches terminate at boulder beaches but have small pockets of calcareous and detrital sand in the backshore. In the western portion of this reach, the sea cliffs are bisected by a single deep gulch that drops at its seaward end approximately 30 feet to a boulder beach. This gulch is located approximately 1.2 miles from the Manele Bay Hotel at Huawai Bay and marks the western extent of the project.

Existing Access: The project shoreline is accessed primarily by a foot trail that runs along the top of the sea cliffs. The trail originates at the western end of Hulopoe Beach and is clearly defined though the kiawe and ilima, the dominant vegetation, to Kaluakoi Point. Beyond the point, the sea cliffs increase in elevation, discouraging access to the cliff bases, which are the primary sites of ocean recreation activities. Pedestrian traffic beyond the point is therefore considerably less than to the point.

The project shoreline is accessible from the pineapple fields above the western end of the project site. It is possible to park at the makai edge of the fields and walk down to the sea cliffs at Huawai Bay.

Portions of the project shoreline are accessible from the ocean; other portions are below high cliffs. During periods of calm seas swimmers from boats can come ashore in certain areas and exit the water onto the lava terraces below the cliffs.

Existing Uses: The primary shoreline activities in the project site are hiking, hunting, shoreline fishing, spear fishing, scuba diving, and opihi gathering. The sea cliffs and the deep waters that front them limit in-water activities primarily to scuba diving and spear fishing from boats during periods of calm seas. During the field survey one boat with a scuba dive charter was observed anchored adjacent to a rocky point in Huawai Bay.

Access to the base of the cliffs, especially at Huawai Bay, is marginal from land and is often precluded by surf surging against the rocks. Historically, some opihi pickers scaled the cliffs with ropes. Today, gatherers gain access to the opihi grounds by boat. Opihi gathering is prohibited within the Manele-Hulopoe Marine Life Conservation District (MLCD) which is in the eastern reach of the project site, but is open beyond Kaluakoi Point, the western boundary of the MLCD. Outside the MLCD spear fishermen from boats also harvest lobster and a variety of fish.

Fishing within the Manele-Hulopoe MLCD is restricted to hook and line fishing from shore. Outside of the MLCD there are no restrictions. Shoreline fishermen, fishing primarily for mamo, papio, ulua, and moi, frequent lava terraces in or near the existing project district. The small bay beyond Kaluakoi Point is known to some fishermen as Moi Bay.

The lands in the project site are privately owned by The Lanai Company, but are open to Lanai residents for hunting. Axis deer are common there. During the field survey, deer trails and droppings were observed and deer scent was strong in a number of places. Informants report the area to be excellent for hunting.

A few hikers use the shoreline trail but usually do not go beyond the clearly defined trail which ends at Kaluakoi Point. Although the vistas along the trail beyond the point are excellent, the land in its present arid condition with widespread growths of kiawe and ilima is not inviting to casual hikers. The most common users are hunters walking through the area looking for axis deer. From Kaluakoi Point to the end of the project site at Huawai Bay, there is no clearly defined trail, but some hunters and other hikers consider walking along the edge of the sea cliffs to be following an established route. Several informants noted that this portion of the trail became overgrown and fell into disuse as former users, particularly opihi pickers, acquired boats and began to access the area primarily from the ocean. Castle & Cooke executives say they have taken former users to the site and none were able to locate the trail. Thus, the question of whether or not there is an actual "trail" from Kaluakoi Point to the western end of the project thus is a matter of some dispute.

5.6.1.2 Recreational Impacts Without Project

The impacts that the Manele Bay Hotel and other approved residential units will have on the recreational activities in the project site will be minimal for most activities. The majority of the visitors and new residents will probably not be oriented to hunting, shoreline fishing, and opihi gathering. These activities will probably see slight but not significant increases in user populations. There may be an increase in the number of hikers, but probably not to the extent that it would create user conflicts between them and the fishermen and hunters.

The primary impact will be on the in-water activities, including scuba diving and spear fishing. The increased residential population near Manele Bay Small Boat Harbor will increase the number of trailered boats on Lanai. This in turn will lead to an increase in the diving activities at the western end of the project site, because fishing restrictions imposed by the Manele-Hulopoe MLCD severely restrict fishing and boating opportunities in the eastern end of the project site. The shoreline in the western end of the project site is, therefore, a natural focal point for divers, especially those engaging in lobster harvesting and spear fishing. The increase in these consumptive activities will also eventually lead to a reduction in the lobster and food fish species populations in these nearshore waters.

The increased visitor population may lead to a slight increase in the number of scuba diving charters in the western end of the project site, but this increase will probably not significantly impact the existing charter activity.

5.6.1.3 Project Impacts

Development of the project will include a golf course to the west of the Manele Bay Hotel and a number of large luxury residences interspersed on the mauka fairways. The location and price of these homes will probably attract more affluent buyers who will more likely be full-time residents rather than part-time or transient residents. The impact of wealthy, full-time residents is likely to be much less than the impact of part-time and more transient residents.

The impacts of the project on the shoreline recreational activities in the project site will be minimal for most activities. The impacts on in-water activities such as scuba diving and spear fishing from boats will be the same as those described in Section 5.6.2.2, Recreational Impacts Without the Project, but the impacts on land-oriented activities will differ.

Along with golf course development, pedestrian access will be maintained on 1.2 miles of shoreline. After the golf course is developed and golf cart paths are constructed, the walk will be much easier and the travel time will be considerably reduced. Hikers, fishermen, and opihi gatherers who do not use the area now will be attracted to the area to reach Huawai Bay and other sites to the west. In general these users are unobtrusive and their occasional presence should not generate significant conflicts with the golfers.

The golf course will destroy an established, although privately-owned, deer hunting area. Resentment about this potential loss was expressed in the field interviews by several informants. They noted that deer tend to congregate in this area due to its limited vehicular access. However, the loss of 458 acres must be viewed in the context of a total available 36,000 acres for deer hunting on Lanai.

5.6.1.4 Mitigation Measures

There is no simple solution to mitigate the impact of increased boating and diving on the lobster and fish populations in the western end of the project site. As the resident population and the number of trailered boats increase on Lanai, the nearshore

areas adjacent to Manele Small Boat Harbor will experience significantly increased consumptive pressures and declines in food species populations. This situation is common to all boat harbors in Hawaii and can only be resolved by the imposition of regulations restricting consumptive activities. However, such regulations would be effective only if the State provides sufficient manpower for consistent enforcement.

The issue of setbacks to preserve public access and the viewplane at the seaward edge of the golf course has been addressed in an October 1990 Memorandum of Agreement between Lanaians for Sensible Growth, the Office of Hawaiian Affairs, and Castle & Cooke, Inc. In this agreement, under "Shoreline Access," a 50-foot public easement is to be dedicated along the accessible cliff coastline from Hulopoe Bay to the intersection of the westernmost boundary of the project. A 50-foot corridor from the edge of the sea cliffs to the golf course is to be left undeveloped along Holes 12, 16, and 17, although the corridor can be less than 50 feet at some areas by "signature" hole 16); and a 150-foot corridor from the edge of the sea cliffs is to be left free of any vertical improvements. (See Appendix K for details of the Memorandum of Agreement.)

Although the golf course will destroy an established hunting area, deer will probably still continue to congregate in the area after the project is developed, especially during dry summer months when the golf course will offer foraging material and drinking water. Perhaps resident archery and black powder muzzleloading hunting could be permitted to control rather than eliminate the deer which impact the golf course.

5.6.2 Nearby Areas

The two nearby areas of most importance for public recreation are the Manele Small Boat Harbor and Hulopoe Beach Park.

5.6.2.1 Existing Conditions

The Manele Bay Small Boat Harbor has only 24 slips for mooring. At present this limits both commercial and recreational users.

Hulopoe Beach Park is situated on the low vegetated dunes in the backshore of Hulopoe Beach. Amenities at the park include unpaved parking, restrooms, fresh water showers, picnic tables, and a camping site. The park is privately owned by the Lanai Company.

> Hulopoe Beach is a 1,500-foot-long, arcuate pocket beach, lying at the head of Hulopoe Bay on the south coast of Lanai. Boulders lying against lava points occur at each end of the beach. During winter, the beach is eroded back 45 feet, exposing beachrock. The sand is a bimodal mixture of medium and coarse calcareous grains. Low dunes and a beach park occupy the backshore. Sand lies offshore, and a patch of boulders outcrop between the 5- and 10-foot depths. The foreslope is steep, as a result of the large swell arriving at this beach. Berms and cusps are common beach features. (Moberly and Chamberlain, 1964, p. 78)

Hulopoe Beach Park is the most popular shoreline recreation site on Lanai for both residents and visitors. Activities include camping, picnicking, swimming, sunbath-

ing, snorkeling, scuba diving, bodysurfing, surfing, and fishing. Fishing for fishes and crustaceans is limited to hook and line fishing and from the shoreline only, a regulation of the Manele-Hulopoe Marine Life Conservation District which extends from Kalaeokahano Point at the east end of Manele Bay to Kaluakoi Point at the west end of Kapihaa Bay. According to the 1989 Update Survey for the Hawaii Statewide Comprehensive Outdoor Recreational Plan (SCORP) (Community Resources, Inc., Table 15BB, April 1990), picnicking and swimming are the two most popular recreational weekend activities for Lanai residents. The SCORP survey does not specify sites, but field observations and interviews confirm that the majority of the residents engage in these activities at Hulopoe Beach Park.

5.6.2.2 Recreational Impacts Without Project

The greatest impacts to shoreline recreational activities from development of the Manele Bay Hotel complex will not occur in the project site, but in Hulopoe Beach Park and in Manele Small Boat Harbor, both adjacent to the project site. These properties are the primary shoreline recreation sites on Lanai and will be highly impacted by the introduction of new visitor and resident populations.

Hulopoe Beach Park: As the only beach park on the island, Hulopoe Beach Park will continue to be used by the existing user groups and will attract new residents and visitors from any future developments. For example, The Lodge at Koele has instituted a daily swimming and snorkeling service to the park for its guests. In September, 1990 the service accommodated approximately 21 people per day while approximately 19 people per day used the hotel's pool. This demonstrates that guest use of the pool and the ocean are nearly equal. This ratio of use will probably be the same or higher at the Manele Bay Hotel because the hotel has excellent proximity to the beach and will also offer a beach service. The Manele Bay Hotel has more than twice as many rooms as The Lodge (250 compared to 102). This means it will probably contribute at least twice as many people on the beach per day as does The Lodge. The hotel may eventually be expanded to 400 rooms. In addition to the hotel, a number of multi-family residential units are to be constructed. When they are completed, many of their occupants will also use the beach park. This will significantly increase the daily beach attendance.

Swimming -- Most of the swimming that occurs at Hulopoe Beach is of short duration. People go in to cool off and get wet, but do not stay in the water for long periods of time (more than 30 minutes). The increased beach attendance will not impact the nearshore carrying capacity for swimming because most swimmers are going in and coming out of the water too quickly to create any congestion.

Sunbathing -- The increased beach attendance will significantly increase the number of sunbathers. Although the beach itself will accommodate the increase, sunbathers will find themselves closer together and long-time Lanaians will perceive that the beach is more heavily used, especially on weekends and holidays.

Snorkeling -- The majority of the snorkelers are off-island visitors who are transported from Maui on commercial boat tours. The Manele-Hulopoe MLCD regulations prohibit operating, anchoring, or mooring any vessel within Hulopoe Bay to Kaluakoi Point. This means that all off-island snorkeling and scuba diving charters must moor at Manele Small Boat Harbor and transport their guests from the harbor to Hulopoe Beach in order to dive there. During the field survey the commercial tours, which are limited to weekdays only, brought approximately 150 snorkelers a day to the beach. Very few local residents snorkel. The increased beach attendance will add to the numbers of snorkelers in the water, but will not adversely affect their snorkeling experience.

The commercial snorkeling tours feed the fish in Hulopoe Bay in the same manner that visitors to other snorkeling sites in the state do. This activity has encouraged large schools of certain species to congregate in the east end of the bay where most of the snorkeling takes place. The advisability of feeding the fish needs to be addressed.

The best snorkeling area in the bay is between the middle of the bay and its eastern point. The same patch reefs that are providing viewing opportunities for snorkelers are also providing waves for surfers. User conflicts between snorkelers and surfers may develop with increased beach attendance.

Bodysurfing -- The Hulopoe shorebreak is a marginal site for bodysurfing. The nearshore bottom drops quickly to overhead depths, creating poor shorebreak conditions for wave-riding. The increased beach attendance will have no impact on bodysurfing as an activity, but has the potential to create additional water safety problems for inexperienced bodysurfers.

Bodyboarding and Surfing -- A good bodyboarding and surfing site exists along the rocky point on the east side of Hulopoe Bay. It is a left slide that normally breaks over a shallow patch reef adjoining the point, but during periods of high surf (six feet or greater), waves break from the point to another patch reef in the middle of the bay. This site is probably the best of the few good surfing sites on Lanai. It is also the only surfing break on the island that is close to Lanai City and accessible by a paved road. For these reasons it is heavily used by the Lanai bodyboarding and surfing community.

Bodyboarding has become a popular statewide visitor activity. The increased beach attendance will significantly increase the number of bodyboarders and will also bring additional surfers. This in turn will probably create carrying capacity problems and territorial conflicts at the surf site. Territorial conflicts between resident and non-resident surfers are a common occurrence in many of Oahu's crowded surfing sites. It will also create additional water safety problems due to the influx of inexperienced bodyboarders.

Fishing -- Fishing is restricted to hook and line fishing from shore in the Manele-Hulopoe MLCD. The increased beach attendance will probably have a minimal impact on competition for fishing sites among pole fishermen, but may contribute to an increase in general types of MLCD violations such as spear fishing and Opihi gathering in restricted areas.

Picnicking and Camping -- Hulopoe Beach Park is the most important picnicking and camping site on Lanai. Picnicking and camping at the beach are traditional activities for Lanai residents, especially on weekends and holidays, and the beach park is the most popular site on the island for these activities. Park improvements include picnic facilities and camping sites.

For off-island visitors, Hulopoe Beach Park is the only authorized camping site on the island. Camping permits are issued by the Lanai Company. The present commercial camping site located at the west end of the park will be relocated inland of the parking lot as part of the park renovation.

The matter of resident camping in the beach park has been a source of community concern. Although non-residents have been restricted to camping in one designated area, residents have customarily camped throughout the park. According to Lanai Company President James Pierce (personal communication, April 1, 1991), the Lanai Company has agreed to make no change in past practices. The company will allow Lanai residents to continue to camp in any place throughout the park where they have camped in past years.

The increased beach attendance will create additional competition for the picnic facilities. Visitors and new residents will also use the picnic tables and barbecue pits. The increased beach attendance, however, will probably have a minimal short-term effect on the camping sites. Most of the visitors and new residents will be in a hotel room or a home, and will not need a camping site for accommodation. Only three camping permits are made available to non-Lanaians at any one time, and Castle & Cooke does not plan to increase this number. However, the development and marketing of Lanai as a visitor destination could well contribute to a more frequent off-island demand for these permits.

Manele Small Boat Harbor: Increased population on the island in the resident and visitor communities will probably lead to increased boating activities, especially for trailered boats among the residents, and will probably lead to increased commercial boating activity among the charter companies from Maui.

Increased boating activity will create increased water safety problems. The nearest Coast Guard assistance is on Maui. The Lanai Fire Department is not equipped to assist boats in distress, but they respond to all incidents with the assistance of their personally owned boats and equipment. They also rely on volunteer assistance.

5.6.2.3 Project Impacts

The greatest impacts in the areas adjacent to the project will come from the cumulative complex and not from the golf course alone. The project will probably increase occupancy rates in the Manele Bay Hotel by attracting more golfers to the island. This in turn will mean more people on the beach at Hulopoe and somewhat more activity at the harbor. However, visitors attracted to Lanai for golfing will probably not use the beach or marine facilities to the same extent as non-golfing visitors.

5.6.2.4 Mitigation Measures

Dole Food Co., Inc.'s recent improvements to Hulopoe Beach Park will help mitigate many of the effects of heavier utilization. These improvements include expanded restroom and shower facilities, new barbecue areas and picnic tables, paved parking, improved drainage, and new landscaping.

Some of the impact on ocean recreation activities in the Hulopoe-Manele area will be reduced by hotel visitors and residents using alternate activity sites. Swimmers may elect to use swimming pools instead of the beach and the ocean for sunbathing and swimming. All other activities, however, are not as easily accommodated elsewhere. Except for fishing, Lanai does not have many alternate sites for other ocean activities, especially sites that are easily accessible and that offer beach park amenities.

State Park Planning Officials have identified a site in the Federation Camp area of Shipwreck Beach as a potential "wild coastline park." This is subject to funding or other means of acquisition. The area is quite windy, giving it potential for windsurfing, an activity that is currently not done on Lanai, and surfing. Visitors may also be attracted for beach combing.

Adjacent to Shipwreck Beach, Polihua Beach is the longest and widest white sand beach on the island. It is the only other beach on the island which offers good swimming opportunities. However, Polihua is not a sheltered beach like Hulopoe. Ocean conditions may be dangerous with high surf and strong currents. Trade winds are occasionally vigorous, creating sand storms on the beach. For these reasons, most residents consider Polihua to be more of a wilderness fishing site than a recreational swimming site. They especially do not consider it a safe beach for families with children. However, if facilities were provided and water safety concerns were addressed (via lifeguards, signage, flag warning systems, etc.), Polihua might serve as an alternate site for many Hulopoe-type ocean activities.

The impact of increased boating at Manele Bay Boat Harbor might be resolved by expanding the mooring capacity of the harbor or by developing an alternate site for recreational boating such as Kaumalapau.

5.6.3 Social Conflict at Hulopoe Beach

This section summarizes and somewhat elaborates foregoing comments about impacts at Hulopoe Beach, from the perspective of potential competition between current residents and future residents or visitors for this crucial recreational resources. A separate discussion about Hulopoe Beach is warranted because of the area's unique value for Lanai residents.

Because this section to a certain extent repeats earlier comments, there will not be the usual format of "Existing Conditions," "Impacts Without Project," "Impacts With Project," and "Mitigations." However, it is worth restating previous conclusions about recreational impacts: Major effects will come primarily from the resort development already approved or underway. The Manele Golf Course and Golf Residential Project will somewhat amplify those impacts (because of higher occupancies, more visitors, and,

eventually, more in-migrant workers), but the basic social and recreational changes will occur with or without the project.

Hulopoe Beach Park is the single most important shoreline recreation site on Lanai. Historically, it has provided an outdoor area to which all Lanai residents have had equal access and where they have gone to relax and socialize, as well as to engage in beach-related recreational activities. Hulopoe offers the island's best swimming beach and easiest access (a 15-minute drive from Lanai City by paved road). By contrast, other major beaches on the island (Polihua, Shipwreck, and Keomuku) are at least an hour's drive and are primarily accessed over secondary roads, some of which presently require a four-wheel drive.

Although Hulopoe Beach Park is privately owned and controlled by the Lanai Company, many residents feel it is a community asset and that longstanding patterns of resident use should not be changed. For example, the previously mentioned concerns about possible relocation of camping have led to definite controversy on the island. Resident fears that resorts will lead to a "two-class society" on Lanai (Section 5.7.2.2) have interacted with rumors that certain benches or picnic tables are being "color-coded" either for residents or for visitors. (As discussed later, Castle & Cooke was not responsible for the color-coding, which has in fact been discontinued.)

Visitor-oriented development of the park -- with its attendant walkways, parking lot, and other facilities -- could also curb another longstanding resident useage pattern: parking immediately beside the beach, which is common at the east end of the beach. Even if camping is allowed to continue in this backshore area, people would not longer be able to park adjacent to their camping sites. Although this may seem to be a minor and even ecologically sound change to outsiders, it may still be viewed by residents as the loss of another customary activity.

Another problem may evolve at the Hulopoe surfing site from the interaction of visitors and local residents. This site is probably the best and most accessible of the few good surfing sites on Lanai. It is heavily used by the Lanai bodyboarding and surfing community. Increased useage (either by visitors or, more likely, newcomer residents) could well create carrying capacity problems and territorial conflicts such as often occur at better surfing sites on other Hawaiian islands. However, on the other islands there are alternate surfing sites that can accommodate crowd overflows; on Lanai, there are almost none.

Some of these potential changes at Hulopoe (e.g., movement of parking back from the beach) have occurred at many other beach parks throughout Hawaii as population has increased. Resentment over these types of adjustments has rarely been intense or led to more serious conflict.

Of more concern is the potential resident feeling that the beach park is being "lost" or "taken away" for the benefit of outsiders. As will be discussed in Section 5.7, this interacts with much broader social concerns over the suddenness of social change on Lanai and historical sensitivities to social inequalities in plantation societies.

On other Hawaiian islands, beach parks have often been the focus of anti-visitor or anti-newcomer feeling -- sometimes assaults, but more often thefts from cars or belongings left on the beach. However, the Lanai Company's ability to provide private security could dampen this tendency (personal communication, Lt. Paul Winters, Commander, Maui County Police Department, Lanai District, February 14, 1991).

Based on general observations of other Hawaii beaches which have undergone social change, some long-term changes at Hulopoe Beach Park may safely be predicted. First, some residents will feel less comfortable there and reduce the frequency of their visits. Second, there will be a natural tendency of visitors to use the west end of the beach (nearer the hotel) more heavily, while residents will more likely prefer the familiarity of the present picnic area at the eastern end. This will not be as the result of any formal "policy," and it will be just a tendency (not a strict territorial division of the beach). Third, there will be more mingling over time, as residents grow used to visitors and newcomers. Fourth, younger Lanai residents will more easily adjust to change and will be more likely than older residents to keep using the beach -- but as part of peer group social functions rather than in extended family activities.

However, it is very difficult to predict how rapidly these changes will take, what the magnitude of the impacts will be, and how much social tension will accompany the changes. These will depend on factors such as the provision of at least partial substitute beach sites for traditional resident activiies, actual speed of change, and the outcome of discussions between Dole Food Co., Inc. and community groups over things such as camping site location and parking areas.

While there is good reason for concern over social conflicts at Hulopoe, it is also important to recognize several positive factors:

(1) It is in the interest of Lanai Resort Partners that the Hulopoe Beach experience be a positive one for visitors and resort residents -- including friendly interactions between visitors and residents. Both Dole Food Co., Inc. and RockResorts are publicly committed to the idea that the beach should be for the enjoyment of all users, and that nobody should be considered "second class" beach users.

(2) A major 1988 statewide survey on tourism impacts found that residents often do resent the "loss" of outdoor recreational areas to visitors (Community Resources, Inc., 1989). But the same survey also found that residents were most likely to enjoy interacting with visitors in exactly those same outdoor recreational settings. Thus, the transformation of "local" beaches to "visitor-oriented" beaches includes social opportunities as well as social costs.

5.7 Other Socio-Cultural Impacts

This section addresses various other qualitative social impacts, such as social structure, community stress, and sense of faith in the future. For many of these topics, it is difficult to identify separate impacts of the proposed Project District Amendment, as compared to effects of overall Lanai resort development, agricultural phase-downs, and

other factors. Therefore, the analysis will often be at the level of cumulative impacts, with attention to project impacts if possible.

In considering socio-cultural impacts, it is also important to remember:

(1) It is difficult or impossible to make an "expert" decision about whether overall impacts are bad or good.

(2) For many social impacts, it is both more possible and more important to control the outcomes than it is to predict them. Therefore, the "Mitigation Measures" portion of this EIS section is considered particularly important.

Conclusions in this section are based on a number of sources:

- Available studies and transcripts about actual or feared tourism impacts in Hawaii generally and Lanai in particular.
- Literature on social change in small rural communities outside Hawaii.
- Social indicator data from Lanai and Maui County.
- Interviews with key social agency workers on Lanai (the police commander, director of the Lanai Youth Center, DHS social worker, DOH Mental Health social worker, coordinator of Senior Citizen Programs for Maui County Department of Human Concerns, and counsellor for Lanai School).
- Additionally, for the Final EIS, approximately 30 community key informant interviews were conducted in February 1991.

5.7.1 Current Social Context: Overview

At the time of writing (September-October 1990 for the Draft EIS; early 1991 for the Final EIS), Lanai was in the process of attempting to adjust to a series of major changes in the community fabric, some which had produced significant anxiety:

- Initiation of hotel construction in 1988, bringing several hundred construction workers to be housed in the middle of Lanai City.
- Opening of The Lodge at Koele in April 1990, the community's first significant encounter with resort work and an upscale visitor population (as well as its first encounter with a major employer other than Castle & Cooke).
- A highly publicized murder-suicide in August 1990, in which the assailant was a longtime resident and the victims were in-migrant resort workers.
- Most immediately, the September 1990 announcement that Dole Pineapple Co. operations would be eliminated over a two-year period.

Such changes could be expected to produce difficulties in any community. However, the effect is greatly magnified on Lanai, due to:

- the small size and close-knit character of the community (with nearly 100% of the population living in one town);
- physical isolation from other parts of Hawaii;
- lack of local news media and consequent abundance of rumor;
- the historical sense that control of the community's future lies almost entirely with Castle & Cooke.

Social agency observers reported an upsurge in family problems and crime in the past few years. Most people interviewed by CRI said the sheer number of new faces on Lanai has been difficult for residents to accept easily. Many believed that implicit or explicit promises by Castle & Cooke leaders had been broken, leading to a lack of trust in the company and its plans for Lanai. (As detailed later, Castle & Cooke has begun to address these concerns with specific actions and programs for housing, job retraining, commercial diversification and community interaction.)

People interviewed for this report said Lanai residents are cautious about expressing themselves but feel increasingly resentful of the changes. At the time the Draft EIS was being prepared (autumn of 1990), many Lanai residents who were informally interviewed by CRI said they felt there was more fear than hope among longtime Lanai residents. A police offical said he felt that there were strong emotions running through the community. However, a more extensive series of community interviews for the Final EIS (conducted in February 1991) indicated that the earlier intense and generalized anxiety had changed into more focused concerns about specific issues. One of the most important of these -- in a new period of recession, war, and falling Hawaii hotel occupancies -- was apprehension over the success of the new hotels.

Additionally, few if any of the people who were interviewed opposed the idea of resort development on the island. There was a general desire for more economic, political, and social opportunities than seemed to be present under the old plantation society. There was also a desire for the services and amenities which come with a larger population base.

Thus, it is possible that the present anxiety will fade and that Lanai will successfully adjust to the transition from an agriculture- to a tourism-based society. However, this will depend on:

- the continued speed of change;
- the economic success of resort development on Lanai;
- timely provision of housing and infrastructure;
- the numbers, characteristics, and attitudes of future newcomers to Lanai;
- communication among community and corporate stake-holders;
- steps to reassure Lanai residents that they will benefit from economic change in ways they desire, and that they have some measure of control over their future.

5.7.2 Attitudes and Issues

5.7.2.1 Survey Data on Attitudes Toward Tourism and Quality of Life on Lanai

While community attitudes may be changing following the events of 1990, two survey research efforts from the late 1980s provide a clear picture of attitudes at that time.

A 1989 baseline social survey of Lanai residents spearheaded by the University of Hawaii School of Social Work (Matsuoka and Shera, 1990) gathered data from 240 households, about 30% of all households on Lanai at the time. The 1988 "Statewide Tourism Impact Core Survey" (STICS) (Community Resources, Inc., 1989) sponsored by the Hawaii State Tourism Branch had a smaller Lanai sample -- 135 residents -- but allows comparison with results from the rest of Maui County and the state as a whole.

Table J-18, "Lanai Resident Attitudes on Resort Development, Late 1980s") shows selected results from both surveys. These data indicate:

- Community satisfaction was extremely high in the late 1980s, as resort construction began on Lanai. Residents of Lanai were much more likely to feel their lives had improved over the last five years than were residents elsewhere in the state.

- Attitudes toward both current and future tourism impacts on Lanai were either very positive or else neutral/mixed. Negative views were in the minority. For example, 68% felt tourism would be "a good type of economic development for Lanai," and only 16% said it would not.

- The STICS survey did contain a few warnings. Lanai had a higher minority than other places doubting overall tourism benefits, and a slim majority was already saying "no more hotels."

However, Lanai residents were much more likely than people elsewhere in Hawaii to feel they needed more tourism jobs on the island.

Other questions on both surveys indicated fairly similar perceptions of tourism impact on specific areas of community life. Lanai residents saw tourism as improving availability of jobs and amenities such as stores and entertainment, but having negative impacts on crime, traffic, and cost of housing. The STICS survey found mildly positive attitudes toward tourism impacts to date on population, pace of life, and quality of family life, but the University Social Work survey found concern about future impacts on "family values."

5.7.2.2 Community Interviews and LUC Testimony

Neither the STICS nor the University of Social Work survey included questions specifically about golf course or upscale resort residential development.

To gain a more in-depth understanding of community issues and concerns about the project, CRI analyzed 1990 testimony before the State Land Use Commission (LUC) and, for the Final EIS, conducted about 30 key informant interviews with community residents in February 1991.

The community interview process does not constitute a scientific random sample survey. However, it does provide an opportunity to gain a more in-depth understanding of resident issues and concerns. There are several purposes for such an interview process:

- To assure complete disclosure of major issues and concerns;
- To document the possibility of some types of qualitative social impacts which are not subject to objective analysis;
- To provide at least anecdotal evidence that certain types of social impacts may be occurring from early stages of resort development.

Key informants were chosen on the basis of their knowledge of the community and/or their involvement in organizations which may be considered "stakeholders" in controversies about the future of Lanai (e.g., Lanaians for Sensible Growth). Initial interviewees were asked to suggest other potential informants with a wide range of backgrounds and viewpoints. A multi-ethnic CRI team conducted the interviews, utilizing an informal conversational approach. Each key informant was assured that individual remarks would remain confidential, although this EIS would include a list of interviewees and a general sense of what was learned in the interview process.

Table J-22 lists the names and organizational affiliations of the informants. Organizations and positions are given only to indicate the individual's knowledge of the community or type of involvement; nobody was asked to speak as the official representative of any group.

Interviewees were asked to comment on the impacts of the project and resort development on Lanai. They were not asked to take a position for or against the project or resort development.

Table IV-10 summarizes major issues which emerged from the interviews (and the LUC testimony). To indicate the importance of issues to key informants and witnesses before the LUC, CRI assessed specific issues or concerns were assessed as having high, medium, or low importance. Both the frequency with which issues arose and the intensity with which they were discussed were considered to rate issues/concerns. These ratings are necessarily subjective and apply only to the persons interviewed at the time of this process.

Following is a somewhat expanded discussion of the issues listed in Table IV-10. Note that many of these concerns represent desires, fears, or apprehensions, not necessarily factual impacts. Both key informant interviews and LUC testimony, most concerns were directed to cumulative effects of overall Lanai resort development. Fewer concerns specific to the project were discussed.

TABLE IV-10

ISSUES/CONCERNS FROM COMMUNITY INTERVIEWS AND LUC HEARINGS

General Topic	Description	Specific Issues/Concerns	Frequency/ Intensity
Project-Related Issues Only	Certain issues focus directly on golf course and golf course residential development. (Other topics may relate to both the project and overall resort development or to overall development alone.)	• May deplete water supply and harm agriculture.	high
		• Damage to the coastal life forms and beauty, including damage due to run-off.	medium
		• Chemicals used on the golf course may seep into the water aquifer.	medium
		• Preservation of all archaeological sites.	medium
		• Fear that values of golf course homes will raise taxes in Lanai City.	low
Suddenness of the Transition from Agriculture to Tourism	The speed with which changes have occurred has increased apprehension about the future.	• The accelerated phase-out surprised many Dole workers and created anxiety about the future.	high
		• Long-time Dole Company workers fear the loss of retirement benefits.	high
		• Change from the traditional work schedule has affected family life.	high
		• Crime, drug, family, and youth problems have increased rapidly.	high
		• Workers need to learn new skills and become accumtom to a different work environment and employer expectations.	high
		• The number of strangers on Lanai increased.	high
		• Growing pineapple has been a source of pride for Lanai.	medium
		• The transportation of goods for residents by the Dole barge may be discontinued and the cost of goods will increase.	low
		• Higher cost of living due to a mix of resort and local economies.	low
		• Lanai's population is too small to fill all jobs.	low
Opportunities for Positive Change	Plans for development and new economic activity offer an opportunity for desired improvements to the community.	• Community input in decision-making.	high
		• Increased medical, social, and commercial services.	high
		• Former residents have returned.	high
		• Different job choices and opportunity to learn new skills.	high
		• Diversification of Lanai's economy.	high
		• Increased availability of affordable housing.	medium
		• Increased Lanai revenues.	low

TABLE IV-10

(Continued)

General Topic	Description	Specific Issues/Concerns	Frequency/ Intensity
Apprehensions about Castle & Cooke	Skepticism about the trustworthiness of Castle & Cooke.	• Perceived lack of consultation with the community about decisions that affect it.	high
		• Believe that some promises have not been kept due to frequent personnel changes.	medium
		• Month-to-month and restrictive commercial leases.	medium
		• Lack of commercial land for Lanai businesses.	medium
Viability of Resorts on Lanai	Skepticism about the ability of Lanai to attract visitors.	• Current low occupancy of Koele Lodge.	high
		• Lack of visitor attractions on Lanai.	high
		• Fear that the resorts may be sold.	low
		• Awareness of the marketing of the whole island as a resort destination.	low
Ocean Recreation	Current residents may be crowded out of beaches and fishing spots or denied access.	• Increased number of people on the beach and fishing trails.	high
		• Restrictions on beach camping.	high
		• Reported color-coding of picnic tables to designate those for visitor and resident use.	high
		• Plans for beach improvements are visitor oriented.	high
Community Cohesion	Fear of (1) inequality and class differences and (2) cultural differences with newcomers. Reflects sensitivities developed during the plantation experience.	• Affluent resort residents as a separate community.	high
		• Newcomers have been given new housing while the needs of current residents have not bee met.	high
		• Many newcomers have a different lifestyle and are insensitive to aspects of local lifestyle.	high
		• Resort workers who view themselves as superior to others.	medium
		• Lack of interaction between newcomers and residents.	medium
		• Perception that few residents have management positions.	medium

Project-Related Issues Only: Issues related directly to golf course and golf course residential development were impacts on the island's water supply and environmental impacts.

Residents were highly concerned that water use by a golf course would result in less water for resident use and agricultural activity. A few expressed suspicion that the pineapple plantation was being phased out at this time primarily to provide water for the new golf course and associated residential development. Many informants hoped that diversified agriculture will be an important part of Lanai's economy. Some were concerned that chemicals used on the golf course would contaminate water supplies.

Damage to wildlife, plants, and marine life due to development and run-off were discussed by some. The preservation of archaeological sites was also a concern. In LUC testimony, some residents expressed the fear that the values of golf course homes would raise taxes in Lanai City.

(NOTE: The foregoing concerns are all addressed in various portions of this EIS. For example, water supply issues are covered in Section 6.4. Property tax impacts were discussed in Section 5.4.)

Suddenness of the Transition from Agriculture to Tourism: According to some interviewees, many Dole workers were surprised that pineapple operations were failing. They only truly realized pineapple operations would end when the ILWU began discussing resort job training for its members. There has reportedly been much anxiety about recently acquired home mortgages, the prospect of finding new employment, and the loss of retirement benefits.

Resort shift work has presented changes to a community in which everyone used to have the same schedule. Traditionally, weekends were times for social events. Parents who have different work schedules have begun to rely on their older children to care for younger siblings. According to some informants, this has caused resentment in teen-aged children and increased youth problems. (See following Section 5.7.3 on "Social Structure" for further discussion.)

Informants also expressed the concern that rapid changes on Lanai have led to increased crime, drug use, and domestic problems. There was still a sense of shock over last summer's suicide/murder. Since development has commenced, Lanai has reportedly experienced an increased demand for health and social services such as services for pregnant women and counseling about domestic, drug, and alcohol problems. (This concern is further addressed in Section 5.7.4.)

Several informants discussed Dole Company workers who are apprehensive of resort work because they have limited English language skills or prefer agricultural work. Interviewees mentioned that those who have begun to work at Koele Lodge have had to make adjustments to different standards of personal appearance and the different style of communication of superiors from the Mainland. (See Section 5.3.2 for further discussion.)

The increased number of new faces in Lanai City is also an issue. The credit purchase system reportedly has been discontinued because merchants do not want to risk extending credit to strangers. Also, traditionally the behavior of children and teenagers was somewhat controlled by the presence of "Aunties and Uncles" who would report behavior to parents. The increased presence of strangers has made this less possible.

Interviewees also noted that Lanai has been proud of its pineapple industry and it is strange to see fields of grass replace fields of pineapple. Several informants wondered if barge service between Oahu and Lanai would continue when pineapple is completely phased out. Presently, the barge transports pineapple to Oahu and consumer goods, including automobiles, to Lanai on its return trip.

In LUC testimony, testifiers expressed the concern that Lanai's cost of living would increase because of the resorts. Also, some felt Lanai does not have the labor force to support the resorts and that importation of labor would be necessary.

Opportunities for Positive Change: Although many expressed anxiety about changes and Lanai's future, many also felt the community could benefit from change. Most informants said the extent of community benefit depends on how much input the community has in decisions made by Castle & Cooke. Many expressed approval for actions by LSG and the proposed formation of a Community Development Corporation.

Several interviewees believed that a larger population will increase the medical, social, and commercial services available on the island.

The return of former Lanai residents, many whom grew up on Lanai and left for jobs or a higher education, is viewed positively. Many hope this is a trend that will continue. Most have returned because of new job opportunities. Informants said new jobs have offered Lanai's youth and working people more options than existed before resort development.

Many informants expressed the desire for a diversified economy on Lanai. Markets created by the resorts are viewed as an opportunity for diversified agriculture and other businesses. Many informants commented that Lanai needs more than Castle & Cooke as an employer. Many viewed the prospect of independent business ventures as dependent on the availability of commercial leases from Castle & Cooke. (See Section 5.7.5 for discussion of "Community Autonomy vs. Corporate Control" and Section 5.7.6.2 for related mitigations.)

The influx of a larger population has led many informants to expect that more affordable housing will have to be built. In LUC testimony, an increase of Lanai's revenues due to development was also viewed positively.

Apprehensions about Castle & Cooke: Some informants stated that residents are intimidated by Castle & Cooke and lack the self-confidence to assert their views. They suggested this may be due to the historical "plantation mentality" of many longtime residents.

Much of the discussion by interviewees about the uncertainies of Lanai's future focused on a lack of trust of Castle & Cooke. Informants discussed the lack of community autonomy and input on decisions which are important to the community. Merchants have been unable to make improvement plans because they currently have month-to-month leases. Some interviewees are skeptical that there will be a place for local businesses in Castle & Cooke's master plan for Lanai City. (Again, see further discussion in Sections 5.7.5 and 5.7.6.2.)

Viability of Resorts on Lanai: Many informants feared that the resort development will be unprofitable and will not provide residents with stable employment. There was concern over current low occupancies at Koele Lodge and the possibility that these may indicate the upscale "mountain lodge" concept is not workable, although many people also acknowledged temporary factors such as the Persian Gulf war and national recession. (NOTE: Various Hawaii resort market assessments have indicated there is currently an oversupply of upscale hotels, but demand is expected to catch up with the supply by the mid-1990s.)

Several interviewees wondered if Lanai has enough attractions for visitors. Only a few interviewees showed awareness of plans to market the entire island of Lanai as a resort attraction. Most interviewees viewed the resorts themselves, their facilities, and the islands beaches as "visitor attractions" rather than the community itself. However, several informants stated that the success of the resorts will depend greatly on cooperation from the whole community.

A few interviewees suspected the resorts will be sold to foreign interests. This was viewed both positively and negatively.

Ocean Recreation: Use of Hulopoe Beach and coastal fishing spots were frequently discussed by interviewees. Many noted that an increased number of tourists is already visiting the beach and taking walks on fishing trails. Informants were particularly negative about any potential restrictions on customary camping and picnicking activities.

Several interviewees reported that picnic tables have been color-coded to designate those for visitor and resident use, and one interviewee said she witnessed a tour guide asking some residents to move from a table color-coded for visitors. (NOTE: According to Castle & Cooke executives, the company was <u>not</u> responsible for painting the tables different colors. Rather, their understanding is that Lanai community groups initiated this system in response to day tours from Maui which were using many of the picnic tables. The Lanai community wanted to designate certain tables for the day tours' use, reserving others for residents. In the recent improvements at Hulopoe Beach Park, Castle & Cooke removed the old painted tables and provided new tables -- all with the same clear stain.)

Others felt that plans for improvements at Hulopoe Beach Park are primarily for outsiders and not residents. Improvements include parking and a kiosk for equipment rental and visitor information. These informants believed these improvements will make the beach seem "visitor-oriented" and that residents will feel less welcome.

Community Cohesion: Informants said there are strong sensitivities to inequality and class differences on Lanai. Regarding resort housing development, many informants said they do not want to see the creation of another "snob hill," referring to housing that once existed only for plantation management. Interviewees feared that the creation of upscale housing will result in a two-class society on Lanai; they thought that current residents may compare their standard of living to the affluent and self-image may suffer. The current tendency for residents to be non-assertive may be intensified. Some informants were afraid that affluent new residents will mistreat less affluent longtime Lanaians and/or that racial divisions between groups will form.

Other issues that add to fears of social stratification include the perception by some residents that housing has been unfairly distributed to newcomers rather than longtime residents and that there are too few residents in resort managerial positions.

Several informants also claimed that some former Lanai residents who returned to work at the resorts view themselves as superior to those who remained on Lanai. Informants said that historically, those who leave Lanai for work or education are perceived as upwardly mobile while those who remain on Lanai are perceived as failures or unambitious.

Informants also discussed residents' sensitivity to cultural differences. Many newcomers (including staff-level hotel workers) have been viewed as unaware or insensitive to local culture and customs. It was mentioned that some resort workers have had difficulty relating to superiors who originate from the Mainland.

(NOTE: The foregoing concerns are all addressed in various portions of this EIS. For example, water supply issues are covered in Section 6.4. Property tax impacts were discussed in Section 5.4.)

5.7.3 Social Structure

5.7.3.1 Existing Conditions

Issues related to social structure can include: (1) presence of newcomers in the community; (2) income similarities or dissimilarities; (3) distribution of power or wealth among various specific groups; and (4) patterns of social communication and social values.

Newcomers: Lanai has a history of absorbing newcomers who in-migrated to take agricultural jobs, as indicated by its high percentage of foreign-born residents (Table J-1) and its shifting ethnic patterns over time (Table J-19, "Lanai Population and Ethnic Shifts, 1930-1980"). However, in more recent years, there was much less in-migration prior to opening of The Lodge at Koele. The 1980 Census found 73% of Lanaians had lived in the same house for the past five years (compared to 50% statewide), and the 1988 STICS survey found that just 7% had moved to the community in the past five years (compared to 34% statewide).

Income Distribution and Levels: As a plantation community, Lanai has had a fairly homogenous income structure. Table J-20, "Family Characteristics and Income

Levels -- Lanai Island, Maui County and State of Hawaii, 1980," indicates Lanai residents in 1980 had relatively few families with either very high incomes or very low (poverty-level) ones, as compared to Maui County or the state as a whole. This table also indicates that 1980 family incomes on Lanai were almost as high as those countywide or statewide. Given the lower housing costs on Lanai (especially for Castle & Cooke employees with a highly subsidized rent level), it may be argued that most Lanai residents are probably accumulating disposable income at a more rapid rate than residents elsewhere in Hawaii, on average.

More recent income estimates provide conflicting impressions. The 1988 STICS survey (which had a high Lanai refusal rate for the income question) suggests a Lanai median income level only about two-thirds the statewide median. The 1989 University of Hawaii Social Work study generates a median income figure of about $25,000 for that year.

On the other hand, a 1990 Castle & Cooke analysis of Lanai payrolls generated an estimated average household income of $36,120 for households containing at least one Castle & Cooke employee. This included Dole, Lanai Company, and RockResorts (Lanai Resort Partners), although it excluded RockResort worker tips, overtime, and salaries of senior managers which would have artificially brought up the average. For Dole and Lanai Company employees, the figure was calculated by annualizing 1990 income figures to date. For RockResorts (Lanai Resort Partners) employees, the figure was calculated by identifying current salaries/wages and annualizing those.

The apparent conflict between the survey and Castle & Cooke income data could be due to several reasons:

- Different methodological approaches (average versus median; survey versus payroll; etc.).

- Possible real increases in income during 1990, due to expansion of higher-paid Lanai Company job opportunities and opening of The Lodge at Koele (which may have resulted in current workers taking additional jobs and/or some people entering the labor force for the first time).

- The Castle & Cooke figures applied only to working households (particularly households with a goodly number of unionized or salaried jobs), whereas the survey would have included households comprised of retirees, the unemployed, workers in lower paid non-Castle & Cooke jobs, etc.

Retirees tend to have much lower incomes, but higher net worth and (for Castle & Cooke retirees) substantial free medical benefits. (In making income comparisons between any two places, such as Lanai and Maui Island, it is important to consider the composition of the population and compare only similar sub-groups. This is why Table J-20 compares family incomes only.)

Furthermore, it should also be noted that 19 units in the new Lanai City apartments have been set aside for low-income families. Castle & Cooke executives say

they have been unable to fill all these units because they cannot find applicants with incomes low enough to meet the federal eligibility criteria.

Allocation of Power/Wealth Among Groups: From a historical perspective, most higher-status, higher-paying jobs in plantation communities went to Caucasians (and, in more recent years, Orientals). Sensitivities about such inequalities are still strong. Focus group participants in the University of Hawaii Social Work study said they felt Filipinos have not been given adequate opportunity at managerial jobs. However, only 7% of Lanaians surveyed in the study expressed any job dissatisfaction. On a statewide basis, the 1988 STICS study found that Caucasians and Mainland-born residents have higher income levels on average, reflecting higher levels of education.

The perception of limited opportunities within Dole may be relative to exact level of accomplishment. Top Castle & Cooke employees located in Honolulu tend to be from the Mainland. However, a recent survey covering 34 of Dole's 35 salaried Lanai supervisors and managers found the following breakdown by place of birth:

Lanai	9
Other Hawaii	11
Philippines	10
Elsewhere	2
No response	2

On another level, political and economic power on Lanai for nearly half a century has been concentrated in two institutions: Castle & Cooke (or its various subsidiaries) and the ILWU. Only with the opening of The Lodge at Koele in 1990 has another major organization, RockResorts, entered the picture on Lanai. Even though RockResorts operates The Lodge at Koele and the Manele hotel, workers are still technically on the payroll of Lanai Resort Partners, which is a Castle & Cooke entity.

Social Communication and Values: The University Social Work focus groups also gave indications of some existing value conflicts among Lanaians -- with native Hawaiians saying some other groups are less attuned to the land, more "here and now" oriented. However, the survey portion of the same study indicated a tight-knit community, with substantial participation in school and civic organizations. The most frequent way in which people gained knowledge of community events was "word of mouth" (85%) within the community. Leisure-hour socializing and recreation is often done in family groups.

Reflected in both the union movement of past decades and the Filipino heritage of many Lanai residents is a heavy emphasis on social equality (Ponce, 1980; Junasa, 1982; Anderson, 1984). While a strong work ethic and desire to improve material circumstances is apparent among Lanai families, there is also a history of collective (more than individual) effort as a socially approved way to obtain economic and political objectives.

5.7.3.2 Future Without Project

On a long-term basis, the planned resort development still retains at least some potential for meeting the goals which the University of Hawaii Social Work study indicates Lanai residents hold for it: i.e., improving the economic quality of life for Lanaians and their families. Residents of Lanai will be exposed to more types of jobs and a greater variety of social contacts than occurred under a plantation economy.

Without the project, however, economic opportunities will be much more limited, due to (1) few jobs (and, concomitantly, fewer advancement opportunities); (2) reduced income opportunities (due to fewer visitors and/or reductions in levels of visitor expenditures); (3) loss of some off-site business support activities; and (4) more limited corporate contributions to community projects. The "without-project" scenario is essentially one of economic stagnation.

Although differing in degree, there will be substantial shifts in Lanai's social structure with or without the project. A prime force for change would be development of 325 resort residential units at Koele, with additional impacts from development of the already-approved resort residential units at Manele (and, temporarily, migrant farm workers filling Dole vacancies in the next year or two).

Newcomers: In CRI's community interviews, one of the most consistent themes was the statement that (paraphrasing:) "There are so many strange faces now; just a few years ago, we used to know every person we would see." This sensitivity to unfamiliar faces is illustrated by a finding from the 1988 STICS survey: Although the average daily visitor census at that time was possibly 20 tourists, 80% of Lanaians interviewed said they saw visitors either daily or several times a week. (However, only 2% of Lanaians said tourists interfered with their lives in any way at that time.)

Several in-migrant hotel workers interviewed by CRI said they found Lanaians basically friendly, although somewhat reserved. However, the newcomers were also struggling to adjust to a sense of "living in a fishbowl" and a perceived strong pressure to conform to local standards of behavior in regard to things which had not mattered in other communities. What is considered "community" by longtime Lanaians may be considered "intrusiveness" by newcomers.

The number of newcomers to Lanai will continue to increase in the next few years. In-migrant resort workers (whose additional numbers will be relatively few under the "without-project scenario") will eventually be absorbed into the community. However, if limited housing supply results in rapid turnover of in-migrant workers unable to sink roots on Lanai, a pool of transient workers would remain perpetual "newcomers."

Tourists and part-time residents are more likely than full- time residents to be seen as "strange faces." Plans to renovate parts of Lanai City as visitor-oriented shopping areas will result in increased numbers of tourists and part-time residents in the town. Strict design guidelines will help prevent the sort of transformation seen in areas such as Lahaina or Kailua-Kona, but there will still be a changed "sense of place" and a local awareness of the high visitor presence. Compared to Manele, Koele residents and visitors will probably contribute to this much more heavily on a per-person basis, since

they are closer to Lanai City and may be expected to go there more often; however, this proximity effect may be balanced by the greater numbers of people coming from Manele.

Outside Lanai City, numerous possible visitor attractions and recreational activities may bring visitors to areas of the island in which Lanaians are unused to seeing outsiders. An "Interpretive Master Plan" (D&M BUCY and Associates, 1989) has been prepared to help assure respectful treatment of such areas; it includes identification of some areas which Lanaians have asked or assumed would not be developed as attractions.

Income Distribution and Levels: Because of resort development, average incomes on Lanai will probably rise (although increases in real standard of living will be heavily dependent on housing costs). Hotel workers now generally earn as much as or more than agricultural workers, and incomes in strictly agricultural communities have often not kept up with those in the rest of the state. Additionally, worker benefits will improve. At present, only Dole "Regular" workers receive medical and vacation benefits; "Non-Regulars" and "Seasonals" do not. At the resorts, even part-time workers will get such benefits under the union contracts (personal communication, Thomas Leppert, Castle & Cooke Properties President, October 27, 1990).

However, without the project, income benefits will be somewhat reduced due to lower visitor occupancies. More jobs may be filled on a part-time or on-call basis, and tipping opportunities will be fewer.

However, greater reliance on the service industry means that Lanai will probably also experience a greater gap in incomes -- i.e., the "rich growing richer and the poor growing poorer." This has been a pattern not only in the state of Hawaii, but in the country as a whole, as the economy has shifted from manufacturing to services. In 1967, the richest 20% of the population claimed 42.7% of household income, while the poorest 40% had just 15.1%. By 1988, the top 20% had 46.3% of the income, while the bottom 40% had 13.4% (U.S. Department of Commerce, Bureau of the Census, 1990).

Perceived income gaps may be even greater, because of the presence of upscale visitors and part-time residents. Again, those at Koele will probably have a greater psychological impact (on a per capita basis) than those staying at the more distant, self-contained Manele area. Additionally, if the Manele Bay hotel is less successful without a golf course, some of the income benefits for residents could be lost.

Allocation of Power/Wealth Among Groups: The potential for development of a stronger middle class on Lanai is linked to (1) success of the Manele hotel, since a more successful operation assures the stability of supervisory and managerial jobs, and (2) the creation of independent small business opportunities for native Lanaians.

In many parts of Hawaii, such business opportunities have been taken more by outsiders than by longtime residents, but this outcome is not inevitable. Castle & Cooke has said it will give first priority in new business leases to on-island businesses. RockResorts has already made attempts to identify Lanaians interested in small business opportunities, though few Lanaians indicated such interest. In the short term, lack of past business skills training or motivation may prove a barrier to business initiative by

Lanaians with plantation backgrounds -- although returning Lanaians or family members may have had different backgrounds. In the long term, studies of traditional agricultural communities absorbing many urban in-migrants indicate that longtime residents gradually adapt more "modern" attitudes toward education and initiative required for business success (c.f., Kamisasa, 1983).

At the highest decision-making levels, economic power on Lanai will remain concentrated in the hands of Castle & Cooke. However, from the day-to-day perspective of the average worker, there will be a greater diversity of job types, immediate employers/supervisors, and worksite policies. Because management will be more decentralized, employees will likely find managers and supervisors to have considerably different values and styles, and there will be more diversity of work settings within the hotels themselves than there was within the pineapple plantation economy.

Furthermore, the gradual growth of the small business sector will offer additional job and entrepreneurial opportunities outside the direct control of Castle & Cooke. The extent to which small businesses become more independent of Castle & Cooke will depend on (1) the outcome of ongoing discussions about longer leases for current Lanai City businesses, and (2) possible acquisition from Castle & Cooke of additional fee-simple land for small farms or businesses. These issues are discussed further under "Mitigations" (Section 5.7.6.2).

It should be noted that all of the foregoing prospects for a strengthened Lanai middle class would be weaker without the project, since they are linked to the success of the overall resort economy.

The influence of the ILWU will remain strong, assuming unionization at the Manele hotel, but Hawaii hotel workers have generally not been as likely to follow the political recommendations of union leaders as organized agricultural laborers were.

International hotel chains typically rotate top managers from job to job in hotels around the nation or the world. Therefore, there will be some continuation of the typical Lanai pattern of top managers being Caucasians or others from outside Hawaii. However, top hotel management in Hawaii has been gradually growing more "local" as graduates of the University of Hawaii School of Travel Industry Management acquire experience throughout the nation and return home to take key positions. RockResorts (Lanai Resort Partners) has announced its commitment to training Lanaians for career upgrades. Over time, resort management will gradually come under day-to-day control of people born in Hawaii, and perhaps Lanai itself. Lanai Resort Partners has already placed four Lanai residents with no previous hotel experience in supervisory positions, and the recently promoted General Manager (previously the Food and Beverage Manager) for the new Manele Bay Hotel is a returning Lanaian.

Social Communication and Values: As population increases, social communication patterns will shift. There will be more reliance on formal news media to keep informed about events on Lanai, less dependence on "word of mouth" (hence, some dilution of the power of rumor on Lanai). Based on observed changes elsewhere in Hawaii, it may be predicted that the family or extended family will be less important as a

source of leisure-hour socializing and recreation; friendship networks based on fellow workers or social peer groups will become more important.

Addition of a part- or full-time affluent resort residential population will provide at least the potential for contributions of business expertise, donations to local cultural/ artistic events, and greater involvement in civic affairs. However, that potential has not often been realized in Hawaii. CRI studies of interaction between longtime "local" residents and new resort-area residents in Princeville, West Hawaii, and West Maui indicate that people living in self-contained resort areas have generally remained socially isolated from surrounding communities. There may be less such isolation on Lanai, both because of the physical proximity of Koele residents to Lanai City and also because Lanai City will remain the shopping center for the entire island. (Commercial development at Manele will be limited to a few convenience stores.)

Creation of a residential community at Manele would be Lanai's first modern settlement not in or near Lanai City. If many full-time residents live there, some sense of community rivalry and competition for public resources might evolve. However, a relatively small full-time residential population is expected without the golf course.

Lanai newcomers originating on the Mainland -- particularly the more affluent visitors and resort residents -- will tend to have different social values than longtime Lanaians. They will probably be politically more conservative. There will be more emphasis on individual (rather than collective) achievement, and more focus on individual rights and freedoms as opposed to established customs and group standards. As on other islands, actual full-time resort residents will constitute a small percentage of the voting public. However, the greater value placed on individually assertive behavior could lead to Mainland in-migrants being perceived as trying to "take over" some Lanai civic and business groups.

A major concern expressed by some Lanai residents in the February 1991 community interviews (Sec. 5.7.2) involved the possibility that affluent Koele or Manele resort residents could treat longtime Lanai residents in a superior or disrespectful way. Some community informants linked this concern to memories of earlier plantation days, where Caucasians dominated an ethnically-stratified society.

It is impossible to predict with certainty whether or not affluent resort residents will actually exhibit (or be perceived to exhibit) such attitudes. One hopeful indicator comes from a recent social impact assessment for a proposed golf course in Hana, where many rich and/or famous new residents have bought homes in an isolated rural community:

> People of upper income levels live in Hana on a full- or part-time basis, and others are guests at the hotel. Conflicts based on economic disparity were not reported during the interview process; such conflicts are either infrequent or may be intertwined with other factors such as ethnicity or culture. [Earthplan, 1991, p. 43]

However, the social impact consultant for this project said that new residents told her they felt their acceptance by the community was something that had to be gradually

earned. Longtime residents said they had mixed feelings about newcomers' desire to take leadership roles in civic organizations, but felt the new people sincerely valued Hana and wanted to keep it from further substantial change (including further waves of newcomers moving into the area). They also distinguished between new residents coming simply to live in Hana vs. those associated with the management of the Hotel Hana-Maui and related businesses. The apparent success of social integration in that community thus reflects a sense of mutual respect between new and longtime residents, which may or may not develop in other rural parts of Hawaii. (Personal communication, Berna Cabacungan, Principal, Earthplan, February 7, 1991.)

5.7.3.3 Project Impacts

For the most part, the project will intensify all foregoing impacts on social structure, by somewhat increasing the number of affluent resort residents and greatly increasing the demand for workers (i.e., in-migrants) at more successful Koele and Manele hotels -- particularly after expansions take place. The project will result in more of the de facto Manele population being residential rather than tourist in nature.

There are some ways in which the project may provide balancing impacts:

- A more successful Manele hotel means more job stability and a better chance for residents to rise to supervisory or managerial jobs at the hotel. Worker income would be more reliable and probably higher due to better tips, higher corporate profits, etc.

- A more successful Manele development also would provide a better base for development of support businesses.

- Within the Manele residential areas, the proposed project district amendment will result in more of the de facto population being residential rather than transient. On a long-term basis, this means greater potential for integration into the Lanai community.

In general, direct and immediate project impacts on social structure will probably be fairly small since there will be relatively little impact in the next five years on the number of resort residents on Lanai. However, delayed indirect impacts -- by facilitating eventual future demand for expanded hotels and thus encouraging more in-migration at a later date -- will be more substantial.

5.7.4 Indicators of Social Stress/Harmony

5.7.4.1 Existing Conditions

Classic indicators of social stress or harmony include data on crime and family stress -- i.e., divorce or child abuse/neglect. (Mental health problems are also a key indicator, although reliable figures are difficult to obtain.) They may also include questionnaire measures of community satisfaction.

As previously indicated, the University Social Work study of Lanai showed strong levels of community satisfaction as of 1989. It also included a compilation of various social indicators from 1980 to 1987, the year before resort construction began on Lanai. These figures indicate extremely low rates for crime, divorce, or child abuse/neglect on Lanai in that period. Excluding some "aggravated assaults," Lanai had only one reported violent crime (a rape) from 1980 to 1987.

It should be noted that such figures reflect reported incidents. Some of the social agency observers who were interviewed for this report said Lanai probably had more problems than the data indicate, particularly in regard to family concerns. Additionally, both drug use and spouse abuse problems predated resort construction on Lanai.

However, according to the social agency informants, there have been sharp increases in social problems since the arrival of several hundred construction workers on Lanai (followed by the initial hotel opening and the pineapple phase-down announcement):

- A number of extramarital affairs between local women and construction workers -- some resulting in separation or divorce, with children remaining in the care of the father -- reportedly has taken place. In some cases, this may have been due to Lanai women's "growing intolerance for chauvinistic and unappreciative husbands" (Matsuoka, 1990).

- Such family stress may be intensifying as women take jobs in the new resort, learning new skills of dress and appearance not required of their husbands (and therefore threatening to the husbands).

- Children have less supervision as parents work evening and weekend shifts for the first time. It has been common in Lanai for very young children to wander around the town, but residents see this in a fresh light because of the sudden appearance of strange faces and heavier traffic.

- Individual mental health problems are reportedly on the rise, particularly since the Dole phase-down announcement. Older workers are believed to be the most affected by anxiety for the future.

- Both actual crime and the fear of crime have increased.

For the most part, these impressions are difficult to confirm with actual data, which is either completely unavailable or else available for just one year past the University Social Work timeframe. (For example, 1988 figures on Lanai divorces or confirmed child abuse/neglect do not show any startling increases over figures from previous years.)

Selected crime data provided by the Lanai police commander do indicate reason for concern:

TABLE IV-11
RECENT LANAI DATA ON REPORTED CRIME

	Burglary	Felony Theft	Total "Part One"*
1987	11	5	70
1988	12	15	98
1989	36	17	104
1990	24	15	124

* "Part One" crimes include those considered most serious, e.g., murder, rape, burglary, larceny, etc.

Source: Lt. Paul Winters, Commander, Maui County Police Department, Lanai District

According to the police commander, there has been a definite increase in domestic violence associated with males losing their jobs while their wives are acquiring better jobs. He also felt Lanai has experienced a significant drug abuse problem related to crystal methamphetamine, although he said there is no evidence to substantiate popular belief that construction workers have been responsible for this.

While drug problems may interact with social change in a harmful way, drugs have been a social concern in all parts of Hawaii, including both tourism- and agricultural-oriented communities. Also, it may be noted that recent Lanai crime rates are still well below Oahu rates.

5.7.4.2 Future Without Project

Based on factors discussed below, it may be predicted that Lanai's current high stress levels (reflecting anxiety over the end of pineapple as much as resort development) are transitional and will eventually fade. However, Lanai may continue to have a particularly difficult transition period for some time, due to its isolation, the speed of the change taking place there, and uncertainties over housing supply:

(1) Reported stress indicators will rise in some part simply because of more social workers on island to record data, as well as cultural patterns of newcomers (who are more likely to register complaints about such things as minor thefts and child neglect).

(2) Predicting the future course of actual stress involves examining potential stressors, including:

- Tourism per se (in and of itself)
- Speed of population growth and social change

- Variables related to crowded housing, infrastructure
- Social structure variables discussed above
- Traffic

(3) Tourism per se has been clearly demonstrated to be a factor only with regard to shift work impact on family routines and initial family effects of women taking jobs in different social settings. The 1988 Statewide Tourism Impact Core Survey (Community Resources, Inc., 1989) found that visitor industry workers were much more likely than others to work evenings or weekends, although workers without children filled many of these jobs.

A situation comparable to that on Lanai today occurred when Kohala housewives started work at the Mauna Kea Beach hotel as the Kohala sugar plantation began its "phase-down" in the late 1960s. Several studies (Cottington, 1969; Hawaii State Department of Planning and Economic Development, 1972; Smith, 1972) examined that situation and found (at least initially):

- Serious marital strains (in some cases leading to divorce and/or wife abuse) attributed to husbands' jealousy over working wives' contacts with male guests.

- A new and improved self-image for women, including increased attention to, and pride in, personal appearance; more self confidence; more assertiveness in family finances. Male self-image, however, suffered.

- Reported problems with unsupervised children associated with shift work and no parent at home.

- Family financial problems associated with increased income, which resulted in overextension of family credit in making purchases.

However, the Smith (1972) follow-up study suggested that marital problems were serious only in a few already-shaky marriages and that families of most other working wives adjusted within a few years. (Also, State child abuse/neglect data for the late 1970s and early 1980s indicated Kohala had one of the State's lowest reported rates of such problems.) Similarly interviews with community leaders in two other areas where tourism supplanted sugar plantations -- Kahuku on Oahu (Community Resources, Inc., 1985) and Kauai's Kiluaea area (Belt Collins & Associates, 1983)--produced reports of only limited and temporary family disruptions when plantation wives entered the resort workforce.

Additionally, project disapproval could result in some lay-offs of Manele Bay Hotel workers hired under the expectation of higher occupancies. Social science studies going back to the Great Depression have demonstrated extreme negative impacts of unemployment and financial crisis on family relationships. Child abuse has also been recently linked to unemployment (Catalano and Dooley, 1980).

(4) Lanai's police commander expects tourism to bring increases in crime, particularly property crimes and minor assaults (personal communication, Lt. Paul Winters, September 24, 1990). This is consistent with assessments given to CRI by police in other resort areas, who say the major problems usually involve larcenies at beach parks and other visitor attractions (as opposed to significant crime rate increases in residential areas).

However, actual data on crime and tourism have produced very ambiguous results. A variety of statistical studies, both in Hawaii (Fujii and Mak, 1979, 1980; Fujii, Mak, and Nishimura, 1978; Chesney-Lind and Lind) and elsewhere (Pizam, 1982; Jud, 1975; McPheters and Stronge, 1974) have all produced evidence of some effect, but the studies often lead to contradictory conclusions about which types of crimes are affected. CRI's examination of reported crime data in West Hawaii and Maui County indicates that overall crime rates in these areas have generally remained stable or even fallen in the 1980s, despite rapid increases in tourism.

Thus, further crime impacts represent a probable danger associated with resort development, but not necessarily an inevitable or lasting result.

(5) A large body of academic literature has examined the consequences of sudden economic change and rapid growth for small rural communities. Early studies of "boomtowns" (small Western communities impacted by mining or energy development) in the 1970s tended to reflect academic theories that speed of change and shifts in social structure were primary factors leading to a wide variety of social ills such as crime, mental illness, drug/alcohol abuse, and a general breakdown in "community" (c.f., Kohrs, 1974; Gold, 1974; Gilmore and Duff, 1975; Cortese and Jones, 1977; Weisz, 1979).

These early studies were eventually criticized as being based more on "anti-growth" ideology than solid data (Wilkinson et. al., 1982). More recent studies (including those set in other countries) have been more carefully designed and have led to more complex conclusions (c.f., Forsythe, 1980; England and Albrecht, 1984; Krannich and Greider, 1984; Stangeland, 1984; Israel and Wilkinson, 1987; Krannich et al., 1989; Berry et al., 1990):

- In general, questionnaire measures of subjective community satisfaction decline in high-growth communities. (This is consistent with the 1988 STICS finding that residents of resort areas were more likely than other Hawaii residents to say the quality of life had grown worse in the past five years.)

- However, objective measures of things such as mental health and crime often do not bear out this sense of community decline. Resident dissatisfaction, while real, apparently is not serious enough to interfere with everyday normal life functioning in most cases.

- Similarly, there has sometimes been substantial resentment expressed toward newcomers by longtime residents. However, patterns of

"neighboring" or "community" have not often broken down under the weight of rapid growth and in-migration. In some cases, they were strengthened.

(6) Traffic has rarely been systematically studied as a source of stress in rural communities. Compared to other island, Lanai still has negligible vehicle traffic. However, traffic increases may be more stressful to Lanaians than most other communities. In the 1988 STICS survey, one question asked why people chose to live or remain in their particular community. The most frequent answers given by Lanaians (34%, versus 19% statewide) involved references to things like small-town atmosphere and lack of congestion/traffic.

In interviews for this study, a common theme involved anxiety about the driving habits of new residents, visitors, and construction workers. Some people said that Lanaians know the individual problems of various senior citizens or small children and adjust driving accordingly; new drivers on Lanai do not.

(7) For the past 10 years, CRI has been studying social change in various parts of rural Hawaii. Social workers throughout the state have frequently told CRI that the most critical factor today producing family disruption and mental health problems is lack of affordable housing. When families must "double up," the resulting lack of privacy is a severe strain on marital relationships, mental health, and well-being of children. Once concerns about the future of current Dole pineapple workers are alleviated, availability of housing may prove to be the most important variable for determining how rapidly the current feelings of stress and dissatisfaction can be resolved. The amount of available housing will increase, although not all of it will be within "affordable" range.

(8) Stress can strengthen, as well as weaken. Lanai has a history of political organization in response to social problems. A number of community groups are now organizing to help deal with change. Recent research in community psychology suggests that such "empowerment" is a critical factor in determining whether residents are diminished or helped to grow by change (Gesten and Jason, 1987; Glidewell, 1987).

5.7.4.3 Project Impacts

As with social structure, project impacts on community stress or satisfaction are likely to be small in comparison with the cumulative changes expected from cumulative resort development and the Dole phase-down.

There is no basis for assuming a golf course would produce significant community stress, independent of recreational concerns discussed previously. The upscale homes around the golf course are unlikely to have any "detectable" crime impact compared to the alternative Manele residential development plan (i.e., higher density development on just 151 acres), according to the Lanai police commander (personal

communication, Lt. Paul Winters, September 24, 1990) -- although they may add to a feeling of resentment of outsiders.

The major direct impact thus would probably be psychological: a reduced sense of "community" on Lanai because of greater socioeconomic differences between the two settlements of Manele and Lanai City/Koele.

Indirectly, the project will eventually provide market support for expansion of both hotels, resulting in additional periods when off-island construction workers stay on Lanai during the week. As previously noted, the initial importation of up to 500 construction workers has resulted in significant actual or perceived community stress. Future hotel expansion and residential housing work is expected to require fewer construction workers (a projected maximum of about 360 in 1996 -- see Section 5.3.1.3), and Lanai at that time will have become a less isolated community. Nevertheless, there is the potential for recurrence of some social problems, depending largely on (1) whether many construction workers are again lodged in Lanai City, and/or (2) where and how they spend their off-work time on Lanai.

5.7.5 Community Autonomy vs. Corporate Control

One of the most important long-term effects of the overall development -- with or without the golf course project -- will be the potential for change in the power balance between the island's major landowner and employer, Castle & Cooke, and other groups or individuals within the community.

As indicated by interviews with community residents and social agency representatives (Section 5.7.2.2), there is a historic sensitivity in this plantation-based community about any perceived social or economic inequity. This leads to tensions about the prospects of working in a "service" industry and of having affluent new residents on the island.

At a larger level, it also leads to strong feelings about the relationship between the community and Castle & Cooke. For decades preceding the current management, residents hesitated to voice substantial criticism about the company for fear (justified or not) of losing their jobs, informants said. There has also been a historic feeling that community residents have little say in Castle & Cooke's plans for their island, since the company's obligations to its shareholders may match or sometimes outweigh any obligations to its employees and the affected community.

The current transition -- of the company to new management and of the island to a new economy -- has produced both a sense of opportunity and a sense of concern. The major perceived opportunity is for more economic opportunities independent of Castle & Cooke's control. A major community concern is that Castle & Cooke's may wish to maintain control over all aspects of the island's economy, even the types of incidental small businesses normally left to entrepreneurs.

There is a wide range of views within the community about the company. Those who are more hopeful and supportive of the company's goals tend to express themselves simply. Critics tend to be more articulate. The following summary of current

community perspectives (based on the interviews in Section 5.7.2.2) therefore tends to be weighted toward the critics. It is intended to provide an overview, not a complete catalogue of all community complaints or all corporate responses:

- The pineapple phase-down announcement has generated a sense of resentment toward the company. Many people understood past statements by Castle & Cooke executives as being assurances that pineapple operations would continue and that resort development would supplement, not replace, pineapple.

- Community and social agency sources also believed the company now has a credibility problem with some Lanai residents due to other past events, including:

  - proceeding with the Manele golf course project when initial plans called for just one course;

  - making company housing available for new resort employees when longtime Lanai residents face increasing housing difficulties;

  - slow progress on providing long-term leases for Lanai businesses and seeking rezoning for new commercial areas;

  - some incidents (true or rumored) in which top Castle & Cooke or RockResorts executives allegedly excluded residents from normally public areas or treated them disrespectfully; and

  - past rapid turnover among senior Lanai Company executives, such that more recent executives are not always familiar with informal understandings reached by predecessors and the community therefore believes that "promises have been broken."

- Most of the same people felt that Castle & Cooke has made progress in dealing with some of these problems. However, they felt new programs should be more extensively communicated to residents and that top Lanai Company executives need to make themselves more available to answer community questions on the island.

- The effect for many community residents at present is a shaky sense of faith in their future on Lanai. They are uncertain that Castle & Cooke will follow through on current promises, and uncertain that new economic ventures will succeed. There is a growing concern that current owners of the company will soon sell all Lanai holdings to foreign investors.

- Castle & Cooke has clearly stated that it wants to end the old "paternalistic" relationship with the community, and many Lanai residents say they also want more independence (although some express regret for the passing of a "more caring" corporate attitude), with the understanding that such a

shift also reduces the role of the company and its subsidization of key services and contributions to the community.

However, both sides are sometimes confused by apparent contradictions. A repeated theme in community interviews was the perceived desire by Castle & Cooke to keep "control" in the community (particularly of small business expansion). Some company officials, for their part, feel they are still being asked to fund programs which are properly the responsibility of local government.

In response to these concerns, Castle & Cooke Properties' Thomas Leppert (personal communication, October 27, 1990 and April 3, 1991) stated:

- In regard to the pineapple phase-down, the company believes that past statements about continuation of pineapple were promises to make a good-faith effort, not an absolute guarantee that pineapple could be preserved indefinitely. He said the differential between foreign labor costs and Lanai costs continues to increase, which produced a disadvantage that could not be overcome.

- He believes the company's housing program is the state's most extensive private-sector effort, measured in either absolute terms or in terms of subsidy dollars per resident population. The reservation of 48 housing units for new hotel employees was needed for the hotel opening, which created new jobs for island residents, and must be measured against the economic opportunities created by opening The Lodge at Koele.

- Some of the other "credibility" concerns are fair, but not entirely the fault of the company or the current management. For example, the company wants to extend long-term business leases, but must first come up with a master plan (including such issues as relocation during the renovation phase) and design criteria. Additionally, the company has moved forward on discussions with the State about land for new commercial and agricultural areas and is making various other efforts to strengthen independent local businesses (see Section 5.7.6.2).

- Castle & Cooke has recognized problems from management turnover and moved to deal with them. There has been no top management turnover in the past 20 months, and new managers have a broader base of skills for addressing Lanai's development issues. They are spending substantially more time on-island and are holding regular community meetings.

- Castle & Cooke has made other major social commitments to Lanai, including:

  - the effort to offer new jobs and all needed training for former Dole Pineapple workers;

  - setting up the Community Development Corporation requested by the community; and

- changes in land planning to benefit residents -- e.g., the Cavendish golf course was originally zoned for single-family development, but the company removed it from that planned use so that residents could use it in perpetuity as a free course.

- Additionally, Castle & Cooke has made major cash and in-kind contributions to the community, as detailed in Table J-21.

Approval of the Manele Bay Golf Course and Golf Residential project would likely have only marginal and indirect effects on any evolving new relationship between company and community. However, changes in this relationship will represent one of the most important cumulative impacts of overall Lanai development.

The challenge for both Castle & Cooke and the community is how to assure a sense of individual dignity and private initiative while marketing an entire island -- including longstanding residential and business areas -- as an integrated visitor attraction. This is presumably the basic agenda for the current series of discussions between LSG and Castle & Cooke on the detailed nature of Lanai resort development.

5.7.6 Potential Socio-Cultural Mitigation Measures

Some of the most critical mitigation measures would include those discussed previously -- i.e., absorption of Dole pineapple workers and provision of housing. These will ease the most immediate source of community anxiety (the future of Dole workers) and mitigate what is arguably the most significant negative impact of rapid development in Hawaii (affordable housing shortages).

There are four major additional areas in which mitigation efforts are or could be carried out:

- integrating new upscale resort residents into the larger Lanai community (perhaps the most relevant concern for the proposed project);

- political and economic diversification (which will help to create a stronger middle class on Lanai, to reduce the "rich-poor" gap and help Lanai residents achieve the objectives which the UH Social Work study suggests underlie original resident support for tourism on Lanai);

- easing transitional problems of social stress; and

- improving communication between residents and developers.

Castle & Cooke has already initiated a number of efforts in these areas. Some of these are described below. Mitigation recommendations not identified as initiatives by Castle & Cooke (or other agencies) represent consultant suggestions only and do not imply any commitment by the applicant.

5.7.6.1 Integrating New Upscale Residents Into Larger Community

(1) Resort residential projects such as those planned for Koele and Manele typically have community associations responsible for maintenance of private roads, provision of security, etc. Owners are assessed monthly fees to provide such services.

These community associations could be vehicles for educating new resort residents about Lanai. They could provide members with historical information about the community and newsletter updates about community events.

(2) The association(s) could also be a mechanism for soliciting contributions for a community development trust fund, or for specific community projects. This would have to be decided by the respective association(s).

(3) Castle & Cooke has hired an Activities Coordinator for Lanai, who is responsible for developing a variety of community-wide recreational programs. As the resort residential population begins to be established, the Activities Coordinator could be instrumental in assessing the types of activities, entertainment, and civic programs which would attract residents of all Lanai communities -- Lanai City, Koele, and Manele.

(4) Castle & Cooke is continuing its search for a Vice President of Community Affairs for Lanai, whose responsibilities will include active problem solving within the community.

(5) The Po`okela program workshops now being offered to Lanai Resort Partners employees (but open to all community members) could be used to target new resort residents. The program component which focuses on the cultural values and ethnic history of Lanai is particularly important for educating new residents, including resort residents.

(6) Castle & Cooke has commissioned an "Interpretive Master Plan" (D&M BUCY and Associates, 1989), which is aimed at helping visitors understand and appreciate the history of Lanai. The plan does not currently focus on new full- or part-time residents, although these are obvious areas of applicability. Castle & Cooke may wish to consider asking its consultants for the plan to prepare an appendix pointing out strategies for assuring that new residents are given equal or greater awareness of Lanai's history.

5.7.6.2 Political/Economic Diversification

(1) As previously discussed, provision of long-term leases to current Lanai City businesses would increase the stability of these businesses and permit greater economic diversification. Castle & Cooke has issued a policy statement expressing the company's commitment to such extended leases, which will permit businesses to make needed improvements. However, the statement specifies that "In the central area, a long-term master plan

will be a prerequisite. This is clearly needed to avoid future displacements and to ensure the interests of all tenants are protected."

Castle & Cooke has just begun a new master planning effort for Lanai City, in conjunction with a revived Retail Merchants' Association. Renovation of existing space and new construction could result in expansion of the current 39,000 square feet of commercial space to a total 60,000 square feet. The actual steps taken in this area will be primarily dependent on the economics and potential of each individual store to finance business expansions.

The master planning will include an effort to identify all Lanai residents (or off-island family members) interested in any sort of local business, including arts and crafts. Following redevelopment, long-term leases would be granted to businesses. However, the Castle & Cooke policy statement further specifies that "Leases will require individual businesses to make appropriate capital outlays. Since longer term leases shift responsibilities, reduce flexibility, and are intended to create a traditional owner/tenant relationship, rents (minimums and percentages) will be adjusted to levels closer to market."

(2) Additionally, Castle & Cooke has recently reached conceptual agreement with the Office of State Planning to convey 25 acres to the State of Hawaii, which would operate commercial and industrial parks -- with long-term leases to Lanai businesses -- independently of Castle & Cooke. The total 25 acres would consist of two parcels. Ten acres would be in the area adjacent to Lanai City which has long been planned for commercial development. The location for an additional 15-acre industrial site has not yet been decided. As of early March 1991, the Office of State Planning had stated that it would ask the Department of Land and Natural Resources to administer this parcel (personal communication, Castle & Cooke Properties President Thomas Leppert, March 5, 1991). Castle & Cooke intends to convey the land to the State with minimal restrictions; any such restrictions would be limited to assuring the company of some input on design guidelines and keeping densities to Lanai City levels.

(3) The company has signed a Memorandum of Agreement with Lanaians for Sensible Growth (LSG) which pledges to:

- provide an annual grant for two consecutive years to aid in the creation of a Community Development Corporation, which will stimulate community-based economic development projects on Lanai;

- provide grants in 1991 to fund projects, proposals, and programs, including a "backyard aquaculture" demonstration program; and

- thereafter, provide additional funding for proposed projects on a case-by-case basis. (The number and size of any such grants would be dependent on the success of resort development on Lanai.)

(4) Castle & Cooke is planning to contract for a business skills inventory on Lanai and to identify the major small business opportunities which have emerged in other rural Hawaii resort areas.

CRI suggests that this study consider cultural factors related to business motivation in communities with plantation backgrounds. If such factors appear to be serious problems, attention should be given to:

- methods of training for attitudinal as well as knowledge variables, and

- identification of other people with "Lanai roots" (e.g., family members or Lanai out-migrants) with stronger aptitudes for business ventures.

(5) Under the Lanai Co., Castle & Cooke is developing a three-year plan for expanding its diversified agriculture operations on Lanai. Much of the program would be aimed at Lanai's own visitor and residential market, but some potential off-island export crops (such as forage for cattle on other islands) are being considered.

Other current or potential products include eggs, papayas, bananas, organic vegetables, cattle, and swine. The current 19 diversified agriculture employees could increase to 40 or 50 if these plans move forward (personal communication, Steve Snow, Director of Diversified Agriculture, Lanai, September 18, 1990). The plans for diversified agriculture would be largely linked to tourism success on Lanai.

(6) Additionally, Castle & Cooke Properties, Inc. (the division of Castle & Cooke under which the Lanai Company falls) has made a verbal commitment to the Office of State Planning to provide land for a State agricultural park, to be utilized by independent farmers (personal communication, Thomas Leppert, Castle & Cooke Properties, chief executive officer, March 5, 1991). Currently under discussion is a 55-year lease to the State (at little or no cost) of 100 acres at Kaunolu. This land includes ten acres already under intensive cultivation by the Lanai Company for truck crops.

(7) Various other Castle & Cooke initiatives to diversify ownership and strengthen independent businesses on Lanai include:

- funding a series of entrepreneurial workshops by the same consultants who are conducting the Po'okela Program in the hotels (Section 5.3.2.7);

- funding a Lanai Arts Program to encourage local arts and crafts on a professional level, including contracts for artworks in both new resort hotels;

- passing over control of the hospital and clinic to local businessmen;

- offering free or inexpensive office start-up space in the old Dole offices to local businesses (although there has been little response to date);

- assisting local Lanai businesspeople to claim a $100,000 legislative grant for tourism promotion, rather than having Castle & Cooke or Rock-Resorts utilize the funds.

(8) Depending on resolution of current federal budget uncertainties, the national Economic Development Administration (EDA) may be able to invoke Title IX of the EDA Act for Lanai as a result of the Dole phase-down (personal communication, Frank McChesney, Economic Development Representative, October 2, 1990). This could provide local government with matching federal grants for infrastructure which would promote local economic development.

Such "infrastructure" could include actual buildings such as a cooling plant for local agricultural produce or a small business center for resort support services. Such facilities would remain in the control of local government and must serve a variety of separate businesses.

5.7.6.3 Easing Transitional Social Problems

(1) Castle & Cooke has agreed to a proposal by the Office of State Planning that it provide land for a joint County-State building to house more social service and public health agency workers.

(2) To deal with personal stress or mental health problems, the company currently provides an Employee Assistance Program (EAP) to all employees and family members. Discussions are underway about the possibility of RockResorts utilizing the same program for its hotel employees, and some preliminary services have already been provided at The Lodge at Koele.

Under this program, a clinical psychologist is now coming to Lanai for counseling sessions. Employees or family members are given up to three free sessions. They may then elect to continue seeing the same therapist at their own expense, or else are provided with referrals to other mental health resources.

(3) For the past several months, Castle & Cooke has been subsidizing the shortfall for the Lanai Day Care Center, which has extended services through the summer months for the first time (personal communication, Richard Kido, Controller, October 6, 1990). The company is now looking at options for further assistance.

(4) Lanai social workers are applying for a Community Coalition grant to the federal Alcohol and Drug Administration. This will include leadership skill training, which would aid in the larger effort for community "empowerment."

(5) To ease the sense of new development "taking over" on Lanai, Castle & Cooke should plan for certain commercial and recreational areas to orient primarily to local residents. This would imply simple architectural design and location away from visitor-oriented shops.

(6) Castle & Cooke's new Activities Coordinator (Section 5.7.6.1) should be given responsibilities for providing effective recreational activities for temporary workers whose past presence on Lanai has sometimes been associated with real or perceived social problems -- e.g., construction workers or migrant farm workers hired to replace Dole employees transferring to resort jobs.

The Activities Coordinator presumably will also be involved in assuring adequate structured youth programs for older children of service workers.

5.7.6.4 Improving Resident-Developer Communication

(1) Castle & Cooke (along with RockResorts and a few other companies) underwrites a new monthly newspaper, the Lanai Times. The paper provides space for alternative editorial views on Lanai's future. If economically feasible, more frequent publication would provide Castle & Cooke with a better opportunity to inform Lanai residents of the various programs intended to ease the transformation from pineapple to tourism.

(2) As development proceeds, more senior executives of the Lanai Company might be located on Lanai itself. The island's communication patterns still rely very heavily on informal personal contact. While Castle & Cooke has been willing to communicate through a variety of public meetings and forums, individual communication with major community leaders is an important need on Lanai.

(3) At the same time, agreements need to be recorded so that future executives know what their predecessors have promised. Several recent Memoranda of Agreement which Castle & Cooke has signed with Lanaians for Sensible Growth is an important first step.

Additionally, sometimes it is valuable to record community or even company expectations, even if no clear agreement has been reached. Such a chronicle can also serve as a reference document for people involved in discussions, now or in the future. On Oahu, the Kuilima Resort developers helped a citizens' group to compile a set of "Policy Statements" outlining community goals and informal understandings in the face of an imminent sale of the resort.

Castle & Cooke recently began implementing a similar approach by transcribing all questions and answers from certain community meetings, thus providing a record of community concerns and responses made to those concerns at particular points in time.

6. INFRASTRUCTURE AND PUBLIC FACILITIES

6.1 Transportation Facilities

6.1.1 Highways and Public Access

The transportation systems and traffic impacts are described in detail in the Traffic Impact Assessment and Updates prepared for the Land Use Commission Petition Environmental Assessment and this EIS by Pacific Planning & Engineering (Appendix F). The trip generation estimates have been coordinated with the Lanai City Traffic Circulation Plan (Pacific Planning and Engineering, June 1989).

6.1.1.1 Existing Conditions

The only public access from the Lanai airport is via Kaumalapau Highway to the intersection of Manele Road and along Manele Road to the resort; there are no other intersections between Kaumalapau Highway and Manele Resort. A private temporary service road is being used for heavy construction equipment and vehicles for the hotel. This road could be upgraded and used for maintenance and for commercial vehicles servicing the hotel after the hotel is in full operation.

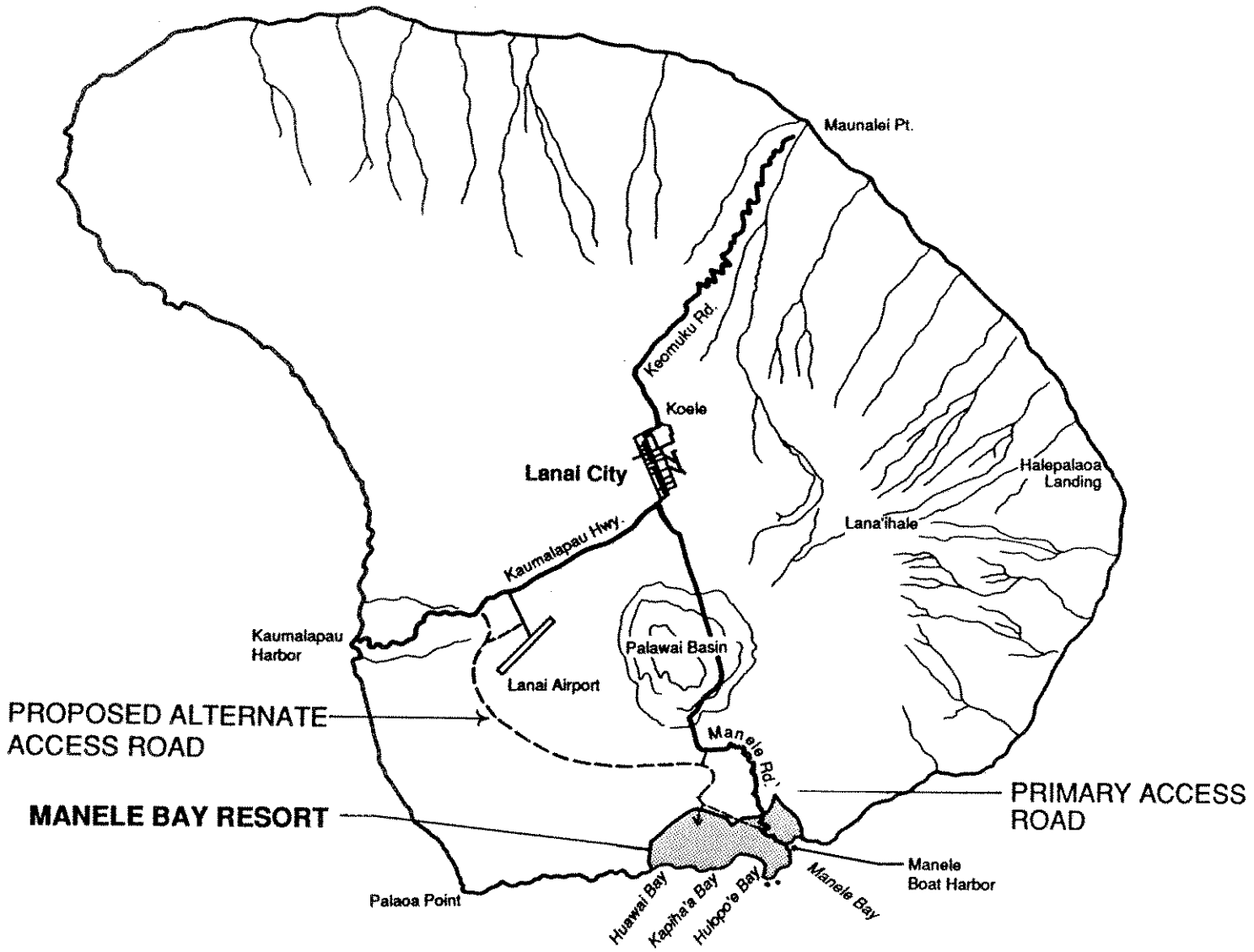
Vehicular access to the Manele Resort (Figure IV-7) is along Manele Road, a State-maintained highway with two lanes within a 19-foot-wide pavement with 6-foot shoulders and a posted speed limit of 35 mph between mileposts 6 and 10. The first half-mile from the intersection has been resurfaced and is in good condition; however, from milepost 6.59 to 10 the road is badly deteriorated and needs resurfacing. From milepost 10 to the end of the resort, the road is winding and narrow with pavement widths of 12-24 feet and shoulder widths of 2 feet. Driving comfort along this segment is relatively slow because of the moderately steep grades, deteriorating surface, narrow shoulders, and inability to pass.

Manele Road between Milepost 6 and 10, with an average pavement width of 19 feet and 6-foot shoulders, has a two-way peak hour capacity of approximately 790 vehicles per hour.

Manele Road between Milepost 10 and 13 (end of pavement), with pavement widths varying between 12 feet (along tangent sections) and 24 feet (at curves) and 2 feet shoulders, has a two-way peak hour capacity of approximately 540 vehicles per hour.

6.1.1.2 Probable Impacts

Research of planned development on Lanai was conducted to accurately estimate future traffic on Lanai and to provide the baseline for assessing the incremental effect of the Manele Resort with the Golf Course and Golf Residential. No analysis was conducted that specifically addressed the incremental effect of the golf-residential upon the resort without the golf. The results in this section then include projections of any traffic to the Manele Resort, including golf users, hotel visitors, and residents.



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0 1 2
NORTH SCALE IN MILES

FIGURE IV-7
VEHICULAR ACCESS TO PROJECT SITE

Methods

Existing traffic was measured at the major intersections on Lanai (Figure IV-8). Future traffic forecasts with and without the Manele Resort Project were estimated for the year 2003. For future traffic estimates without the project, a literature search and specific methodology for estimating traffic on Lanai was employed (Figure IV-9 and Appendix F). The future land uses resulting from the planned developments (other than Manele) were analyzed using Trip Generation Reports that were modified as necessary for unique qualities of Lanai. Commercial, residential, resort, and industrial uses planned for 2003 were included in the analysis.

Traffic Impacts

For an average weekday, the results of the traffic forecasts indicate that the project will cause additional traffic at all of the study intersections (Figure IV-10). The largest increase of vehicles will occur from vehicles turning right onto Kaumalapau Highway going toward Lanai City and from vehicles turning left onto Manele Road. On selected days, it is likely that the volumes will be greater than that shown but not in any significant number.

In general, the proposed golf course and residential development, including the resort development when completed in 2003, will not significantly impact traffic flow on the study intersections.

The traffic forecasted for Manele Road will increase two-way peak hour traffic from the present 53 vehicles per hour to 388 vehicles per hour in the year 2003. The forecasted total traffic is below the present reduced capacity of Manele Road (540 vehicles per hour) during the afternoon peak hour.

Level-of-Service

The level-of-service (LOS) analysis at the critical intersection of Kaumalapau Highway and Manele Road indicates almost no change in the LOS for all shared land uses, even with the on-going and proposed developments at Lanai City and Manele Resort. Only one movement will change LOS from free flow, LOS A, to stable flow, LOS B.

6.1.1.3 Mitigation Measures

Traffic volumes associated with the Manele Resort including the proposed golf and golf residential development would not increase significantly. Therefore, specific mitigation measures would not be required.

The road surface condition and grade of Manele Road must be considered with regard to the total number of visitor expected counts under the full operation of the Manele Resort. Two possible options are being evaluated by the proponent and the State Department of Transportation: (1) that Manele Road be realigned and portions of the existing road be widened and resurfaced to current standards for safety and the comfort of those driving to and from the resort or (2) the construction of an alternate

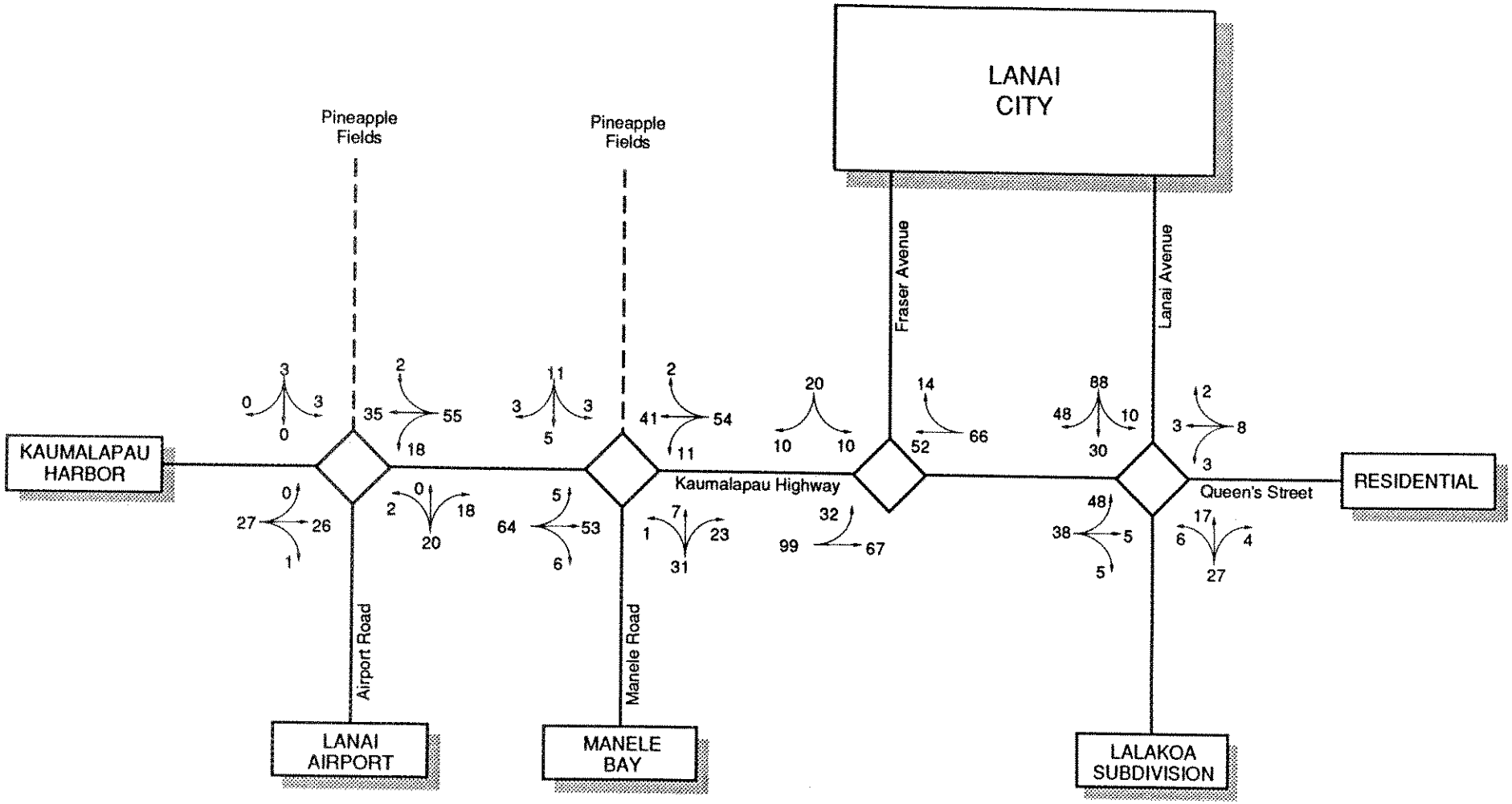

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FIGURE IV-8
1988 AFTERNOON PEAK HOUR TRAFFIC

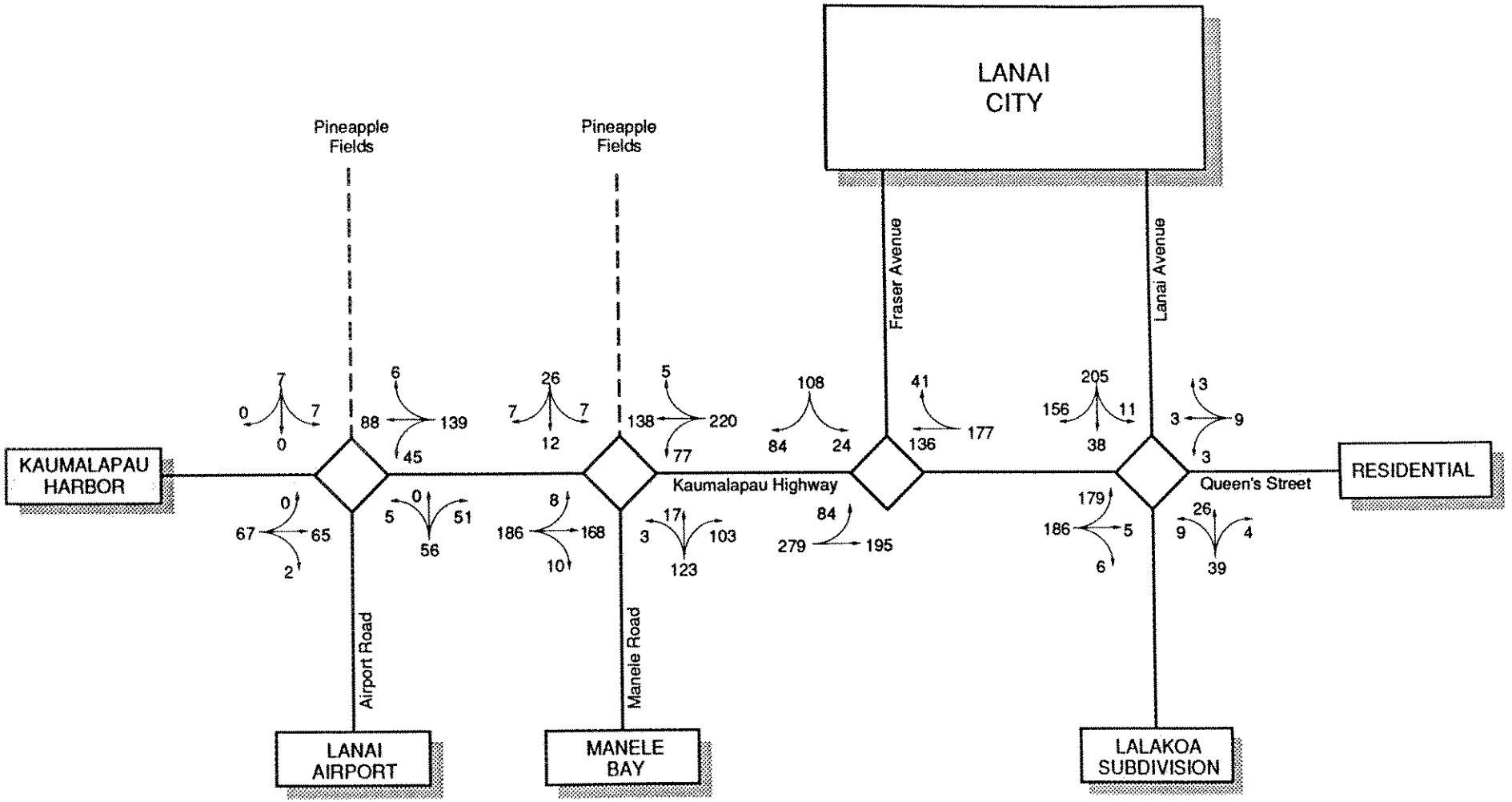

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FIGURE IV-9
2003 AFTERNOON PEAK HOUR TRAFFIC WITHOUT PROJECT

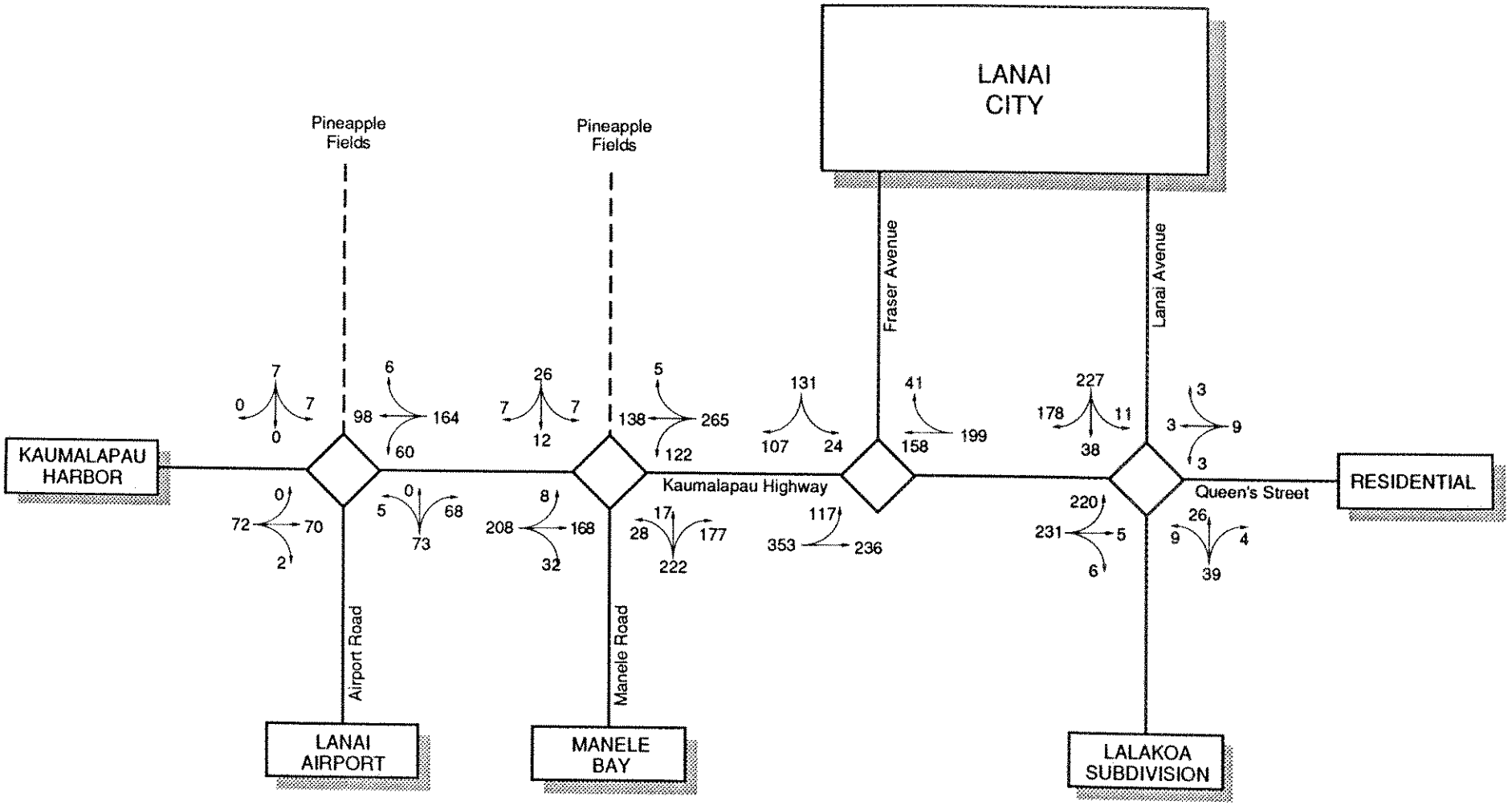

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FIGURE IV-10
2003 AFTERNOON PEAK HOUR TRAFFIC WITH PROJECT

access road from the Lanai airport vicinity directly to the Manele Resort (see Figure IV-7). This alternate road would replace Manele Road as the primary ingress and egress to the Manele development, thereby eliminating the need to upgrade Manele Road.

These road improvement proposals are part of the overall Manele Resort Development proposal and are not specifically linked to the Golf Course and Residential Development. The road improvements could, however, increase safety for the visitors and residents using the Manele Golf Course. Therefore, the Manele Road improvements or new access road construction are not included as specific mitigation measures for this proposed action, but are noted herein to document ongoing evaluations for the overall Manele Resort project.

6.1.2 Air Transportation Facilities

The Lanai Airport is the only air transportation facility on Lanai. The principal study used in this analysis is the *Lanai Airport Master Plan Improvements: Draft Environmental Impact Statement* prepared by Park Engineering for the State Department of Transportation, Airports Division (1990).

6.1.2.1 Existing Conditions

Lanai has one airport comprising 93 acres in the Ahupuaa of Kalulu, located on lands owned by the State of Hawaii. The airport and all surrounding lands are designated Agricultural by the State. Any expansion of the airport would require acquisition of additional private lands from Castle & Cooke.

The airport at Lanai is situated in the southwestern part of the island about three miles southwest of Lanai City and over three miles directly northwest of the project site. The airfield contains a 5,000-foot runway with a capacity of 50 operations during Visual Flight Rule (VFR) conditions. Present peak hour operations are about 14 operations. Over 100 flights weekly are scheduled to Lanai. According to the Lanai Airport Master Plan Improvements: Draft Environmental Impact Statement, the annual service volume (ASV) of the airport is approximately 115,000 operations for the mix of aircraft and facilities. At present, the airport is experiencing congestion in airport operations due to the current level of activity and limited facilities.

6.1.2.2 Probable Impacts

The Project would increase the number of residents and visitors to Lanai and therefore impact the airport facilities through greater use of airport services. This involves heavier demands on the passenger terminal, parking facilities, air cargo operations, and other general aviation support facilities. Increased air transportation needs could be met through increasing flight frequencies to Lanai. Given the present congestion and limited support facilities at the airport, the proposed project would adversely impact existing air transportation facilities. The demand created by the proposed project alone is small, but the cumulative effect of proposed development on Lanai would be significant.

6.1.2.3 Mitigation Measures

In a study for the Lanai Airport Master Plan, aviation activities were projected to increase through the year 2005. From a 1987 baseline of 57,203 passengers and 16,178 aircraft operations, the study estimated an increase of 200,000 passengers and 21,400 aircraft operations by 2005. To manage this increase, the Master Plan requires improvements which will provide for unrestricted operations for the aircraft types forecasted. The plan calls for extension of the runway to 7,000 feet, new holding aprons, larger approach and protection areas, an instrument landing system, as well as improvements to the passenger terminal, aircraft parking apron, cargo facilities, and general aviation support.

Since the estimates made in the future aviation demand study considered both the increased resident population resulting from new jobs due to the construction of the Koele and Manele Hotels, and the concomitant increase in visitors to Lanai, no further mitigation measures for general air transportation would be necessary.

6.1.3 Harbors

6.1.3.1 Existing Conditions

Kaumalapau Harbor is a small commercial harbor serving the island of Lanai. The harbor handles 95 percent of all shipments of construction material, wholesale goods and other supplies required by Lanai residents; however, the principal activity in the harbor is pineapple shipment (personal communication, R. Tudor, Dole Company, September 1990). Approximately 80 percent of the cargo handled by the harbor is agriculturally related, with the balance consisting of merchant containers and construction equipment. The harbor is state-owned, but is under long term lease to Dole Company.

The docking and storage facilities at Kaumalapau Harbor are estimated to be operating at capacity (personal communication, I. Ungara, Agricultural Operations Superintendent, Kaumalapau Harbor, September 1990). Since the harbor is too small to accommodate normal ships, special barges are used to transport goods from Honolulu Harbor. The tugboats which tow the barges are not able to maneuver within the harbor, and two tenders must transfer the barges to the 400-foot dock. Both the fuel barge and the liquid fertilizer barge occupy the entire length of the dock when in port. Covered and outside storage capacity are estimated to total about three acres.

There is a small boat harbor at Manele Bay owned and operated by the State of Hawaii. At present there are 23 mooring spaces for shallow draft boats, although Harbors Division plans to request funding in the next fiscal year to construct a new marginal wharf which would create additional moorings at the harbor. Permanent mooring is restricted. The channel and entrance to the harbor are marked by navigational buoys and lights, and the harbor is protected by a rock jetty. Restroom facilities, drinking water and some storage are available. Other storage is obtainable on adjacent lands with permission of the landowner, Dole Food Co., Inc.

Various recreational and commercial boating activities use Manele Bay Small Boat Harbor facilities. Both fishing and pleasure cruises originate from the harbor. Sailboats are generally visitors from off island, while most motor craft belong to Lanai

residents. Private boaters use the harbor for overnight visits. Commercial tour boats from Lahaina visit the area on a day trip basis.

6.1.3.2 Probable Impacts

The proposed project would temporarily increase the flow of construction materials at Kaumalapau Harbor. In the long term, it is anticipated some increase in imported supplies would occur from demands of a larger residential population.

Through the Manele Golf Course and Golf Residential Project, some increased use of Manele Bay Small Boat Harbor is likely, due to the proximity of new residents to the harbor and more visitors to the improved park facilities at Hulopoe Bay.

6.1.3.3 Mitigation Measures

Although Kaumalapau Harbor is considered to be operating at or near capacity, the planned reduction in pineapple would likely affect harbor capacity more than the proposed project. Lanai Company currently receives approximately ten containers a month at the harbor which are related to the Koele Hotel and Manele Bay Hotel projects. Construction equipment for individual contractors are shipped on an "as needed" basis. No specific mitigation measures would be required for the Manele Golf Course and Golf Residential Project, due to the lower volume of supplies needed for the project over a longer time period.

No mitigation measures are recommended for Manele Bay Small Boat Harbor beyond implementation of the planned expansion of wharf facilities.

6.2 Climate, Meteorology, and Air Quality

6.2.1 Existing Conditions

Both federal and state standards have been established to control ambient air quality. At the present time, six parameters are regulated including: (1) particulate matter, (2) sulfur dioxide, (3) nitrogen dioxide, (4) carbon monoxide, (5) ozone, and (6) lead. Hawaii state air quality standards are more stringent than the comparable national limits except for the standards for sulfur dioxide. State and national standards for sulfur dioxide are the same. Appendix G provides the detailed study of air quality for the project including the results of modeling analysis.

Regional and local climate, together with the amount and type of human activity, generally dictate the air quality of a given location. The climate of the Manele Bay area is very much affected by its situation with respect to the tradewinds and the mountains on Maui and Molokai. Due to the wind shadow effects, winds are predominantly light and variable in this region, driven by local landbreeze/seabreeze circulations. Calms or nearly calm conditions are estimated to occur about 25 percent of the time, resulting in frequent periods of relatively poor ventilation. Temperatures in the Manele area tend to have a wider range than many other low-level locations in the state due in part to the light winds that prevail. Temperatures range from the upper 40s to low 50s in the early morning in winter to the low 90s during the daytime in summer. Rainfall in this part of

the state is scant and can be highly variable. Most occurs in conjunction with winter storms that pass through the area, and the remainder falls during summer afternoons and evenings as a result of the movement onshore of moisture laden marine air. Average annual rainfall at the project site is only about 10 to 20 inches.

Present air quality on Lanai is estimated to be very good, with blowing dust from agricultural activities and vehicular travel over narrow, partially-paved or unpaved roadways providing the only potentially significant air quality problems. Periodic field burning of the wastes from pineapple cultivation and short episodes of volcanic haze also occasionally affect prevailing air quality.

6.2.2 Probable Impacts

Construction activities will temporarily increase the volume of windblown dust that would be annoying and create a nuisance with the hotel personnel and visitors.

Long term air pollution impacts that could result from constructing the project as planned are estimated to be relatively insignificant. The primary potential long term impact will occur indirectly from carbon monoxide emissions emanating from vehicular traffic traveling to and from the development. Quantitative analysis of worst-case levels of carbon monoxide near critical intersections on roadways leading to the project show only minor increases over concentrations that would prevail without the additional traffic expected to be generated by the project.

The spraying of pesticides for golf course maintenance creates the potential for aerial drift of various toxic chemicals, but assuming that proper application procedures are carefully followed, there should be no serious air quality impact from this activity.

6.2.3 Mitigation Measures

Because the project site is very dry and dusty, a conscientious fugitive dust control program would have to be implemented during project construction to prevent potential problems with the wind blowing particulates into the existing hotel complex. Mitigative measures include frequent watering of exposed ground during construction, temporary grassing, covering of trucks transporting loose soil, using wind screens, and landscaping or paving of bare dirt areas as early as feasible in the development process.

All worst-case projected levels of carbon monoxide were well within acceptable air quality standards, and thus no mitigation measures are recommended in this regard. It is recommended, however, that Manele Road be widened to two full lanes in order to alleviate the dust generation that now occurs when oncoming vehicles have to travel with one set of wheels on the unpaved roadway shoulders in order to safely pass each other.

The residential units included in this project will create an increased demand for electricity and an increased need for solid waste disposal. The additional levels of air pollutants resulting from diesel-fueled generation to meet project electrical needs have been computed to be very small. Even so, this potential impact could be somewhat mitigated by employing solar energy design features in new unit construction to the maximum extent possible. Such features include solar water heating for all units, and

window orientation to maximize cross ventilation and light without unduly increasing indoor heat buildup, thus minimizing the need for air conditioning. Current plans call for disposal of solid wastes in landfills. Exhaust emissions from refuse trucks and heavy equipment working in the landfill to meet this additional solid waste disposal demand should be very small. Special mitigation measures to limit these emissions should not be needed.

6.3 Noise Quality

6.3.1 Existing Conditions

The existing background ambient noise levels as measured at six sites at the project site, as well as in the island's population center of Lanai City are in the "Minimal Exposure, Unconditionally Acceptable" category under applicable federal standards (Figure IV-11). Existing noise is generally associated with traffic. Calculations of existing (CY 1988) traffic noise levels during the PM peak hour period range from 49 Leq to 61.8 Leq. Existing background ambient noise levels at the project site are estimated to be less than 45 Ldn and are controlled by the natural sounds of wind, foliage, and birds, as well as by intermittent aircraft. Measured aircraft noise levels resulting from aircraft operating at Lanai Airport and from transiting aircraft generally ranged from 60 to 76 dB (Lmax). Please refer to Appendix H for the noise analysis for this project.

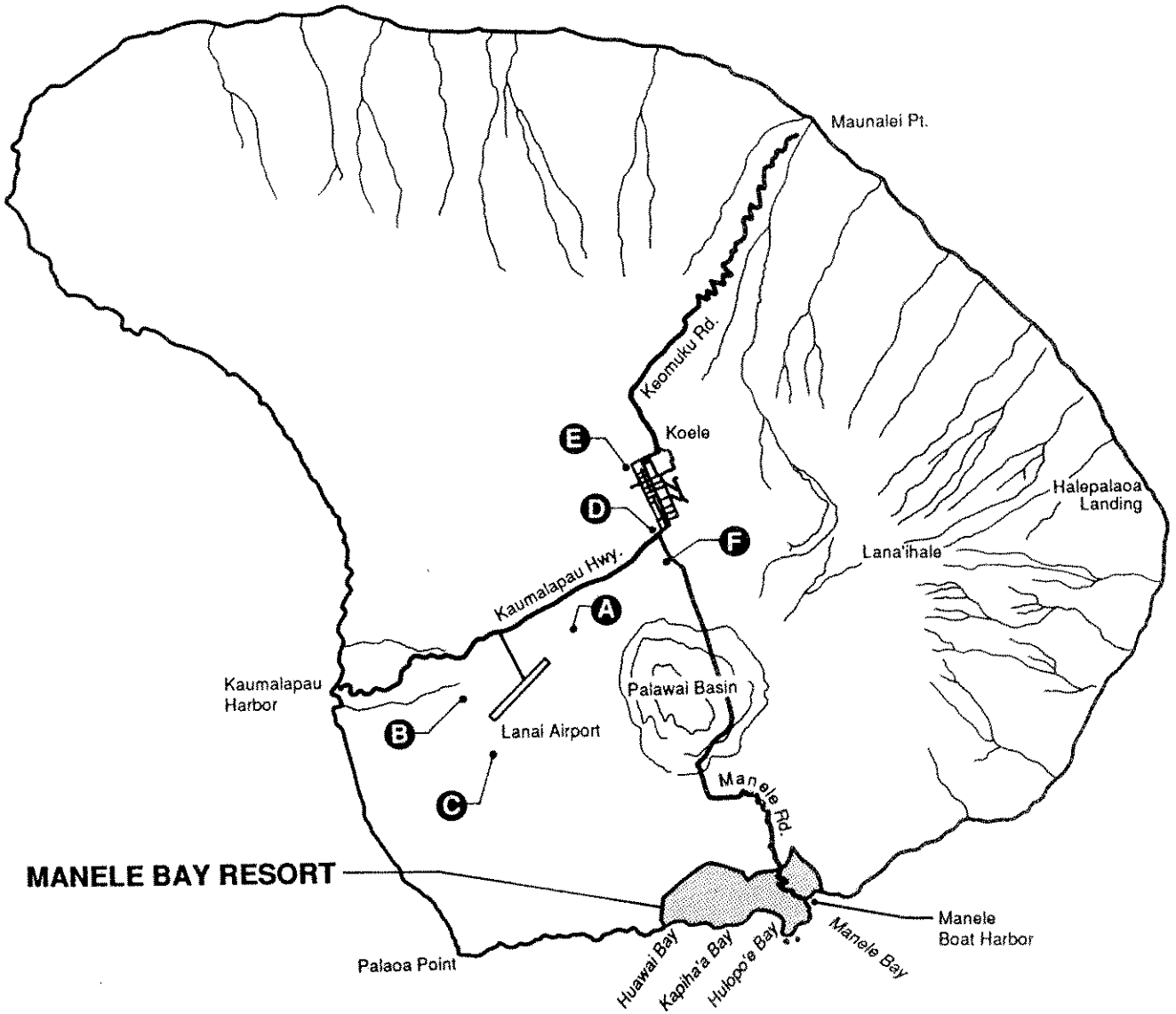
6.3.2 Probable Impacts

Predictions of future traffic noise levels were made using the traffic volume assignments referenced in Part 6.1.1, Highways and Public Access, of this Chapter. The future condition without the proposed project is expected to result in traffic volumes which are greater than those associated with the previously approved Manele Bay Hotel and resort developments. By CY 2003, traffic volumes throughout Lanai are expected to increase significantly due to planned resort and housing developments. Traffic noise levels are also expected to increase from the existing low levels. Noise increases directly related to the proposed Manele Golf Course and Golf Residential Project are expected to be slight, ranging from under 1 Ldn in Lanai City to 2.4 Ldn along portions of Manele Road. Overall noise levels are expected to remain well within the 55 to 65 Leq, "Moderate Exposure, Acceptable," level.

The 60 and 55 Ldn aircraft noise contours for Lanai Airport should continue to remain beyond 3 miles northwest of the project site. Even with future extension of the runway, aircraft noise levels over the project site are predicted to remain below 30 Ldn. Aircraft single event levels are also expected to be similar to existing levels of 55 to 65 dB (Lmax). CY 2005 aircraft noise levels over the project site are expected to remain compatible with the proposed golf course and residential uses.

6.3.3 Mitigation Measures

By CY 2003, traffic volumes throughout the island are expected to increase from existing volumes. It is also expected that the number of heavy trucks associated with current construction and agricultural activities will diminish. The largest increases in



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By: Belt Collins & Associates November 1990

0 1 2
SCALE IN MILES

NORTH

FIGURE IV-11
LOCATION OF NOISE MEASUREMENT SITES

traffic noise attributable to project traffic are expected to occur along Manele Road. Fortunately, noise sensitive developments are not located in close proximity to the high speed sections of Manele Road, and adverse traffic noise impacts from the proposed project are not expected.

Along the project's circulation roadways, traffic noise levels are expected to be less than 55 Ldn at 50, 70, and 110 feet setback distances from the centerlines of the roadways whose PM peak hour traffic volumes are approximately 100, 200, and 400 vehicles per hour. Because the project's development plan allows for adequate setback distances to the proposed residences, adverse noise impacts on future residents from project traffic are not expected. With the Hotel also over 100 feet from the circulation roadways, no adverse noise impacts are expected there.

The proposed project should not cause adverse aircraft noise impacts on the golf course or on project residences. Also, the location of the project site should not impact the future airport expansion potential at Lanai Airport. Based on existing and forecasted aircraft noise levels over the project site, special aircraft noise attenuation measures are not considered mandatory within the project site.

Audible construction noise will probably be unavoidable during the entire project construction period. The noise sensitive areas which are predicted to experience the highest noise levels during construction activities on the project site are within the Manele Bay Hotel complex, which is presently under construction. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources, and due to the exterior nature of the work. The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise limits and curfew times is another noise mitigation measure which can be applied.

Blast induced ground and air vibrations have the potential to startle or annoy surrounding guests, and to also cause damage to structures. It is recommended that air blast and ground vibration levels be monitored closely; that the timing of blasting be scheduled to avoid unnecessary disturbance to the guests; and that blast engineering techniques be used to minimize vibration and air blast damage.

6.4 Water Supply

In years past, Lanai's water requirement was almost exclusively for pineapple cultivation and domestic use as no other major users were on the island. With the establishment of the Lanai Project Districts at Koele and Manele (Maui County Code 19.70 and 19.71), subsequent resort development, and introduction of diversified agriculture, the trends for water use are rapidly changing on Lanai.

September 1990, Castle & Cooke, Inc. announced the phase out of pineapple plantations on Lanai whereby over a two to three year period the cultivation of pine-

apple would be reduced from the existing 6,500 acres to approximately 100 acres to be used for local consumption. Consequently, the current water demand of 1.8 mgd would likely drop substantially. How much of that water could then be used by the resorts or would be transferred to other agricultural uses on the island has not been determined and is not part of this analysis. Nevertheless, each new development brings with it a potable water requirement (or supply) and the implicit need for evaluating the adequacy of the source and storage capacity and the transmission capability and water pressure.

Lanai's water sources, transmission, and storage capabilities, as well as future water resource management and system improvements are described thoroughly in the Lanai Water Master Plan: Final Report (M & E Pacific, Inc., 1990). The Water Master Plan is a complete evaluation of Lanai's water sources and water system needs and it provides recommendations for island-wide improvements to domestic and irrigation water systems. The following section briefly describes the existing setting for the water system at the Manele Project District only and analyzes the impacts and future requirements of the proposed Manele Golf Course and Golf Residential Project.

6.4.1 Existing Potable and Non-potable Water System

6.4.1.1 Existing Regional Water Sources

A single high level aquifer in which wells, shafts, and tunnels have been developed, serves the island of Lanai. The average total recharge is estimated to be 9.1 mgd and the sustainable yield is 6.0 mgd. The present Lanai water system, as it is configured, can be counted on to supply 3.0 mgd on a sustained basis, expressed as an average daily flow. The total system peak instantaneous capacity is 8,300 gallons per minute (gpm), comprised of simultaneous flow of 300 gpm for plantation needs, 3,000 gpm for fire flow, 1100 gpm for domestic supply, and 1200 gpm for landscape irrigation. New developments on Lanai are estimated to demand a supply capacity of 10,300 gpm; therefore, improvements to source and storage capacity, and transmission systems are necessary.

The Maunalei area wells (1 through 5) are located in the principal high level recharge zone, a 4.6 square mile area in the highlands southeast of Lanai City (Figure IV-3). Wells 6 and 7 were added to the system in the 1980s. An exploratory water well drilling program (M & E Pacific, Inc., 1990) for other wells resulted in the following:

- Well 8 is suitable for potable use (test rate 1,100 gpm).
- Well 9 is suitable for irrigation but not direct potable use (test rate 340 gpm).
- Well 10 is not suitable for potable or irrigation use unless treated or blended (test rate 47 gpm).

Alternative water sources include rain catchment, brackish water, and sewage effluent reclamation. Upper elevation developments could factor rain catchment into the water availability. Lower level ground sources lie outside of the secondary high level water zone or consist of alternate sources such as treated sewage effluent or desalinated brackish water. Water obtained from Well 10 is indicative of an alternative low-level source (Figure IV-3). It is south of the Palawai Basin and remote from the principal high level recharge zone. Thus its hydraulic head is disparately different from the high level,

the water is of higher temperature (104.5 degrees F), and it contains different constituent concentrations.

6.4.1.2 Lanai Project District 1 - Manele Water Sources

The Manele area is served by an existing high pressure (250 psi) 10-inch irrigation main (Figure IV-12). The Manele Bay Hotel (including 400 rooms) and Phase I improvements to the Hulopoe Beach Park could require an average day demand of 448,270 gpd for human consumption and landscape irrigation (M & E Pacific, Inc. 1987). Approximately 65,000 gpd of irrigation water will be supplied from the wastewater treatment plant. Test hole T-6 is planned to supply the remaining water for the hotel and Hulopoe Beach Park improvements (M & E Pacific, Inc., 1987).

6.4.1.3 Manele Distribution

The existing Manele Project District distribution system consists of an interconnected network with several pumping sources supplying both the domestic and the irrigation needs (Figure IV-12).

Manele Bay Hotel is serviced off an existing 10-inch diameter main. Back-flow preventers have been installed to prevent agricultural fertilizers, pesticides, etc., from entering the domestic water supply line.

Castle & Cooke, Inc. own the existing system serving the Hulopoe Beach and Manele Small Boat Harbor. This is a separate system from that of the Lanai Community and it provides approximately 3,000 gpd.

6.4.1.4 Manele Storage

A new reservoir system (0.5 mg) has been constructed to serve the Phase I developments at Manele, Hulopoe Beach Park and Manele Small Boat Harbor (Figure IV-12); however, additional storage would eventually be required as the capacity of this unit is too small for the proposed Manele Residential development needs if the hotel is expanded to 400 rooms as planned.

6.4.2 Proposed System

Proposed water infrastructure improvements for the Manele Resort will include pressure breaker tanks, a storage reservoir, and a buried transmission main (Figure IV-12). In addition, two new high level wells would be necessary to maintain adequate instantaneous peak flow and pressure in the total island water system. To meet the irrigation requirement at Manele, two wells, a storage reservoir, and distribution lines are recommended.

6.4.2.1 Proposed Domestic Wells

The Final Water Master Plan (Lanai) recommended completion of Wells 8 and 9 for domestic supply and landscape irrigation and exploration for a new high level well

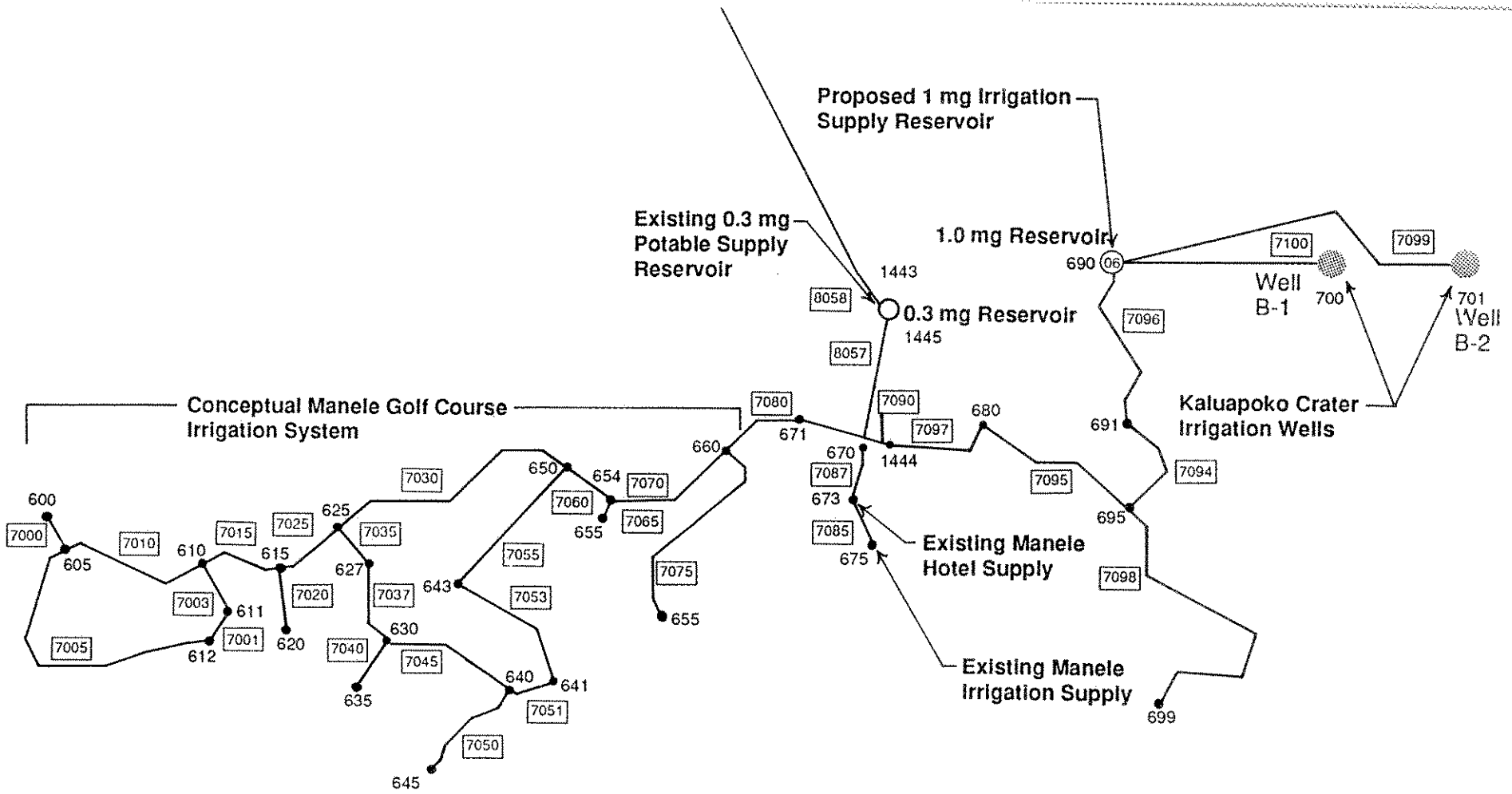

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FIGURE IV-12
SCHEMATIC OF MANELE HOTEL AND GOLF COURSE WATER SYSTEM

and alternate water source wells for Manele domestic and irrigation supplies. The new high level well (Well 11) would be constructed above Kaluanui Flats midway between Well 4 and 5 to provide domestic water into the agricultural distribution system to replace water used in the irrigation system for Manele development (Figure IV-3). The water source for the domestic use and the golf clubhouse would be primarily from this high-level aquifer in the Central Sector. A new high level well and pump system is proposed to serve the Manele Development. It will be installed and tested under the State Water Code (HRS 174C) requirements as outlined in the State "Well Construction Permit and Pump Installation Permit" guidelines.

6.4.2.2 Proposed Transmission

Testing of the exploratory wells at Kaluapoko (i.e., B-1 and B-2 on Figure IV-12) is required prior to determining the availability of these wells for domestic or irrigation use. If the water quality tests prove satisfactory for domestic use, the system could be used for the Manele potable water demand. New distribution lines would be required from the wells to the Manele reservoir and alternate transmission lines are warranted for back-up in the event of mechanical failure and transmission loss.

A distribution system will be constructed to serve the Lanai Project District 1-Manele. The water distribution system will be designed to meet construction standards of the County of Maui. The system will be operated and maintained by the Lanai Company.

6.4.2.3 Proposed Storage

The Project will require additional storage reservoirs. Potable water would be required for the residential units; the existing Manele Bay Hotel and expansion would be served from the new 0.5 mg reservoir system; however, additional capacity would be required for the proposed residential use.

Additional non-potable water storage is needed for the Manele golf course development and a new 1 mg irrigation supply reservoir could be sited in close approximation to the Kaluapoko test wells, B-1 and B-2, if they prove feasible (Figure IV-12).

6.4.3 Probable Impacts

As previously discussed (Section 2.2), estimated water demand for the Project would be 1.46 mgd, including 0.80 mgd for the golf course irrigation and 0.40 mgd for the landscape irrigation which would be served by an alternate non-potable water source.

6.4.3.1 Potential Manele Residential Domestic Demand

The water required for the domestic supply for the 425 units is not appreciably greater than the amount for 416 units, previously authorized under the existing Project District ordinance. The County of Maui standards allow 560 gpd/unit for multi-family (i.e. condominiums) and 600 gpd/unit for single-family homes. The estimated water demand under the amended project district residential development from the proposed 425 units would be 56,000 gpd for multi-family (100 units) and 195,000 gpd for single-family

(325 units) or 251,000 gpd (0.25 mgd) as compared to the authorized Project District requirement of 246,640 gpd (0.25 mgd) or 41,440 gpd for multi-family and 205,200 for single-family residential units. Therefore, the estimated water demand in mgd with and without the project district boundary amendment would be essentially the same (variance of 4,360 gpd).

6.4.3.2 Potential Residential Landscape Irrigation Demand

Since the proposed action lowers the density of the developed area, it is likely that there will be a subsequent increase in landscaped area surrounding the homes. The water requirement for landscaping would be met by nonpotable sources and is estimated to be 0.3 mgd greater than without the project. Daily air temperature fluctuations and evapotranspiration rates, type of plants requiring water, size and aspect of landscaped area, and number of residences occupied during that time of the year influence the estimate. Therefore, this estimate assumes that all homeowners landscape and or lawn two-thirds of their property and the average single family lot would be 32,670 square feet (0.75 acres). Total irrigated area would be 243.75 acres and approximately half of those homes will be in the amendment area (122 acres). The irrigation for multi-family condominium landscaping would remain essentially the same as in the existing project district requirement. The evapotranspiration rate is estimated at 6,340 gpd/acre (M & E Pacific, November 1989 Environmental Assessment for LUC Petition). Therefore, the resultant water requirement for landscape irrigation would be 0.4 mgd. This is compared with the landscape irrigation requirement under the existing project district configuration of approximately 0.1 mgd.

6.4.3.3 Potential Manele Golf Course Demand

The irrigated portion of the golf course under the "target course" concept would be 110 acres and the grass species used for turf were selected for their low water requirement. Therefore, under these mitigative measures, the estimate for irrigation of the golf course is approximately 0.55 mgd (Leppert, 1990).

Wells B-1 and B-2 in the Kaluapoko Crater have been recommended for irrigation use (Figure IV-12); however, the yield from these exploratory wells has not been verified. It is expected that the irrigation requirement could be met by development of Wells B-1 and B-2, supplemented by reclaimed water from the wastewater treatment plant (estimated at 70,000 gpd to be increased as the plant is being used to 140,000 gpd).

6.4.4 Mitigation Measures

6.4.4.1 Ongoing Evaluation

The water demand estimates for proposed changes on Lanai have been systematically calculated by the Lanai Water Company (Table IV-1). Estimates that could significantly change this scenario and thus affect the region's total demand, now estimated as 2.74 mgd for potable and 1.45 mgd for alternative sources by the year 1996, include the following:

- Planned versus actual phaseout of Dole pineapple plantation.
- Planned versus actual increase in diversified agriculture use.
- Delays in approval and construction of any of the proposed resort, residential, or golf course projects.
- Type, total area, and frequency of landscape irrigation for community, resort-residential developments.

6.4.4.2 Irrigation Using Non-potable Water Sources

Alternative sources proposed for irrigation use include: brackish water from the non-potable wells, blended water, or surface water. Programs to explore each of these alternatives are underway at this time. Results from these tests will reveal if any of these sources are viable for Manele. If the irrigation requirement for the golf course could be met by these alternative sources, the impact on the potable water supply would not be as great.

6.4.4.3 Landscaping and Water Conservation Measures

Use of natural plants that have low water requirement is an excellent way of reducing the irrigation needs in landscaping. Landscape design guidelines could include plant lists of attractive dryland plants and residents encouraged to use them in their lawns and landscapes.

6.4.4.4 Water Resource Management Measures

After years of water resources being managed by several groups on the island, an agreement has been reached to consolidate the management tasks under the sole responsibility of the Lanai Company. This consolidation and centralization should engender better communication, better record keeping, and focus on the planning and implementation of the water system improvements island-wide. One of the first steps in the Lanai Company's management plan was the development of the Lanai Water Master Plan (July 1990).

Other measures that could be taken are to impose covenants on water consumption for dwelling units and creating a management organization to ensure the compliance with these covenants and the success of the water saving measures.

The State of Hawaii Commission on Water Resource Management (Water Commission) has reviewed a petition to designate Lanai as a Water Management Area; and although they did not designate it as such at the time (1989), they instituted strict reporting requirements on water use and planned use on the island. The reporting should provide the State a means of monitoring the effects of actual development including the Manele projects. The Water Commission, through review and follow-up on the reports, will be in a position to work with the Lanai Company in managing the water resource in the future on Lanai. The Lanai Company has implemented one of the Water Commission's recommendations to investigate ways to make greater use of the non-potable water for irrigation (State of Hawaii, Commission on Water Resource Management, Department of Land and Natural Resources, 1990).

6.5 Wastewater Collection, Treatment, and Disposal

6.5.1 Existing Conditions

The wastewater collection system for the Manele Project District is currently under construction. The wastewater system is composed of 8-inch and 6-inch sewer lines, force mains, and three pump stations which transport the wastewater flow to a wastewater treatment plant (WWTP) (Figure IV-13). The plant, designed to process 75,000 gallons per day and with the capacity to be expanded to 140,000 gpd, is located mauka of the Project District at an elevation of 400 feet.

6.5.2 Probable Impacts

Wastewater anticipated from this development is domestic sewage from the residential units and from the golf course activities. The quantities of sewage generated from the residential development will be 0.19 mgd on an average day, based on 425 units, an occupancy rate of 75% maximum, and following the Department of Health's current regulation of 200 gpd/bedroom.

When fully built-up, the new residential development would be sewered by gravity flow lines to pumping stations at the lower elevations of the golf course. It is anticipated that three pumping stations will be required; additionally, the WWTP would have to be expanded to accommodate expansion of the development. Wastewater would then be pumped to the WWTP through 8-inch lines.

The rate of residential development over the years is estimated to be less than 50 units/year. The corresponding incremental increase in flow would be 22,500 gpd per year for the maximum day flow and 7,500 gpd/year for the average day. These incremental rates are small and can be readily accommodated in the program of plant expansion originally intended for the Manele Project District.

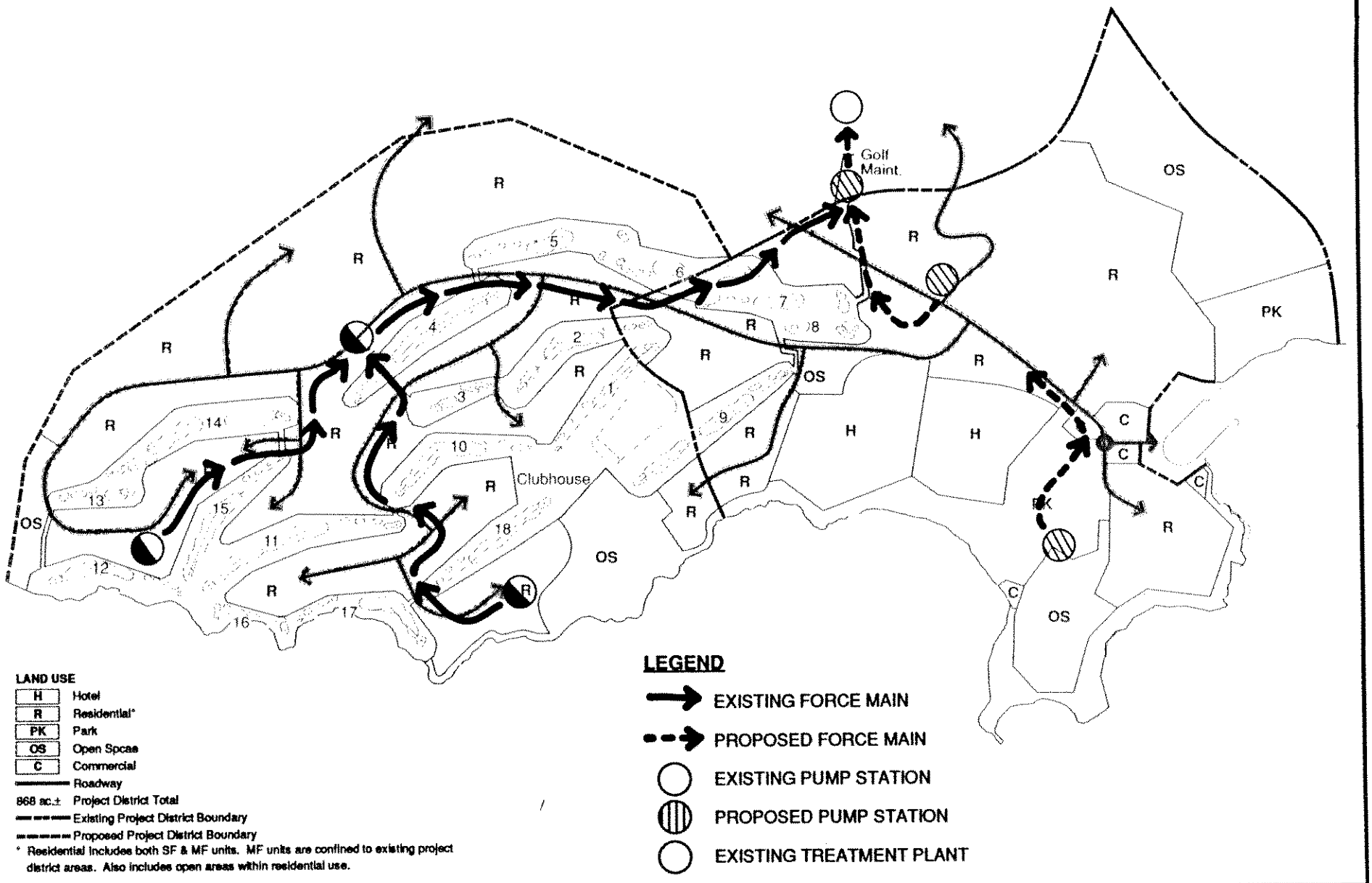
6.5.3 Mitigation Measures

Anticipated wastewater flows from this project can be accommodated in the program of WWTP expansion and system planning for the existing Manele Project District. Hence, no additional mitigation measures are necessary.

6.6 Solid Waste Collection and Disposal

6.6.1 Existing Services and Facilities

Lanai's only landfill is located approximately one mile south of the airport access road between the airport and Kaumalapau Harbor. It is filled to over capacity; however, it is still accepting non-toxic and non-infectious solid waste. According to Maui County Public Works Department, the County and Castle & Cooke, Inc. are in the final stages of selecting a new landfill site that meets current regulations. Final design permits and approvals, and construction will take approximately two years (personal communication, Brian Hashiro, Solid Waste Division Chief, November 2, 1990).



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North

0 600 1200
Scale in Feet

FIGURE IV-13
CONCEPTUAL WASTEWATER PLAN

Refuse is hauled from Lanai City residences weekly by Maui Co. A private hauling company services commercial establishments on the island. Most likely a similar system will be made available to the residents of Manele.

6.6.2 Probable Impacts

After full build-out, the golf course and residential development would produce additional refuse from approximately 430 pick-up sites throughout the project area. Trucks would have to stop at each residence and at the golf clubhouse and maintenance facility on a regular basis to pick up and haul refuse.

The project development has an indirect effect of an island-wide increase in landfill demand. A cumulative secondary impact is the increase in the waste stream.

6.6.3 Mitigation Measures

The cumulative effect of constructing and operating the resort developments planned for Lanai will substantially increase the waste stream through addition of materials cleared and grubbed during construction, cardboard packaging, construction materials used and discarded, etc. In order to manage this vast accumulation of materials, some of which could be reused, a Solid Waste Management Plan should be developed that evaluates and provides guidelines for feasible management techniques for Lanai (i.e., composting, waste reduction, recycling, etc.).

6.7 Electrical Power and Communications

6.7.1 Existing Conditions

Electric power generation units and transmission facilities on Lanai are owned and operated by Maui Electric Company (MECO). Total island generation capacity is over 12,000 kw.

The Lanai Power Plant generation capacity is approximately 4,760 kw and the Miki Power Plant capacity is 6,000 kw. The Manele Bay Resort electrical system consists of a fixed 350 kw engine-driven generator and a portable, trailer-mounted 100 kw engine-driven generator. The peak recorded load during 1990 was 2,950 kw and the total projected demand for existing and future loads on Lanai is estimated at 5,679 kw.

Telephone service for the Manele area is provided by GTE Hawaiian Telephone Company (GTE). Telephone signals are transmitted to the island by microwave, then to the resort by fiber optic cable, and are distributed from an office located at the resort service support area via an underground duct system. CATV service for the resort area is provided similarly.

6.7.2 Probable Impacts

The electric power generation and transmission system on Lanai is more than adequate to provide for the projects planned to be operational within the next five years (MECO, 1990). Electric and communication facilities have already been extended to the

project site for the purpose of serving the Manele Bay Hotel, wastewater treatment plant, and other Phase I improvements. The electrical demand is estimated to be 750 kw for the fully operating hotel, 490 kw for the wastewater treatment plant, and 160 kw for the other improvements in the Phase I Manele Resort development (MECO, 1990).

The additional power requirement resulting from the golf and golf residential use is estimated to be 2,800 kw. Extension of the distribution for power and communication facilities will be planned to coincide with the residential and golf development and the electrical distribution system will be constructed and maintained according to approved utility standards. The on-site electrical system will be an underground facility with the exception of service transformers and switching equipment. A network of underground ducts and handholes will be provided to facilitate cable installations by the utility companies.

Furthermore, because the utility companies must maintain their lines and structures for the purposes for which they were installed and for their best use, the lines will have minimal negative impact on the surrounding communities.

6.7.3 Mitigation Measures

Because the electrical power, telephone, and/or CATV systems have been planned as part of the Manele Resort Master Plan, the additional demand from the golf and residential development can be met by the existing system. Therefore, mitigation measures are not warranted.

6.8 Police and Fire Protection

6.8.1 Existing Conditions and Plans

Police Protection

- The Maui County Police Department has one police station on Lanai (Figure IV-14). The existing police station is a one room facility with a separate confinement area on the same property.

- The Lanai police force consists of seven officers -- one lieutenant, one sergeant, and five patrolmen. There are officers on duty 24 hours a day.

- The existing station will be replaced with a larger one on land donated by Castle & Cooke.

- The Lanai Police Station has requested five additional officers to met increased needs due to the Manele Bay Hotel. This will allow one officer on each beat.

The Office of State Planning (OSP) surveyed State and Maui County departments about future governmental needs on Lanai. The Maui County Police Department estimated Lanai will need 11 additional police officers during the next 20 years (Office of State Planning, 1990).

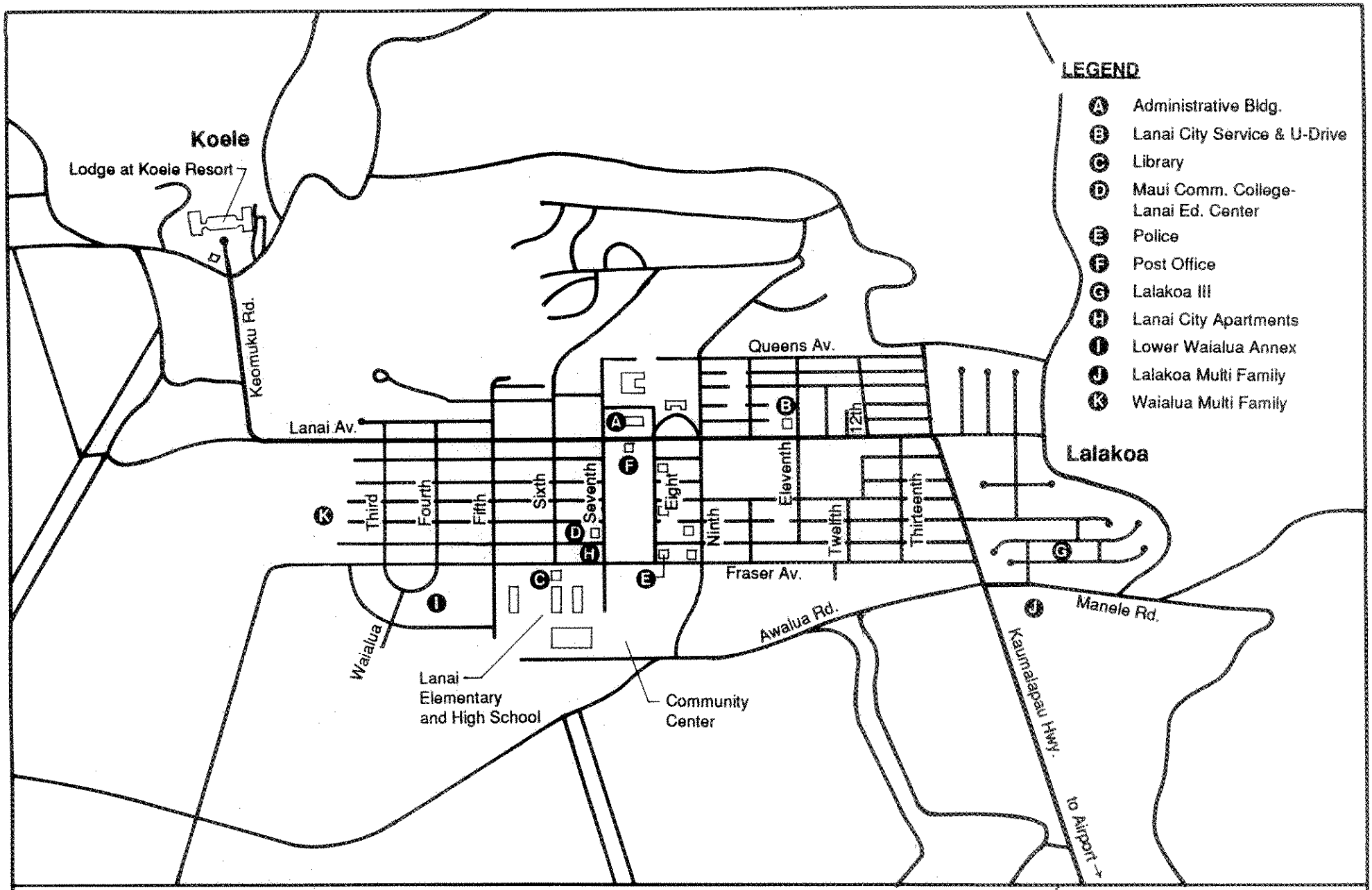

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FIGURE IV-14
HOUSING AND COMMUNITY SERVICES

Fire Protection

- The Maui County Fire Department has one fire station on Lanai which operates 24 hours a day. It was built in 1988 on land donated by Castle & Cooke. In addition to fire protection duties, the firemen assist the island's ambulance service.

- The station has a crew of four firemen -- two from Lanai and two who travel from Maui for their shifts. Prior to September 1989, Lanai was served by a volunteer fire crew.

- For ocean rescue missions, the station occasionally requests assistance from the Lahaina and Wailuku fire stations on Maui.

- Funds have been requested from the County of Maui for one additional fireman and the purchase of ocean rescue equipment. Currently, a boat owned by one of the firemen is used for ocean rescue operations.

6.8.2 Probable Impacts

The project will not require additional services beyond those already planned. Plans for improved services are based on projected population levels which implicitly assume project development.

6.8.3 Mitigation Measures

Mitigation measures are not warranted because the project will not have additional impact on services.

6.9 Health Care Services

6.9.1 Existing Conditions and Plans

Lanai Community Hospital

- The facility is operated by the State Department of Health. It has six acute care beds and eight long-term care beds. The emergency room is open 24 hours a day.

- The hospital has no in-house physician. Lanai's two doctors are on call. Patients requiring surgery are referred to hospitals on Oahu.

- To meet health care needs on Lanai in the next 20 years, the State Department of Health recommends the following: renovation of the Lanai Community Hospital to facilitate full hospital care services, 20 additional long-term care beds, ten additional staff members, and one full-time physician. The Department of Health also estimated five additional personnel will be required to administer substance abuse, mental health, public health, and environmental health services (Office of State Planning, 1990).

Dental Care

- Lanai has one part-time dentist (Monday through Wednesday) who flies in from Maui.

Mental Health Services

- Services are provided by the State Department of Health. The department employs one full-time counselor on Lanai. Psychologists make weekly and monthly visits.

- The Maui County Department of Human Concerns estimates Lanai will need two additional counseling services personnel in the next 20 years (Office of State Planning, 1990).

6.9.2 Probable Impacts

The project will not require additional services beyond those already planned. Plans for improved services are based on projected population levels which implicitly assume project development.

6.9.3 Mitigation Measures

Mitigation measures are not warranted because the project will not have additional impact on services.

6.10 Schools and Education Facilities

6.10.1 Existing Conditions and Plans

Lanai Elementary and High School

- The school is the only school on the island. During the 1989-1990 school year, school enrollment was 503 students. There are 36 teachers.

- Enrollment at the school is expected to increase by approximately 70 in the next five years (personal communication, Roy Hirose, State Department of Education).

- The State Departments of Education and Labor and Industrial Relations plan to open a Transition Center at the school. The purpose of the center will be to prepare residents, primarily students, for entrance into the job market. The center will also provide counseling services to help residents cope with lifestyle changes due to Lanai's changing economy.

- The State Department of Education estimates the school will require approximately nine to fourteen additional classrooms in the next 20 years (Office of State Planning, 1990).

Maui Community College

- College courses are offered by Maui Community College at the Lanai Education Center. Some courses are transmitted to Lanai for television viewing through the Skybridge program and Hawaii Interactive Television System. Program enrollment is 55 students.

- The University of Hawaii Cooperative Extension service estimates the center will require two additional personnel in the next 20 years (Office of State Planning, 1990).

6.10.2 Probable Impacts

The project will not require additional services beyond those already planned. Plans for improved services are based on projected population levels which implicitly assume project development.

6.10.3 Mitigation Measures

Mitigation measures are not warranted because the project will not have additional impact on services.

6.11 Recreational Facilities

6.11.1 Existing Conditions and Plans

County of Maui

- Maui County operates one gymnasium, two tennis courts, a baseball field, and a community center (consisting of a multi-purpose room with kitchen facilities). A contract to renovate the gymnasium is now out to bid.

- Recreational facilities at Lanai Elementary and High School include a gymnasium, a baseball field, two basketball courts, and three tennis courts.

- The Maui County Department of Recreation estimates Lanai will need eight additional recreation and caretaker employees in the next 20 years (Office of State Planning, 1990).

State of Hawaii

- Lanai has no County or State parks. The State Department of Land and Natural Resources has identified Shipwreck Beach as a potential State wild coastline park.

6.11.2 Probable Impacts

The project will not require additional services beyond those already planned. Plans for improved services are based on projected population levels which implicitly assume project development.

6.11.3 Mitigation Measures

Mitigation measures are not warranted because the project will not have additional impact on services.

(Note: For further discussion of recreational impacts, refer to Section 5.6 of this chapter.)

6.12 Social Services

6.12.1 Existing Conditions and Plans

Child Protective Services and Income Maintenance

- These services are provided by the State Department of Human Services. Two staff members are assigned these duties.

- In the next 20 years, the Department of Human Services estimates Lanai will need ten additional personnel (Office of State Planning, 1990).

The Elderly

- Services for the elderly are provided by the "Nursing Home without Walls" program administered by the State Department of Human Services and a senior citizen's program operated by the County of Maui.

Unemployment and Social Security

- The Department of Labor and Industrial Relations and the Federal Office of Social Security do not have offices on Lanai. Services such as unemployment recordkeeping and services related to social security applications are provided by the State Department of Human Services staff.

Veterans Services

- A Federal Veterans Administration worker makes monthly visits to provide services regarding the receipt of benefits.

Currently, social service agencies are not centrally located and expansion of services is limited by a lack of office space. In its assessment of governmental needs on Lanai, the OSP recommends a multiple agency human service center for Lanai. The OSP suggests Castle & Cooke provide land for the center. The State of Hawaii will pay for

construction of the center and purchase or lease the property from Castle and Cooke (Office of State Planning, 1990).

6.12.2 Probable Impacts

The project will not require additional services beyond those already planned. Plans for improved services are based on projected population levels which implicitly assume project development.

6.12.3 Mitigation Measures

Mitigation measures are not warranted because the project will not have additional impact on services.

CHAPTER V

RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS, POLICIES AND CONTROLS FOR THE AFFECTED AREA

1. STATE LAND USE DISTRICT

The site of the proposed Manele Golf Course and Golf Residential Project was designated by the State of Hawaii Land Use Commission as 285 acres Rural and 173 acres Agriculture. Permissible uses within an "R" rural district under §15-15-27 of the Land Use Commission Rules include low density residential uses with a minimum lot size of one-half acre. Under Chapter 205-3 and 205-5(b), Hawaii Revised Statutes, permissible use for Agriculture lands includes..."open area recreational facilities, including golf courses and golf driving ranges, provided that they are not located within agricultural district lands with soil classified by the land study bureau's detailed land classification as overall (master) productivity rating class A or B."

The Lanai Company has recently obtained redesignation of Rural and Agricultural lands to Urban to allow for the development of a golf course. It needs to seek redesignation of additional Rural and Agricultural lands to Urban for large lot, single-family dwellings. Under §15-15-18 of the Land Use Commission Rules, standards for determining an Urban district would include the site's proximity to employment centers and basic services, a substantiation of economic feasibility, and satisfactory topography and drainage. Furthermore, "land contiguous with existing urban areas shall be given more consideration than non-contiguous land." Inasmuch as the proposed site use consists of large lot, single-family dwellings and golf related activities necessary for the financial feasibility of the overall Manele Project, the site is located adjacent to an existing Urban district with available basic services, and the site contains no restrictive topography or productive agricultural soil, reclassification to Urban conforms with the standards of Land Use Commission as outlined above.

2. HAWAII STATE PLAN

The Hawaii State Plan as set forth in Chapter 226, Hawaii Revised Statutes, consists of a series of broad goals, objectives, policies, and priority guidelines which are to act as guidelines for the growth and development of the State. These goals, objectives, policies, and priority guidelines constitute the major reasons for the proposed Manele project. The goals and their relationship to the proposed action are as follows:

a. **Goal**: A strong, viable economy characterized by stability, diversity, and growth that enables the fulfillment of the needs and expectations of Hawaii's present and future generations.

Discussion: The present local economy is dominated by pineapple production. This production is expected to cease by 1993. The proposed action offers

an economic alternative that will open new job opportunities and create a stronger, more diverse, and stable economy.

b. **Goal**: A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.

Discussion: Tourism is a relatively clean, non-polluting industry that is not only compatible with, but also dependent upon, an unspoiled environment.

c. **Goal**: Physical, social, and economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life.

Discussion: Given the stoppage of pineapple production, the outlook for the economic well-being of individuals and families on Lanai would be unfavorable. The increased job opportunities provided by the proposed project would lessen the need for the migration of residents in search of employment and the corresponding break up of families. The development would produce direct growth in tourist-related industries and provide future employment expansion opportunities. Thus the project would increase the economic well-being of the community as a whole.

The proposed Manele project would also promote the following State Plan objectives, policies, and priority guidelines:

Sec. 226-5 Objective and policies for population

Policy (b)(2) Encourage an increase in economic activities and employment opportunities on the neighbor islands consistent with community needs and desires.

Policy (b)(3) Promote increased opportunities for Hawaii's people to pursue their socioeconomic aspirations throughout the islands.

Discussion: The Lanai Project District 1-Manele and the Koele Project District are the products of the Maui County approval processes with community participation toward well-planned developments consistent with community needs and desires. The Manele golf course will assure the success of the hotel and other uses permitted in the Lanai Project District 1-Manele. This will serve to promote increased opportunities to choose and pursue socioeconomic aspirations for residents of Lanai, who otherwise would be facing economic hardships with the phase-out of pineapple.

Sec. 226-6 Objectives and policies for the economy - in general

Objective (a)(1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people.

Objective (a)(2) A steadily growing and diversified economic base that is not overly dependent on a few industries.

Policy (b)(10) Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems.

Discussion: Pineapple has been the primary economic base of Lanai. However, the pineapple industry as a viable source of employment will soon end. The golf course at Manele will cover a varied range of employment choices from food services to course maintenance and management. In addition, the golf course will assure the success of the hotel and other uses permitted in the Lanai Project District 1-Manele. Thus, the project will add to and diversify the economic opportunities in Lanai, an area which is lacking in convenient job choices for its residents today, and which is expected to be worse off in the near future.

Sec. 226-8 Objective and policies for the economy - visitor industry

Objective (a) Planning for the State's economy with regard to the visitor industry shall be directed towards the achievement of the objective of a visitor industry that constitutes a major component of steady growth for Hawaii's economy.

Policy (b)(2) Ensure that visitor industry activities are in keeping with the social, economic, and physical needs and aspirations of Hawaii's people.

Policy (b)(3) Improve the quality of existing visitor destination areas.

Policy (b)(4) Encourage cooperation and coordination between the government and private sectors in developing and maintaining well-designed, adequately serviced visitor industry and related developments which are sensitive to neighboring communities and activities.

Policy (b)(5) Develop the industry in a manner that will continue to provide new job opportunities and steady employment for Hawaii's people.

Policy (b)(6) Provide opportunities for Hawaii's people to obtain job training and education that will allow for upward mobility within the visitor industry.

Discussion: Inasmuch as the Lanai Project District 1-Manele is a product of the Maui County approval process, it has received extensive government agency and citizen review. Active citizen participation and government comment have ensured that the well-designed developments are reflective of community concerns. The golf course will serve as a necessary amenity to support the success of these developments. The Lanai Project District 1-Manele will provide continued employment opportunities to those citizens of Lanai facing unemployment due to the pineapple phase-out. Those who elect to, will be provided with job training and educational opportunities to better prepare them for careers in the visitor and service industries.

Sec. 226-103 Economic priority guidelines

Priority Guideline (a)(8) Provide public incentives and encourage private initiative to develop and attract industries which promise long-term growth potentials and which have the following characteristics:

(A) An industry that can take advantage of Hawaii's unique location and available physical and human resources.

(B) A clean industry that would have minimal adverse effects on Hawaii's environment.

(C) An industry that is willing to hire and train Hawaii's people to meet the industry's labor needs at all levels of employment.

(D) An industry that would provide reasonable income and steady employment.

Priority Guideline (b)(1) Promote visitor satisfaction by fostering an environment which enhances the Aloha Spirit and minimizes inconveniences to Hawaii's residents and visitors.

Priority Guideline (b)(2) Encourage the development and maintenance of well-designed, adequately serviced hotels and resort destination areas which are sensitive to neighboring communities and activities and which provide for adequate shoreline setbacks and beach access.

Priority Guideline (b)(3) Support appropriate capital improvements to enhance the quality of existing resort destination areas and provide incentives to encourage investment in upgrading, repair, and maintenance of visitor facilities.

Priority Guideline (b)(4) Encourage visitor industry practices and activities which respect, preserve, and enhance Hawaii's significant natural, scenic, historic, and cultural resources.

Priority Guideline (b)(5) Develop and maintain career opportunities in the visitor industry for Hawaii's people, with emphasis on managerial positions.

Discussion: Lanai has long been without visitor facilities. The designation of the Koele Project District and the Lanai Project District 1-Manele by the County of Maui acknowledges the need to provide for well-planned developments pursuant to the uses permitted in the districts. The proposed golf course supports the economic health and quality of the visitor industry on Lanai by providing to the existing Koele and Manele resorts an additional recreational facility which is in heavy demand by visitors. The Manele golf course project is a relatively clean, non-polluting industry that is not only compatible with, but also dependent upon the unspoiled natural, scenic, historic, and cultural resources of the area.

Sec. 226-104 Population growth and land resources priority guidelines

Priority Guideline (b)(2) Make available marginal or nonessential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.

Discussion: The area has Land Study Bureau Overall Productivity Ratings of "E19" and "E22", designating an area of poor productivity potential for most agricultural uses. The soil capability classification is VIIs, meaning it contains severe agricultural limitations because of unfavorable texture and extremely rocky or stony conditions. Such marginal and non-essential agricultural lands are especially appropriate for a golf course as a needed amenity for the hotel in the Lanai Project District 1-Manele.

3. STATE FUNCTIONAL PLANS

Chapter 226, Hawaii Revised Statutes, The Hawaii State Plan, provides a long-range guide for Hawaii's future and establishes a Statewide Planning System. The system includes the formulation of fourteen State Functional Plans to manage and coordinate functional area activities and to guide resource allocation decision-making. Each plan addresses statewide needs, problems and issues, and recommends policies and priority actions to mitigate those problems and bring about desirable conditions.

3.1 State Agriculture Plan

The State Agriculture Functional Plan identifies the major issues of statewide concern affecting Hawaiian agriculture and the underlying needs and requirements of the commodity industries for resources such as land, water, capital, human resources, and transportation; and for government support to agriculture in the areas of farm management, cultural practices, livestock production, waste management, government regulation, pest and disease control, handling and processing, marketing, and research and development.

Land currently zoned Agriculture to be utilized by the proposed project is severely limited by soil conditions. The area is currently classified by the Land Study Bureau as having a very poor productivity potential for agricultural uses and is not under cultivation. Because of this classification, the land does not fall under the State Agriculture Plan's definition of Lands "most suitable and needed for agriculture."

3.2 State Conservation Lands Plan

The State Conservation Lands Functional Plan defines and attempts to address areas of statewide concern including watersheds, terrestrial habitat, ocean space, natural areas, air and water quality, sensitive areas, and scenic, historic, and cultural sites. Specifically the plan deals with the protection of rare and endangered species and habitats.

The area for the proposed golf course contains one species of plant, Canavalia pupecens, on the US Fish and Wildlife Category II list. More information and monitoring will be necessary to make a "rare or endangered" determination. Siting of the golf

course and residential elements of the proposed project avoid impacts upon the existing populations of this species. In particular, a population of Canavalia pubescens is located within an archaeological preserve and so it too will be preserved.

3.3 State Education Plan

The State Education Functional Plan was produced by school professionals in the Department of Education to articulate a collective vision for public education and the procedures needed to achieve a desired future. The Plan outlines actions to be taken by the Department of Education to improve current conditions and to attend to various societal issues and trends. Therefore, they are not applicable to the Manele Golf Course project.

3.4 State Higher Education Plan

The State Higher Education Functional Plan specifies the objectives, policies, and high priority implementing actions that the State's post secondary education community will follow. There are no policies or implementing actions in this functional plan, prepared by the University of Hawaii in 1984, of direct relevance to the Manele Golf Course and Golf Residential Project.

3.5 State Energy Plan

The purpose of the State Energy Functional Plan is to define and implement objectives which include the provisions of dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people; and of increased energy self-sufficiency.

The proposed golf course and residential development is an "easily serviceable," "compact" development within the Manele Bay resort area, thus it fulfills the intent of Policy D(1) regarding energy-efficient land use.

The County of Maui Department of Public Works will review the energy conservation techniques as regards building designs submitted as part of the building permit application to assure compliance with its energy conservation regulations.

3.6 State Employment Plan

The State Employment Functional Plan is intended to guide employment, training, and human resources services in Hawaii. The Plan's objectives are to improve the qualifications of entry-level workers and their transition to employment; to develop and deliver education, training and related services to ensure and maintain a quality and competitive workforce; to improve labor exchange; to improve the quality of life for workers and families; and to improve planning of economic development, employment and training activities.

The proposed project complies with the tenets of the State Employment Functional Plan in that it ensures a viable alternative source of employment to the disappearing opportunities in the pineapple industry. Although many of the transitional training

programs listed in the Plan's implementing actions are to be carried out by appropriate State agencies, Castle & Cooke will be implementing special services needed to remove employment barriers and to provide access to the new employment opportunities.

3.7 State Health Plan

The State Health Functional Plan focuses on changing the State's role in public health from that of individual health care provider to one of advocacy and a catalyst for public and private sector efforts. The Plan's attention to health promotion and disease prevention, communicable disease prevention and control, health care access to special populations, health care service to rural communities, and Department of Health leadership are the responsibility of the State and not applicable to the proposed Manele Golf Course and Golf Residential Project. The topic of environmental health and protection is covered through the environmental assessment and is discussed in terms of the proposed project elsewhere in this EIS.

3.8 State Historic Preservation Plan

The State Historic Preservation Plan is designed to set forth guidelines for the delivery of services and the allocation of resources by State agencies with regard to the preservation of history and the heritage of Hawaii. Essentially all of the policies and implementing actions in the Plan are directed at State agencies, especially the Hawaii State Department of Land and Natural Resources. The Manele Golf Course and accompanying residential sites have been the subject of an intensive archaeological survey, covered elsewhere in this EIS. It should be noted that all sites listed as worthy for preservation on the proposed project site have been retained. This helps fulfill Policy (C)(4) and implementing action (C)(4)(a), calling for a variety of mechanisms to better protect historic properties.

3.9 State Housing Plan

The State Housing Functional Plan addresses Hawaii's housing problems through a plan of action based on State housing development, and joint public and private efforts to finance, build and maintain an adequate supply of affordable housing. The Plan focuses on a renewed State commitment to housing initiatives in six priority areas, including increased home ownership, rental availability, attention to special needs groups, and preserving housing stock.

Although many of the policies and implementing actions are directed towards State agencies, the Applicant has entered into a contractual agreement with the County of Maui to supply affordable housing associated with the needs of the project. The housing will be a mix of affordable units, affordable rentals, and market housing in compliance with the objectives and policies of the State Housing Functional Plan.

3.10 State Human Services Plan

The State Human Services Plan reflects an overall theme of support for families and an investment in human resources, through better access, coordination, and increased public and private sector partnerships. Priorities include initiatives for the

elderly, children, and individual and family efforts to become independent from the welfare system.

Loss of job and employment potential can only be seen as negative factors on family stability. Inability to afford to move an entire family to a neighboring island job site increases the separation of families. Lack of adequate employment opportunities increases the population share on support services. Although the objectives and policies of the Human Services Functional Plan are directed towards State agencies, the extent to which the proposed project will provide adequate employment opportunities can help to prevent future problems in the human services area.

3.11 State Recreation Plan

The State Recreation Functional Plan is oriented toward improving public recreation opportunities in Hawaii. Its objectives focus on land use planning, recreation facilities and programs, conservation and resource management, public access, and coordination.

Several objectives and policies of the Recreation Functional Plan are met by the proposed Manele Golf Course and Golf Residential Project. They are:

> Policy (A)(3) Emphasize the scenic and open space qualities of physical resources and recreation areas.
>
> Objective (C) Provide a comprehensive range of opportunities which fulfill the needs of all recreation groups effectively and efficiently.
>
> Policy (C)(1) Maintain an adequate supply of recreation facilities and programs which fulfill the needs of all recreation groups.
>
> Objective (D) Assure the provision of adequate public access to lands and waters with public recreation value.
>
> Policy (D)(2) Promote the securing of public access to resources with recreational value.
>
> Policy (D)(3) Ensure that the community feels safe and comfortable in accessing to public recreation lands.

Discussion: The proposed development will not limit access to the existing foot trail along the rocky coastline bordered by cliffs. Instead, the fishing areas and scenic spots should become more accessible as transportation routes into the area improve. Developed lands bordering the ocean front will be in golf course fairways and will adequately respect the setback. Thus, open space will be preserved. The various recreational opportunities of the area, including fishing, hiking, camping, and picnicking, would not be constrained. Building and maintaining of the golf course will increase the recreation opportunities for those in both Koele and Manele resorts and for residents of the area. In addition, many amenities will be upgraded in Hulopoe Beach Park and coastal trail areas to improve public usage and safety.

3.12 State Tourism Plan

The purpose of the State Tourism Functional Plan is to set forth objectives, policies, programs and projects to guide State and County governments and the private sector in implementing the visitor industry objectives, policies and priority guidelines contained in The Hawaii State Plan. The overall theme of the Tourism Functional Plan is "The achievement of a visitor industry that constitutes a major component of steady growth for Hawaii's economy."

The proposed Manele Golf Course and Golf Residential Project complies with the following objectives and policies of the Tourism Functional Plan:

> Objective (A) Maintenance and enhancement of Hawaii's share of existing and potential visitor markets.
>
> Implementing Action (B)(1)(a) Encourage the development of an orderly mix of visitor accommodations including full-service hotels, condominium apartments, and some single-family homes, in order to meet the lodging desires of the broad spectrum of our visitor guests.
>
> Policy (B)(2) Improve the quality of existing visitor destination areas.

Discussion: The island of Lanai's visitor destination potential is as yet untapped. The island has sufficient attributes and attractions to emerge as the newest of the state's luxury destination resorts and to be competitive in a worldwide resort market. Key attractions of the island are its isolated, yet easily accessible, location; its extraordinary beaches; its diverse mix of physical attractions and recreational opportunities; its rural and relatively undeveloped nature; and its high degree of consolidation under a single private owner.

Visitors to Lanai are expected to be similar to those at other neighbor island luxury resorts, with most being affluent individuals seeking a private, exclusive retreat with a high level of personalized services and varied recreational opportunities. These affluent and older guests have a higher propensity to golf at luxury, high-personal service hotels than at resorts which attract budget or group visitors.

With projected demand estimated to be around 260 rounds per day, inclusion of the golf course and residential components to the existing Lanai Project District 1-Manele can be seen as integral necessities for the success of the entire complex.

> Policy (B)(4) Ensure that visitor facilities and destination areas are carefully planned and sensitive to existing neighboring communities and activities.
>
> Implementing Action (B)(4)(a) Ensure that new hotel and condominium projects be set back from the shoreline for access which facilitates and encourages public use of those areas.
>
> Implementing Action (B)(4)(c) Ensure the construction, as necessary in connection with both new hotel and large resort condominium projects,

of affordable dwelling units adequate to accommodate employee households.

Implementing Action (B)(4)(d) Plan development of resorts in a coordinated manner to minimize loss of public recreational opportunities in designated visitor destination areas.

Implementing Action (B)(4)(e) Resort development should take place within designated visitor destination areas.

Discussion: Inasmuch as the Lanai Project District 1-Manele visitor destination area is a product of the Maui County approval process, it has received extensive government agency and citizen review. Active citizen participation and government comment have ensured that the well-designed developments are reflective of community concerns. Adherence to the established shoreline setback will maintain public access to recreational opportunities in the area. The applicant has entered into agreements with the County of Maui to supply affordable housing units associated with the project.

Objective (C) Enhancement of career and employment opportunities in the visitor industry.

Policy (C)(2) Provide opportunities for Hawaii's people to obtain job training and education that will allow for upward mobility within the visitor industry.

Discussion: With the phase-out of the pineapple industry on Lanai, island residents will be faced with the need to find alternative employment opportunities. New careers in the tourist industry and related service industries will require retraining. The applicant will be implementing a vigorous education program geared to providing the necessary job skills for those who wish to pursue careers in the visitor industry.

3.13 State Transportation Plan

The State Transportation Functional Plan includes separate programs for each mode of transportation: land, air and water. The overall objective of the plan is to provide for the efficient, safe, and convenient movement of people and goods. Compliance with policies and implementing actions to improve vehicular traffic [Policy (C)(3), Implementing Action (C)(3)(b)] is discussed in other areas of this EIS.

4. HAWAII WATER CODE

Chapter 174C, Hawaii Revised Statutes, The State Water Code, was enacted by the State Legislature in 1987 to "protect, control, and regulate the use of Hawaii's water resources for the benefite of its people." Exclusive jurisdiction and final authority in all matters of administration of the State Water Code is the responsibility of the Commission on Water Resources Management, Department of Land and Natural Resources. The policies of the State Water Code are broad including topics such as protection of water resources, maintenance of ecological balance and scenic quality, improvement of water

quality, and establishment of comprehensive water planning statewide. A major element of the State Water Code is the development of the Hawaii Water Plan (see below).

Discussion: Preparation and submission of this EIS and the supporting marine and water resource assessments, and implementation of the proposed mitigation measures attempts to comply with these policies. Compliance with the Hawaii Water Plan implementation guidelines as discussed below is also part of the fulfillment of these State Water Code policies.

5. HAWAII WATER PLAN

The Hawaii Water Plan is comprised of seven plan elements: a Water Resource and Protection Plan, the Water Quality Plan, the State Projects Plan, and Water Use and Development Plans for each of the four counties within the state (i.e. Honolulu, Maui, Kauai, Hawaii). The major water issue for Lanai as identified in the Hawaii Water Plan is the limited amount of potable water to serve the increased demand that is occuring through development of resort, housing, and agricultural uses. In deference to this concern, the Commission on Water Resource Management has reviewed a petition to designate Lanai as a Water Management Area; and although, they did not designate it as such at this time (1989), they instituted a monitoring program for water use and planned use on the island. The State recommends investigating ways to make greater use of the non-potable water for irrigation and to conduct experiments to determine the extent to which fog drip adds to the groundwater supply in order to better assess the potable water availability on the island.

> Objective (1) Maximize the availability of useful water through the preservation and expansion of water supplies
>
> Implementing Action (2) Increase confidence levels for sustainable yields in all hydrologic units. This may include more comprehensive monitoring work ..., more extensive rainfall monitoring, refinements in calculations for return irrigation water, interhydrologic unit transfers, and refining the water balance equation. Because of current demands, or anticipated demands for the development of certain sectors and systems,..., the following hydrologic units are recommended for priority attention. (g) Central Lanai -(Lanai - 50101, 50102)

Discussion: The strategy in meeting the objective (1) is to prevent saltwater intrusion into the fresh water sources through careful management of the withdrawals from any particular hydrologic unit. On Lanai, the Central Sector aquifer is the island's primary potable water source. The water source for domestic use and the golf clubhouse would be primarily from this high-level aquifer in the Central Sector. A new high level well and pump is proposed to serve the Manele Development. When it is required, it will be installed and tested under the State Water Code (HRS 174C) requirements.

Water to be used for golf course irrigation and other landscaping would be from alternative sources (e.g., brackish water from new low level wells, surface water). This

would alleviate some of the demand on the potable water system and help to implement the State's objective.

> Objective (2) Maximize the utility of the State's water resources for all uses of water by both mankind and nature
>
> Strategy (2)(A) Maximize the efficient use of water and limit quantities ofwater use to the minimum required for efficient and economic utilization.
>
> Implementating Action (2) Encourage conservation ofwater in accordance with identified minimum required quantities: a) educate the public on how to conserve water, b) offer economic incentives to encourage conservation, c) impose regulator restrictions on an as needed basis.

Discussion: Implementation of the mitigation measures established through this impact assessment process including possible water covenants on the residents and public awareness programs would fulfill these objectives.

> Strategy (2)(B) Maximize the efficient use of water and limit the quality of water used to the minimum required for efficient and economic utilization.
>
> Implementing Action (2) Encourage conservation of water in accordance with identified minimum required qualities: a) educate the public on how to conserve water, b) offer economic incentives to encourage conservation, c) impose regulator restrictions on an as needed basis.

Discussion: Developing the alternative non-potable sources of water to meet the irrigation requirement at Manele complies with the objective (2) to maximize the water use and the implementing actions for economy of water quality.

6. HAWAII COASTAL ZONE MANAGEMENT PROGRAM

Federal Coastal Zone Management (CZM) enforcement authority (Public Law 92-583, as amended) has been delegated to the state (Chapter 205A, HRS). Other than the review of federal applicants, federal permits, or federal activities, state CZM review authority has been delegated to the county level through the Special Management Area controls.

7. MAUI COUNTY GENERAL PLAN

The Maui County General Plan was adopted in 1980 as Ordinance No. 1052. The broad General Plan objectives for planned growth are implemented through district community plans. The Manele Golf Course and Golf Residential Project falls under the Lanai Community Plan. Among the objectives of the Maui County General Plan met by the proposed action are:

Objective (I)(B)(1) To use the land within the County for the social and economic betterment of the County's residents.

Objective (II)(A)(1) To provide an economic climate which will achieve stabilization, controlled expansion, and diversification of the County's economic base.

Objective (II)(B)(1) To require exceptional and continuing quality in the development of visitor industry facilities.

Objective (II)(B)(2) To control the development of visitor facilities so that they do not infringe upon the traditional social, economic and environmental values of the community.

Objective (II)(B)(3) To ensure that visitor industry facilities shall not disrupt agricultural and social pursuits and will not be allowed to deplete the County's natural resources.

Objective (II)(B)(4) To develop a visitor industry which will enhance the social and economic lifestyles of Maui County's residents.

Objective (V)(A)(1) To provide high-quality recreational facilities to meet the present and future needs of our people.

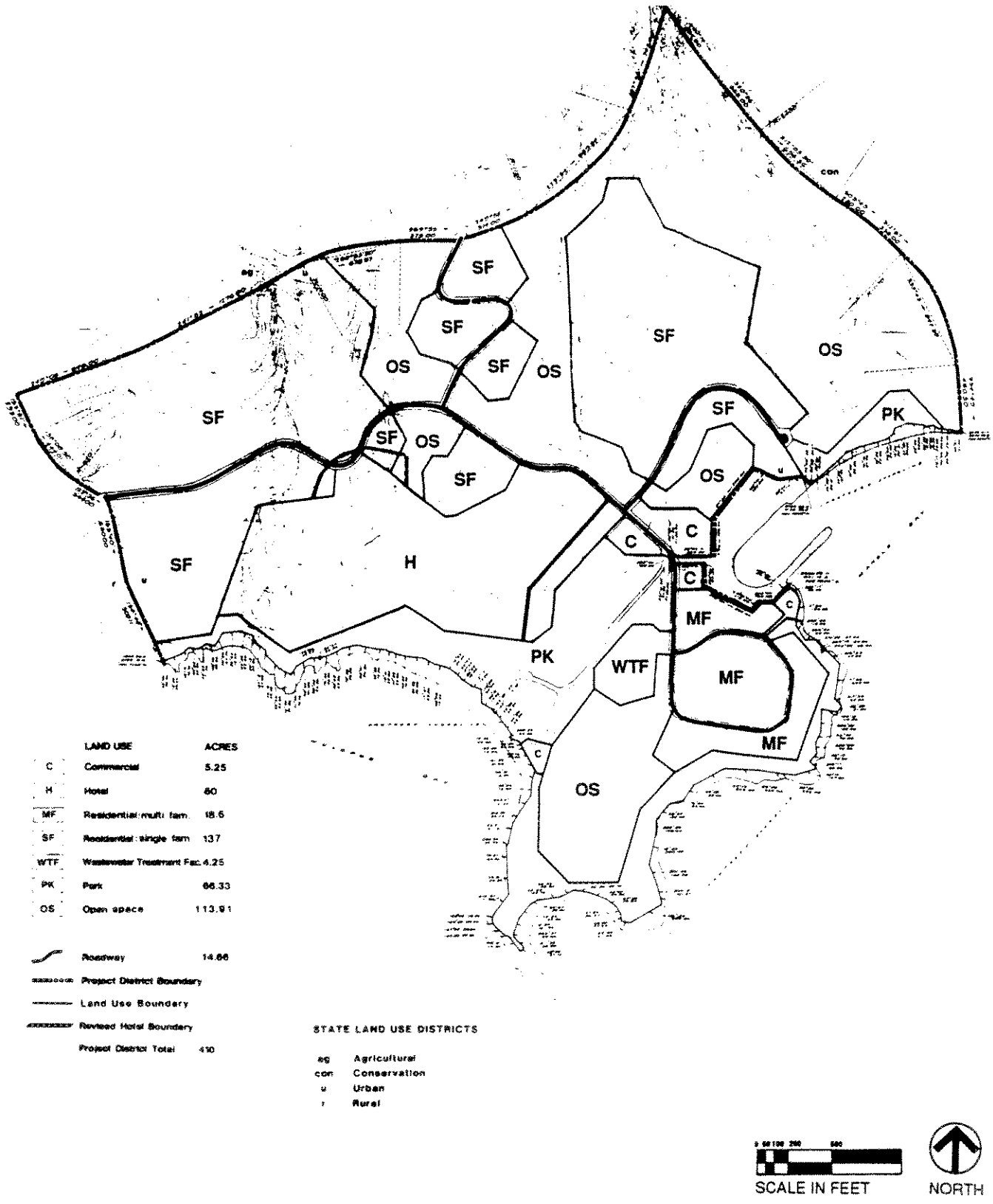
8. LANAI COMMUNITY PLAN

The Lanai District Community Plan, adopted in April 1983, provides the implementation scheme for the County's broad objectives and policies pertaining to Lanai. The Plan includes the planned distribution and intensity of land uses and public facilities, statements of standards and principles with respect to development, statements indicating the sequence in which future development is to occur, and maps showing zoning and design.

The Lanai Community Plan acknowledges the State Land Use District classification for that portion of the property in the Agricultural District. The remaining portion of the property in the Rural District is designated Open Space. The open space use is intended to limit development on certain urban and non-urban designated lands which may be inappropriate for intensive development due to environmental, physical or scenic constraints. Appropriate urban and non-urban uses may be allowed on a permit basis.

9. LANAI PROJECT DISTRICT 1-MANELE

The Lanai Project District 1-Manele (Figure V-1), adopted by the County of Maui in 1986 as Ordinance No. 1578, incorporates zoning-type restrictions for the area, including appropriate land uses, development densities, height limits, and setback



MANELE GOLF COURSE AND
GOLF RESIDENTIAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
For: Lanai Co., Inc.
By: Belt Collins & Associates November 1990

FIGURE V-1
EXISTING COUNTY PROJECT DISTRICT LAND USE

requirements. The purpose and intent of the District is to establish a low-density, low-rise resort which provides another economic base for the island. Land uses include single-family residential, multi-family residential, hotel, commercial, park, open space, and public.

The proposed action will require an amendment to the Project District to include golf courses as a permitted use and to include the additional acreage within the Project District boundaries. See Table II-1 for proposed acreages in each land use category in both the existing Lanai Project District 1-Manele and the amendment area.

10. COUNTY SPECIAL MANAGEMENT AREA

The proposed Manele Golf Course and Golf Residential Project site falls within the "Special Management Area" zone (Figure V-2) and is therefore subject to the Special Management Area (SMA) rules and Regulations of the County of Maui. Following is a discussion of the proposed project's relationship to the objectives and policies of Chapter 205A, HRS, and to the SMA Guidelines in the Maui County Code, Chapter 20.12.570.

10.1 Objectives and Policies

10.1.1 Objectives and Policies Relating to Recreational Resources

The proposed project would not affect shoreline recreational opportunities or hinder public access to the shoreline. On the contrary, the Applicant would improve access by increasing safety along the existing path. Also planned is improved road and public facilities to improve public usage and access.

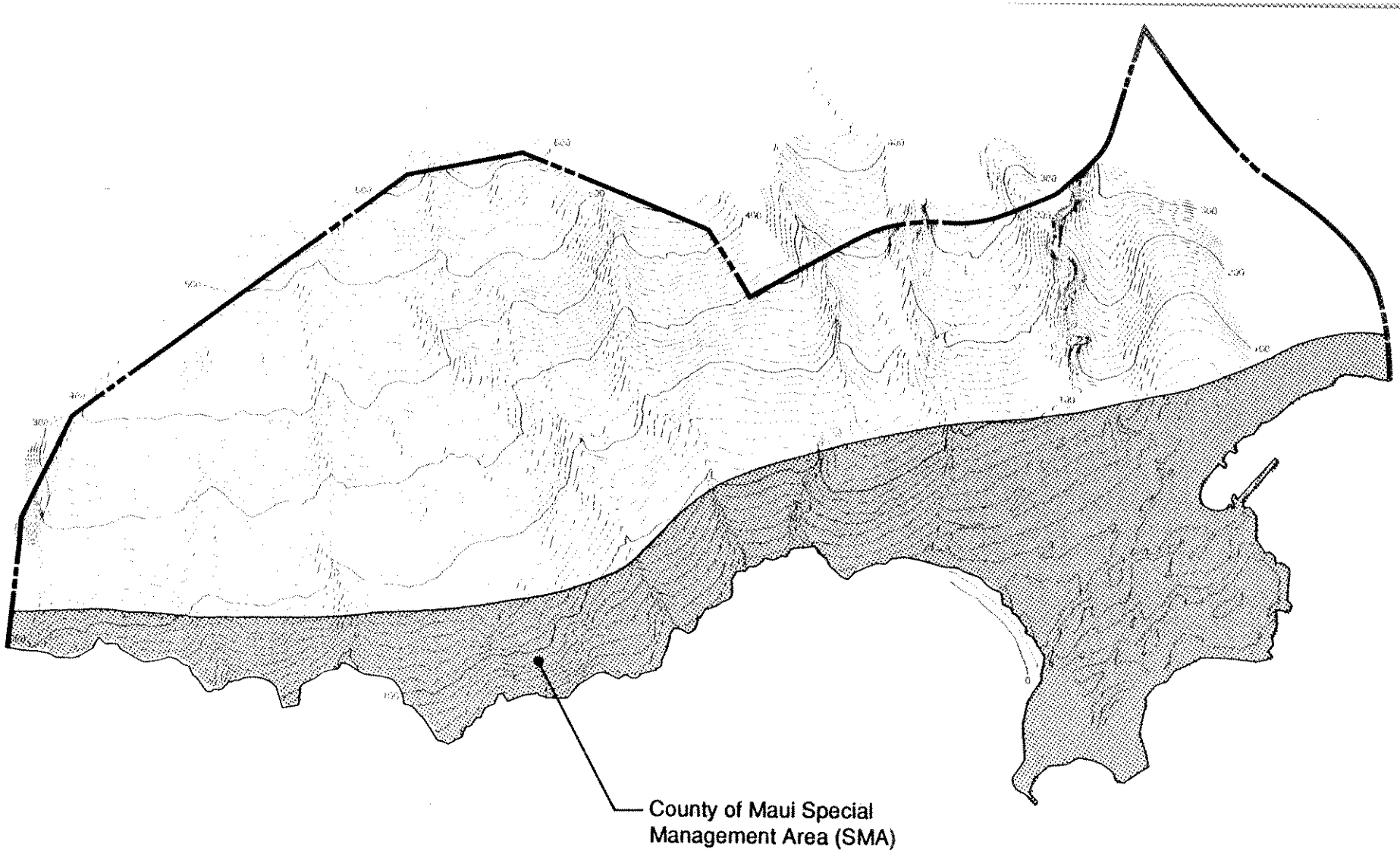
Construction of the golf course and residential units is not expected to have an adverse effect on coastal recreational resources. Recreational values of the coastal waters would be preserved. Recreational use of the site's shoreline is expected to increase due to improved access, although some solitary recreational activities now pursued may be discouraged by development of the site.

10.1.2 Objectives and Policies Relating to Historic Resources

The project site has been the subject of intensive archaeological surveys. The recovery of information from these surveys has recommended several sites for preservation. These sites have been preserved in the proposed action. If other sites are uncovered during construction, the Applicant intends to cease work in that area and not resume until the significance of the newly discovered sites is evaluated.

10.1.3 Objectives and Policies Relating to Scenic and Open Space Resources

The construction of the proposed golf course and residential units would result in a change in the visual environment from a natural to man-made character consistent with the adjoining Lanai Project District 1-Manele. Public views to the shoreline would not be significantly affected. Abundant landscaping would enhance the open spaces.



MANELE GOLF COURSE AND
GOLF RESIDENTIAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT
For: Lanai Co., Inc.
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NORTH 0 400 800 1200 SCALE IN FEET

FIGURE V-2
SPECIAL MANAGEMENT AREA

10.1.4 Objectives and Policies Relating to Coastal Ecosystems

The Hulopoe-Manele Bay area is designated a Marine Life Conservation District by the Department of Land and Natural Resources. There is an abundance of offshore marine life including fish, algae, soft coral, turtles and dolphins. Impacts to the offshore ecosystems due to storm water runoff, erosion, fertilizers, pesticides, herbicides, or irrigation would not be significant.

10.1.5 Objectives and Policies Relating to Economic Uses

The policies under this heading state that reasonable growth in areas designated for visitor industry facilities (which are recognized as coastal dependent developments) is to be permitted, assuring that adverse impacts be minimized. The proposed Manele golf course and residential units will assure the success of the hotel and other uses permitted in the adjoining Lanai Project District 1-Manele. As demonstrated elsewhere in this EIS, the proposed project is not expected to cause any major adverse impacts. In areas of potential adverse impacts, mitigating measures will be taken to minimize them.

10.1.6 Objectives and Policies Relating to Coastal Hazards

The proposed project site is within a coastal area which is subject to potential hazards from storm waves and tsunamis. Design of structures will incorporate elements aimed at reducing impacts from these hazards. The project will comply with the requirements of the Federal Flood Insurance program.

Erosion is not now a hazard in the area due to low rainfall. Planned landscaping of the site will tend to reduce any potential erosion once the site is developed.

10.1.7 Objectives and Policies Relating to Management of Development

This EIS is a tool for communicating the impacts of the proposed project at an early stage of planning. It is intended to facilitate participation in the planning and review process.

10.2 Evaluation Guidelines

The law establishing the SMA also contains guidelines to be used by Maui County when reviewing proposed developments. These guidelines are to ensure adequate access, adequate and properly located public recreation areas, provisions for solid and liquid waste treatment, and minimum adverse affects to water resources and scenic and recreational amenities (Guidelines A.1-4). Further guidelines seek to minimize, where reasonable, any alterations to existing bodies of water, developments which would reduce areas usable for public recreation, developments which would reduce public access, developments which would substantially interfere with public views to and along the shoreline, and any development which would adversely affect water quality (Guidelines E.1-5). Before a development shall be approved, it must first be found that it will not have a substantial adverse environmental affect, and that the development is consistent with applicable State and County plans and policies (Guidelines B.1-3).

As discussed above, the proposed Manele Golf Course and Golf Residential Project is in compliance with the SMA guidelines. Access to the shoreline and beach areas would not be reduced. View planes would not be impacted. The proposed action does not call for any alterations to existing bodies of water, nor would there be any significant adverse impacts to water quality. The proposed action is consistent with applicable State and County plans and policies, and with the objectives of the SMA regulations. Finally, not only is the Applicant committed to minimizing adverse impacts; the multi-level review and permit process that must be adhered to before development is undertaken will ensure that mitigation measures are made conditions to the construction.

11. SHORELINE SETBACK

Hawaii Revised Statutes, Chapter 205, Part II, Shoreline Setbacks, establishes setbacks of not less than 20 feet and not greater than 40 feet inland above the upper reaches of the wash of waves other than storm and tidal waves. Counties are allowed to set greater setback distances and enforcement has been delegated to county planning departments. The Memorandum of Agreement (see Appendix K) recognizes a 75-foot setback for the Manele area with the exception of a 50-foot setback along the cliff at three golf holes. At the appropriate time, the applicant will seek a Shoreline Setback Variance for these setbacks from Maui County. No structures shall be constructed within the shoreline setback and the shoreline area shall be essentially unmodified from its existing condition.

CHAPTER VI

TOPICAL ISSUES

1. RELATIONSHIP BETWEEN SHORT-TERM USES AND MAINTENANCE OF LONG-TERM PRODUCTIVITY

Analyses of various on-site environmental features have found the Lanai Company's Manele Bay property to possess physical attributes that are desirable both as amenities in a residential/resort development and for their own sake. These attributes include magnificent ocean views, a primitive rocky cliff coastline, and dry, warm climate. The studies performed (see Chapter I, Section 3.) have also indicated that the design of the proposed project is compatible with and should enhance the existing natural environment. Specific measures that will be employed to mitigate potential adverse environmental impacts, as listed in Chapter I, Section 6. and discussed in Chapter IV, have been incorporated in the design and would be followed in the construction and operation phases of the project.

No short-term exploitation of resources that will have negative long-term consequences have been identified. The proposed golf and residential resort development as envisioned by the developer will be high quality and will be designed to last for decades. The principal long-term benefits of the proposed project include the productive use of the property at a lower density than that currently authorized by the existing Lanai Project District Ordinance and the provision of a revenue-producing active recreational facility that will serve Lanai residents and visitors alike. Increased residential, resort, recreational, and economic opportunities for various socioeconomic levels would be provided along with increased community services and activities. The proposed project is a logical extension of the Manele Bay Hotel and Resort. Open spaces surrounding the project site and vistas to the ocean would be retained for the long-term benefit of the immediate area residents and visitors to the area; 458 acres of land would be permanently converted from natural scrub vegetation to landscaped area, turf grasses, and house sites.

As noted in the discussion of Alternatives Considered (Chapter III), one short-term use of the property would be to retain the present vacant status of the property. This appears to be less than optimum use of the property. As golf and residential units are developed and the Manele Bay Resort succeeds, significant socio-economic benefits to the community will result, in the form of increased job opportunities, increased recreational and community services facilities and opportunities, and increased tax revenues. Direct, full-time employment opportunities and temporary construction employment will be generated by the project and these in turn will have benefits that ripple through the regional and island economy. Similarly, indirect and induced employment will be generated in those industries and services that cater to the construction and service related businesses serving the proposed project. Private subsidies from the landowner and public revenues from excise, personal, and real property taxes are expected to more than offset any expenses associated with the expansion of public services to meet the requirements of the proposed project development and indirect population growth (see Chapter IV, Section 5.5).

2. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The development of the Manele Golf Course and Golf Residential Project would result in the irreversible and irretrievable commitment of certain natural and fiscal resources. Major resource commitments include the land on which the project is located and on which the facilities would be constructed, as well as money, construction materials, manpower and energy. The impacts of using these resources should be weighed against the expected positive socioeconomic benefits to be derived from the project versus the consequences of taking no action or adopting and other less beneficial use of the property.

A significant portion of the property would remain in open space and the single-family residential areas are planned at very low density and will presumably include natural areas. The project would include landscaping planted along the golf course and residential units and along the roadways, contributing positively to the aesthetic character of the area. Further, a shoreline pathway will be incorporated in the plan to enhance the passive recreational use of the area.

The commitment of resources required to accomplish the project includes building materials and labor, both of which are generally non-renewable and irretrievable. Construction of and resultant travel to/from the project by residents and visitors would require the consumption of petroleum products and petroleum based electrical generation. This too represents an irretrievable commitment of resources.

The proposed project does not call for a substantial commitment of government supplied services or facilities that would not be required without the proposed project. In general, the residents of Lanai and existing resort developments will require increases in police, fire, medical, and social services whether or not the Manele Golf Course and Residential development is constructed. The project would add to the cultural and recreational facilities available to the residents of the project and to Lanai residents in general. Similarly, the project would add to the tax revenues of the county and state.

3. UNRESOLVED ISSUES

The project planning has evolved to the point that the majority of issues have been resolved to the satisfaction of the applicant, the state and local agencies, and the community. Ongoing public participation has been formalized through a Memorandum of Agreement between the applicant and the Lanaians for Sensible Growth (a citizens group on Lanai that has taken a lead in expressing the concerns of the Lanai community) and the Office of Hawaiian Affairs (Appendix K). The Lanai Company (Castle & Cooke, Inc.) will continue to work with the residents and businessmen of the area, as well as administrative and elected officials to assure that the final development plans meet the project objectives and satisfactorily address concerns that have been raised to date as well as those that may be raised during the public review of this EIS.

Issues that should be resolved throughout the planning and design stages of the project are:

(1) The alignment of the extended Manele Road in relation to the multi-family residences in the project district and throughout the amendment area has not been fixed because it is a decision that must be made by the State Department of Transportation since the road is within their jurisdiction.

(2) Specific residential lots have not been delineated in this EIS. The applicant intends to bring forth specific site plans and design guidelines for the residential development after the environmental impact statement and mitigation measures are reviewed and approved by the approving agency.

(3) Shoreline setback issues will be resolved during Shoreline Setback Variance processing by Maui County.

(4) Additionally, most of the indirect or long-term social impacts of resort development can almost always be considered "unresolved issues." This is because exact outcomes can never be predicted and/or because programs to deal with social issues are best devised closer to the actual time of the impact. For example, the project is expected to provide market support for Lanai hotel expansions later in the 1990's, and many of the associated social concerns (construction worker housing, operational labor sources, and permanent housing for in-migrant hotel workers) will have to be resolved at that time. Also, the extent to which population growth proves socially beneficial vs. detrimental to current residents will ultimately depend on the outcome of current discussions between the community and Castle & Cooke about topics such as increased political and economic diversification on the island (e.g., more opportunities or leasehold security for independent Lanai business people).

Similarly, there is potential social conflict over increased visitor use of Hulopoe Beach. However, actual impacts depend on park management decisions yet to be made.

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CHAPTER VII

PARTIES CONSULTED AND THOSE WHO PARTICIPATED IN THE PREPARATION OF THE EIS

The environmental impact statement was prepared for the Manele Golf Course and Residential Project by Belt Collins & Associates with input provided by subconsultants. The following were involved:

1. CONSULTED PARTIES

The notice of availability of the Draft EIS Preparation Notice (DEISPN) for the Manele Golf Course and Golf Residential Project was published in the OEQC Bulletin by the Office of Environmental Quality Control on May 22, 1990. The agencies listed below were sent copies of the DEISPN. No comments were received from these agencies; however, one comment letter was received and is reproduced in Chapter VIII.

Department of Public Works
Department of Water Supply
Department of Land and Natural Resources
State Commission on Water Resource Management
Department of Transportation (Highways Division)
Department of Agriculture

2. ORGANIZATIONS AND INDIVIDUALS WHO ASSISTED IN THE PREPARATION OF THIS EIS

Belt Collins & Associates

Edward H. Iida, PE	Civil Engineer; contributed to sections on Infrastructure; BS in Civil Engineering.
Ed Kuniyoshi	Planner; contributed to project concept and land use summary; MA in Urban Planning.
Anne L. Mapes	Planner and Project Manager; contributed to organization and content of all sections; MS in Business Administration.
Ramona Mattix	Planner; contributed to sections on Water Resources, Soils, Visual Quality; MA in Community and Regional Planning.

Tom Nance, PE	Civil Engineer, contributed to sections on Water Resources; MS in Civil Engineering.
Nancy E. Olmsted	Environmental Planner and Principal Investigator; contributed to organization and content of all sections; MS in Natural Resource Management.
Thomas P. Papandrew	Principal in Charge; planner and registered landscape architect with a BA in Architecture.
Mara Soloway	Editor; contributed to organization and editing of all sections; BA in Communication Studies.
Jan Sturgeon	Planner; contributed to organization and editing of all sections; MS in Technical Communication.
Mark Willey	Environmental Planner; contributed to sections on Alternatives, Impacts, Policies; MA in Urban and Regional Planning.
Amy Yamakawa	Graphic Designer; contributed to graphics and maps; BA in Fine Arts.

Subconsultants

W. Kent Alkire, III	**Jack Nicklaus Golf Services** - Provided golf course design and integrated management plan for operation and maintenance of the golf course.
Richard Brock, Ph.D.	**Environmental Assessment Co.** - Provided marine life and water quality evaluation.
Yoichi Ebisu	**Y. Ebisu & Associates** - Provided analysis of noise impacts.
Hal Hammatt Mark Stride	**Cultural Surveys Hawaii** - Provided inventories, evaluation and preservation plan for archaeological and cultural resources.
Conrad Higashionna	**Pacific Planning & Engineering** - Provided traffic impact assessments.
John Knox, Ph.D. John Kirkpatrick, Ph.D.	**Community Resources, Inc.** - Provided analysis of socioeconomic impacts and public services.
James Kumagai, Ph.D.	**M & E Pacific, Inc.** - Provided background environmental studies and detailed analyses of water resources, assessment of biocides and fertilizers.

Ken Nagata	Provided flora and fauna assessments.
Barry D. Root	**Barry Neal & Associates** - Provided analysis of air quality impacts.

CHAPTER VIII

COMMENTS RECEIVED DURING THE EIS PREPARATION NOTICE COMMENT PERIOD AND RESPONSES

The Environmental Impact Statement Preparation Notice (EISPN) requesting an environmental assessment determination for an amendment to the Lanai Community Plan to expand the Manele Project District boundaries was issued May 22, 1990. The following agencies were requested to review and comment on the proposed action:

1. STATE AGENCIES

Department of Public Works
Department of Water Supply
Department of Land and Natural Resources
State Commission on Water Resource Management
Department of Transportation (Highways Division)
Department of Agriculture

No comments were received from any of these agencies.

2. PRIVATE ORGANIZATIONS WHO RESPONDED TO THE EIS PREPARATION NOTICE

The University of Hawaii at Manoa responded to the EISPN (see letter dated July 31, 1990 that follows) and suggested the Draft EIS specifically address potential impacts to archaeological resources and to coastal water quality. Detailed evaluations of these topics have been included in this DEIS.

CHAPTER IX

AGENCIES, ORGANIZATIONS AND PERSONS WHO RECEIVED A COPY OF THE DRAFT EIS, WRITTEN COMMENTS RECEIVED DURING PUBLIC REVIEW PERIOD AND RESPONSES

The Draft EIS was officially submitted to the Office of Environmental Quality Control (OEQC) on November 20, 1990 and notice of its availability published in the OEQC Bulletin on November 23, 1990 and December 8, 1990. The official date for receipt of comments was January 7, 1991. All comments received as a result of the 45-day public review period, and responses thereto, are included in this Chapter. Also included are comments received after January 7, 1991 and responses thereto.

Following is a list of agencies, organizations and individuals who were sent copies of the Draft EIS. Those who responded in writing are marked with an asterisk (*).

Federal Agencies

U.S. Army - DAFE (Facilities Eng. USASCH)
U.S. Army Regional Division, USEPA Region IX
* U.S. Army Engineer District, Honolulu
U.S. Department of Agriculture, Soil Conservation Service
U.S. Department of the Interior, Fish and Wildlife Service
U.S. Department of the Interior, Geological Survey, Water Resources Division
U.S. Department of Transportation, U.S. Coast Guard
* U.S. Department of the Navy

State Agencies

Department of Accounting and General Services
* Department of Agriculture
* Department of Business and Economic Development
* Department of Defense
Department of Hawaiian Home Lands
* Department of Health
* Department of Land and Natural Resources
Department of Transportation
* Housing Finance and Development Corporation
Office of Environmental Quality Control
* Office of Hawaiian Affairs
* Office of State Planning
* State Energy Office
* University of Hawaii, Environmental Center
University of Hawaii, Water Resources Research Center

Maui County

* Department of Human Concerns
* Department of Parks and Recreation
* Department of Public Works
* Department of Water Supply
  Economic Development Agency
* Planning Department

Public Utilities

Hawaii Electric Light Company, Inc.

Community Organizations, Other Public Interest Groups and Individuals

American Lung Association of Hawaii
* Lanaians for Sensible Growth
* Native Hawaiian Legal Corporation
* Kay Okamoto
  Sierra Club Legal Defense Club, Inc.

DEPARTMENT OF BUSINESS
AND ECONOMIC DEVELOPMENT

JOHN WAIHEE
GOVERNOR
ROGER A. ULVELING
DIRECTOR
BARBARA KIM STANTON
DEPUTY DIRECTOR
LESLIE S. MATSUBARA
DEPUTY DIRECTOR

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 FAX (808) 531-5243

RECEIVED
NOV 25 1990
BELT COLLINS & ASSOCIATES

November 27, 1990

Ms. Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96814

Dear Ms. Mapes:

Subject: DEIS Manele Golf and Golf Residential Project

We wish to inform you that we have no comments to offer on the subject environmental impact statement preparation notice.

Thank you for the opportunity to review the document.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK:hkeis19

cc: Office of Environmental Quality Control

IX - 3

BCA
BELT COLLINS
& ASSOCIATES
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Landscape Architecture

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September 30, 1991
91P-436 (044.03)

Mr. Maurice H. Kaya
Energy Division
Dept. of Business & Economic Development
State of Hawaii
335 Merchant Street, Room 110
Honolulu, Hawaii 96813

Dear Mr. Kaya:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

Thank you for your November 27, 1990 letter on the above project. Although you had no comments, we appreciate you and your staff taking the time to review the document.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO:
5090
Ser 00F2/3938
27 NOV 1990

Mr. Philip Ohta, Planner
County of Maui, Planning Department
200 South High Street
Wailuku, HI 96793

Dear Mr. Ohta:

MANELE GOLF AND GOLF RESIDENTIAL PROJECT

The Draft Environmental Impact Statement (DEIS) for Manele Golf and Golf Residential Project, Manele, Lanai, Hawaii, has been reviewed, and we have no comments to offer. Since we have no further use for the DEIS, it is being returned to your office.

Thank you for the opportunity to review the draft.

Sincerely,

W. K. Liu

W K LIU
Assistant Base Civil Engineer
By direction of
the Commander

Copy to: (w/o encl)
The Lanai Co
Belt Collins & Associates
OEQC (w/DEIS)

IX - 4

BELT COLLINS & ASSOCIATES

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 30, 1991
91P-437 (044.03)

Mr. W. K. Liu
Assistant Base Civil Engineer
Department of the Navy
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860-5020

Dear Mr. Liu:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

Thank you for your November 27, 1990 letter on the above project. Although you had no comments, we appreciate you and your staff taking the time to review the document.

Sincerely,

Anne L. Mapes

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

JOHN WAIHEE
GOVERNOR

ALEXIS T. LUM
MAJOR GENERAL
ADJUTANT GENERAL

MYLES M. NAKATSU
COLONEL
DEPUTY ADJUTANT GENERAL

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL
3949 DIAMOND HEAD ROAD, HONOLULU, HAWAII 96816-4495

November 28, 1990

Engineering Office

Mr. Philip Ohta
Planner
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

IX - 5

Dear Mr. Ohta:

DEIS Manele Golf and Golf Residential Project

Thank you for providing us the opportunity to review the above subject project.

We have no comments to offer at this time regarding this project.

Sincerely,

Jerry M. Matsuda

Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contracting & Engineering Officer

cc: Mr. Thomas C. Leppert,
The Lanai Company
Ms. Anne T. Mapes,
Belt Collins & Associates

NATIONAL GUARD

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 30, 1991
91P-438 (044.03)

Lt. Col. Jerry M. Matsuda
Office of the Adjutant General
Department of Defense
State of Hawaii
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Dear Lt. Col. Matsuda:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

Thank you for your November 28, 1990 letter on the above project. Although you had no comments, we appreciate you and your staff taking the time to review the document.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

DEPARTMENT OF
HUMAN CONCERNS
COUNTY OF MAUI

200 SOUTH HIGH STREET, WAILUKU, HAWAII 96793

HANNIBAL TAVARES
Mayor
ROBERT AGRES, JR.
Director
MIRIAM K. KAHALEKAI
Deputy Director

(808) 243-7805

DEC 19 1990

December 17, 1990

Mr. Christopher L. Hart, Director
Planning Department
County of Maui
200 South High Street
Wailuku, Maui, HI 96793

Dear Mr. Hart:

Subject: Draft Environmental Impact Statement for
Manele Golf and Golf Residential Project

The Office of Economic Development have reviewed the subject Environmental Impact Statement and find that, in general it has adequately identified and assessed the major environmental impacts which can be anticipated to result from the proposed project.

We have no other comments to offer at this time; however, we thank you for the opportunity to review the Draft Environmental Impact Statement.

Very truly yours,

Fred Matsumoto

FRED MATSUMOTO
Economic Development Coordinator

cc: The Lanai Company
Belt Collins and Associates
Office of Environmental
Quality Control

IX - 6

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 30, 1991
91P-439 (044.03)

Mr. Fred Matsumoto
Economic Development Coordinator
Department of Human Concerns
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Matsumoto:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

Thank you for your December 17, 1990 letter on the above project. Although you had no comments, we appreciate you and your staff taking the time to review the document.

Sincerely,

Anne L. Mapes

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

MAILING ADDRESS: P.O. BOX 2359, HONOLULU, HAWAII 96804 FAX: (808) 523-8637

JOHN WAIHEE
GOVERNOR
ROGER A. ULVELING
DIRECTOR
BARBARA KIM STANTON
DEPUTY DIRECTOR
LESLIE S. MATSUBARA
DEPUTY DIRECTOR

DEC 20 P2:

December 13, 1990

MEMORANDUM

TO: County of Maui, Planning Department
Attn: Mr. Philip Ohta, Planner

FROM: for Roger A. Ulveling

SUBJECT: DEIS for Manele Golf Course and Golf Residential Project

We have reviewed the Draft Environmental Impact Statement for the Manele Golf Course and Golf Residential Project to determine conformance with the State Tourism Functional Plan (STFP). The proposed project supports the Manele Bay Resort which is located within one of the State's nineteen resort regions designated by the STFP.

Based upon our review, the proposed project is in conformance with the objectives, policies and actions contained within the Physical Development, and the Employment and Career Development sections of the STFP.

RAU:MAA:cat

cc: The Lanai Company
Belt Collins & Associates
Office of Environmental Quality Control

IX - 7

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 30, 1991
91P-440 (044.03)

Mr. Murray E. Towill, Director
Dept. of Business, Economic Development & Tourism
State of Hawaii
P.O. Box 2359
Honolulu, Hawaii 96804

Dear Mr. Towill:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

We received Mr. Ulveling's December 13, 1990 memorandum to Maui County Planner, Mr. Philip Ohta concerning the above project.

Thank you for your department's comments. Mr. Ulveling's memorandum and this response will be included in the Final EIS for the Manele project.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

HANNIBAL TAVARES
Mayor

RECEIVED
JAN 2 1991
BELT, COLLINS & ASSOCIATES

CHRISTOPHER L. HART
Planning Director

JOHN E. MIN
Deputy Planning Director

COUNTY OF MAUI
PLANNING DEPARTMENT
250 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793

December 28, 1990

Ms. Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Boulevard
Suite 200
Honolulu, Hi 96813

Dear Ms. Mapes:

Re: Draft Enviromental Impact Statement for the Manele Golf Course and Residential Project, Manele, Lanai.

The Maui Planning Department has reviewed the draft Environmental Impact Statement for the proposed Manele Golf Course and Residential Project and has the following comments:

1. Chapter 1, Section 6.1.5 - Infrastructure and Public Services. The use of potable water is proposed for watering the project site to control dust and soil loss prior to planting areas under construction. Although this increase in water demand is only temporary, a non-potable source should be utilized.

2. Chapter 1, Section 6.2.2 - Natural Environment. Canavalia Pubescens will be monitored during construction to determine the extent of the population; and the population would be avoided when excavating for home sites. No mention is made of the existing population within the proposed golf course site as stated in Kenneth Nagata's "Biological Resources Study". His recommended mitigative measures should be implemented to protect this species.

3. Chapter 5, Section 9 - Lanai Project District 1 - Manele. This section states that the Project District should be amended to include golf course as a permitted use in the Open Space District. The proposed amended Project District ordinance lists the golf course as a separate use and not as a permitted use in the Open Space District.

4. Chapter 5, Section 11 - Shoreline Setback. The proposed 75-foot setback for the Manele area with the exception of a 50-foot setback along the cliff at the three (3) signature golf holes has not been established by the County of Maui. According to the new Shoreline Setback Rules and Regulations of the County of Maui, the current shoreline setback along the golf course boundary would be 150 feet. The applicant will need to apply for a Shoreline Setback Variance during the Special Management Area Use Permit and Project District Phase II approval process to establish the proposed 75-foot and 50-foot setbacks.

If you may have any questions regarding these concerns, please contact Mr. Philip Ohta of my staff.

Very truly yours,

CHRISTOPHER L. HART
Planning Director

cc: Mr. Thomas Leppert
Mr. Philip Ohta

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, Suite 200, Honolulu, Hawaii 96813
Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Saipan • France • Thailand

September 30, 1991
91P-441 (044.03)

Mr. Brian Miskae, Director
Planning Department
County of Maui
250 S. High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Miskae:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

We received Mr. Hart's December 28, 1990 letter commenting on the above project. Following are our responses to the comments.

1. If possible, a non-potable source of water will be used for watering the project site to control dust and soil loss during construction. However, given the phasing out of pineapple on the island of Lanai, Castle & Cooke will have sufficient potable water for such temporary uses. Other sources are brackish and surface water. Effluent will not be used for irrigation.

2. Chapter I is the introductory and summary chapter of the EIS. Chapter IV contains descriptions of the affected environment, environmental consequences and mitigation measures. Please refer to Chapter IV, Section 3.1 for more detailed discussion of Canavalia pubescens.

3. We agree that the proposed amended Project District ordinance lists the golf course as a separate use. Chapter V, Section 9 will be changed to reflect this.

4. Regarding setbacks at the project site, the applicant is cognizant of Maui County's Shoreline Setback Rules and Regulations. It will seek to obtain the necessary approvals to establish the proposed 75-foot and 50-foot setbacks for the golf course.

Thank you for your comments and participation in the EIS review process. Your letter and this response will be incorporated into the Final EIS.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke

RECEIVED
JAN 3 1991
BELT, COLLINS & ASSOCIATES

JOHN WAIHEE
GOVERNOR OF HAWAII

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
KEITH W. AHUE
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

December 27, 1990

Mr. Philip Ohta
County of Maui
Department of Planning
250 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Ohta:

SUBJECT: Historic Preservation Review of the Draft EIS for the Manele Golf and Golf Residential Project
Manele, Lanai
TMK 4-9-02:1

IX-10

Thank you for the opportunity to review this document.

We have reviewed the sections referring to historic preservation concerns: 4.1 - existing conditions, 4.2 - probable impacts, and 4.3 - mitigation measures.

4.1 Existing Conditions. This document refers to three archaeological surveys conducted in the proposed project area. However, only one report (Cultural Surveys Hawaii 1990) is included in Appendix C, Archaeological Resources Inventory and Mitigation Plan. Although our office has copies of the other two reports (Cultural Surveys Hawaii 1989 and Kaschko and Athens 1987), we recommend that these reports be also appended to the Final EIS or their archival location be noted, so other reviewers and the general public can have access to them. All three reports were previously reviewed by our office and have been determined adequate in presenting results of the surveys. The summary description of the different types of sites and features based on function appears to have been adequately discussed in 4.1.1. Figure IV-6 also clearly shows the location of all the sites in the project area.

4.2 Probable Impacts. Site significance assessments (4.2.1) are clearly presented in Table IV-5. We concur with these significance evaluations.

4.3 Mitigation Measures. For a detailed discussion of the mitigation measures, this subsection refers to the Data Recovery and Preservation Plan prepared by Cultural Surveys Hawaii. We have reviewed this plan, and we concurred with the recommended measures. These have been incorporated in Table IV-5.

In paragraph 2 of IV-41, we disagree with the number of sites that do not need further work. Instead of 38 sites, only one site, site 2, is no longer significant (Table IV-5). The rest of the 54 sites are recommended for either preservation and/or data recovery. We recommend that the second sentence in paragraph 2 be revised.

Specific sites that will undergo data recovery are listed in 4.3.2. This list is incorrect and is contradictory to the recommended mitigation treatments for a number of the sites as given in Table IV-5. The following sites/features should not undergo archaeological data recovery: 6, 7, 12C, 19C, 21, 22A, 22B, and 22C. These sites have been committed to preservation, so they should be deleted from this data recovery list.

If you have any questions, please contact Ms. Annie Griffin at 587-0013.

Sincerely,

DON HIBBARD, Director
Historic Preservation Program

cc. The Lanai Company
Belt Collins & Associates
Office of Environmental Quality Control

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, Suite 200, Honolulu, Hawaii 96813
Phone: (808) 521-5361, Fax: (808) 538-7819
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September 30, 1991
91P-442 (044.03)

Mr. Don Hibbard, Director
State Historic Preservation Division
Department of Land and Natural Resources
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

Dear Mr. Hibbard:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

We received your December 27, 1990 letter to Maui County Planner, Mr. Philip Ohta concerning the above project. Your comments are contained entirely in Mr. Paty's January 18, 1991 letter to Maui County Planning Director Brian Miskae. Attached is a copy of our response to Mr. Paty, which we hope addresses your concerns.

Thank you for your division's comments. Your letter and this response will be included in the Final EIS for the Manele project.

Sincerely,

Anne L. Mapes

Anne L. Mapes

ALM:lf

Attachment

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Forestry and Wildlife

RECEIVED
JAN 3 1991
BELT, COLLINS & ASSOCIATES

MEMORANDUM December 28, 1990

TO: ROGER C. EVANS, Administrator
Office of Conservation & Environmental Affairs

FROM: MICHAEL G. BUCK, Administrator Michael Buck

SUBJECT: Draft EIS for Manele Golf & Golf Residential Project Manele, Lanai
TMK: 4-9-02:01

The following comments are made concerning rare, native plants and coastal trails:

1) The rare native plant, Boerhavia herbsii, which grows within the poorly developed coastal strand vegetation community (Appendix A), has not been addressed per say in the draft EIS. Although its official taxonomic status and range is not precisely understood, it originally was found and described from specimens observed in the Manele-Kaluakoi area of Lanai. Efforts to preserve this species and the coastal strand community of which it is a part should be made. What are the probable impacts, protection and mitigation measures for this species?

2) The rare native species, Canavalia pubescens, (currently a Category 2 candidate species for listing as threatened or endangered by the U.S. Fish and Wildlife Service) occurs on the proposed project area. Protection of these plants in situ with compatible land use and buffer zones around the plant colonies should be a condition of the EIS.

3) It is stated in Chapter IV-17, "Portions of the site will be left intact where feasible, especially along the shoreline. Potential impacts to the vegetation of the site will be significant in that much of the existing vegetation will be lost." The draft EIS does not define which areas and what species will be preserved in situ. Both rare species, C. pubescens and B. herbsii, should be addressed for preservation in situ. Supplemental plantings are to be encouraged, in addition to, but not taking the place of, in situ management.

4) Figure IV-7 illustrates an alternative road route to the project site from the airport. A listed endangered plant species, Abutilon menziesii, occurs in the vicinity of the proposed road. The proposed route should widely avoid these plants and their habitat, due to the increased chance of dryland fires starting along the roadsides.

5) The Statewide Trail and Access System, Na Ala Hele, recommends that in addition to the public easement along the coast to the westernmost boundary of the project, a continuous, public pedestrian access be dedicated that would extend from Hulopoe Beach, along the coast to Manele Harbor, and through the park space to the easternmost boundary of the project. Additionally, mauka/makai accesses to the coastal trail should utilize historic pathways that may be found in the project area. Historic trails should be restored with supervision by the State's Historic Preservation Division.

cc: Historic Preservation Division

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, Suite 300, Honolulu, Hawaii 96813
Phone: (808) 521-5361 Fax: (808) 538-7819
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September 30, 1991
91P-443 (044.03)

Mr. Michael G. Buck, Administrator
Division of Forestry and Wildlife
Department of Land and Natural Resources
1151 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Buck:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

We received your December 28, 1990 memorandum to Mr. Roger Evans concerning the above project. Your comments are contained entirely in Mr. Paty's January 18, 1991 letter to Maui County Planning Director Brian Miskae. Attached is a copy of our response to Mr. Paty, which we hope addresses your concerns.

Thank you for your division's comments. Your memorandum and this response will be included in the Final EIS for the Manele project.

Sincerely,

Anne L. Mapes

ALM:lf

Attachment

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

RECEIVED
DEC 6 1990
BELT, COLLINS & ASSOCIATES

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

(P)1991.0

DEC 3 1990

County of Maui
Planning Department
200 South High Street
Wailuku, Maui, Hawaii

Attention: Mr. Philip Ohta

Gentlemen:

Subject: Manele Golf and Golf Residential Project
Draft EIS

Thank you for the opportunity to review the subject document. We have no comments to offer.

Should there be any questions, please contact Mr. Ralph Yukumoto of the Planning Branch at 548-7192.

Very truly yours,

T. Tominaga

TEUANE TOMINAGA
State Public Works Engineer

RY:jk
cc: The Lanai Company
Belt Collins and Associates
Office of Environmental Quality Control

September 30, 1991
91P-444 (044.03)

Mr. Teuane N. Tominaga
Public Works Division
Dept. of Accounting and General Services
State of Hawaii
Kalanimoku Building
1151 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Tominaga:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

Thank you for your December 3, 1990 letter on the above project. Although you had no comments, we appreciate you and your staff taking the time to review the document.

Sincerely,

Anne L. Mapes

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

RECEIVED
JAN 7 1991
BELT, COLLINS & ASSOCIATES

REPLY TO ATTENTION OF:
Planning Division

January 2, 1991

Mr. Philip Ohta, Planner
County of Maui, Planning Department
200 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Ohta:

We have reviewed the Draft Environmental Impact Statement (DEIS) for the Manele Golf Course and Golf Residential Project, Lanai, Hawaii. The following comments are offered:

a. Alterations of streams may require a Department of the Army permit from the Corps of Engineers. For information about permit requirements, please contact the Operations Division at 438-9258.

b. As indicated on page IV-11 of the DEIS, no Flood Insurance Rate Map has been published by the Federal Insurance Administration for Lanai Island.

Sincerely,

Kisuk Cheung
Director of Engineering

Copies Furnished:

The Lanai Company
650 Iwilei Road, 3rd Floor
Attn: Thomas C. Leppert
Honolulu, Hawaii 96817

Belt Collins & Associates
680 Ala Moana Boulevard, Suite 200
Attn: Anne L. Mapes
Honolulu, Hawaii 96814

Copy Furnished (Continued):

Office of Environmental Quality Control
State of Hawaii
465 South King Street, Room 104
Honolulu, Hawaii 96813

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

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Phone: (808) 523-5361, Fax: (808) 538-7819
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September 30, 1991
91P-445 (044.03)

Mr. Kisuk Cheung
Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Building 230
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

We received your January 2, 1991 letter to Maui County Planner, Mr. Philip Ohta concerning the above project.

a. The applicant is not aware of any perennial streams at the project site. However, the applicant will consult your Operations Division to ascertain whether a Corps of Engineers permit is required if any water diversion is contemplated in the future.

Thank you for your department's comments. Your letter and this response will be included in the Final EIS for the Manele project.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

RECEIVED
JAN 28 1991
BELT, COLLINS & ASSOCIATES

JOHN WAIHEE
GOVERNOR OF HAWAII

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

January 17, 1991

In reply, please refer to:
EPHSD

90-3-286

To: Director, Planning Department
County of Maui
Attention: Mr. Philip Ohta, Planner

From: Director of Health

Subject: Draft Environmental Impact Statement (DEIS)
Manele Golf Course and Golf Residential Project
Lanai, Hawaii - November 1990

Thank you for allowing us to review and comment on the subject DEIS. We provide the following comments.

Wastewater Disposal

A review of the subject DEIS focused on the wastewater collection, the reclamation treatment system and reuse or disposal. The following concerns need to be addressed:

1. The proposed wastewater design flow analysis on page IV-112 is difficult to follow and does not appear to be consistent with the Project Description on page I-4. Based on the Project Description the proposed wastewater design flow of 70,000 gallons per day (gpd) with the capacity to be expanded to 140,000 gpd stated on page IV-112 is inadequate. A table, enumerating the types of uses in the project description and subsequently the design flow, would be helpful.

2. Details of the assurances for the reuse and/or disposal of wastewater are not presented.

Water Pollution

A potential area of concern associated to the proposed project is compliance with applicable water quality standards. Potential sources for water quality standards noncompliance are:

1. Non-point source discharges from the golf course and residential area.

2. Excess irrigation of the golf course using treated wastewater.

3. Wastewater pump stations malfunctions resulting in overflows.

Compliance of the applicable water quality standards is of particular concern since part of the receiving waters in the vicinity of the project is within the Manele-Hulopoe Marine Life Conservation Area, a receiving water designated as Class AA.

Drinking Water

1. The DEIS states that new wells, transmission lines, pressure breaker tanks, and storage reservoirs will be required for the proposed project. Because each new well will serve 25 or more individuals at least 60 days per year or have a minimum of 15 service connections, the use of each well as a source of drinking water will require compliance with the Department's Administrative Rules, Title 11, Chapter 20, "Potable Water Systems."

2. Section 11-20-29 of Chapter 20 requires that all new sources of potable water serving a public water system be approved by the Director of Health prior to their use. Such an approval is based primarily upon the submission of a satisfactory engineering report which addresses the requirements set in Section 11-20-29.

3. Section 11-20-30 of Chapter 20 requires that new or substantially modified distribution systems for public water systems be approved by the Director. According to the DEIS, the water system will be operated and maintained by the Lanai Company.

4. It appears that the proposed development is situated below the Department's Underground Injection Control (UIC) line. Land areas located below the UIC line are generally considered not to contain underground sources of drinking water.

5. The DEIS does not specifically indicate whether or not drywells will be used for the disposal of surface water runoff. However, in the event that drywells are utilized, the developer should be reminded that these wells would be classified as injection wells and must comply with the Department's Administrative Rules, Title 11, Chapter 23, "Underground Injection Control." Chapter 23 requires UIC permits for the construction and operation of all injection wells.

6. The standard golf course conditions (attached) apply.

for JOHN C. LEWIN, M.D.

Attachment

cc: (w/ attachments)
The Lanai Company
Belt Collins & Associates

STATE OF HAWAII
DEPARTMENT OF HEALTH

April, 1990 (Version 3)

EIGHT (8) CONDITIONS APPLICABLE TO THIS NEW GOLF COURSE DEVELOPMENT

1. The owner/developer and all subsequent owners shall establish a groundwater monitoring plan and system which shall be presented to the State Department of Health for its approval. The groundwater monitoring plan and system shall minimally describe the following components:

   a. A monitoring system tailored to fit site conditions and circumstances. The system shall include, and not be limited to, the use of monitoring wells, lysimeters and vadose zone monitoring technologies. If monitoring wells are used, the monitoring wells shall generally extend 10 to 15 feet below the water table.

   b. A routine groundwater monitoring schedule of at least once every six (6) months and more frequently, as required by the State Department of Health, in the event that the monitoring data indicates a need for more frequent monitoring.

   c. A list of compounds which shall be tested for as agreed to by the State Department of Health. This list may include, but not be limited to the following: total dissolved solids; chlorides; PH; nitrogen; phosphorus; or any other compounds associated with fertilizers, biocides or effluent irrigation.

2. Baseline groundwater/vadose zone water data shall be established as described in this paragraph. Once the monitoring system and list of compounds to be monitored for have been determined and approved by the State Department of Health, the owner/developer shall contract with an independent third-party professional (approved by the State Department of Health) to establish the baseline groundwater/vadose zone water quality and report the findings to the State Department of Health. Testing of the analyses of the groundwater shall be done by a certified laboratory.

3. If the data from the monitoring system indicate the presence of the measured compound and/or the increased level of such compound, the State Department of Health can require the owner/developer or subsequent owner to take immediate mitigating action to stop the cause of the contamination. Subsequently, the developer/owner or subsequent owner shall mitigate any adverse effects caused by the contamination.

4. Owner/developer shall provide sewage disposal by means of connection to the public sewer system; or by means of a wastewater treatment works providing treatment to a secondary level with chlorination. Effluent from this wastewater treatment works may be used for golf course irrigation, subject to Condition #3. The entire system shall be approved by the State Department of Health in conformance with Administrative Rules Title 11, Chapter 62, Wastewater Treatment Systems, effective December 10, 1988.

5. If a wastewater treatment works with effluent reuse becomes the choice of wastewater disposal, then the owner/developer and all subsequent owners shall develop and adhere to a Wastewater Reuse Plan which shall address as a minimum, the following items:

   a. Management Responsibility. The managers of the irrigation system using reclaiming wastewater shall be aware of the possible hazards and shall evaluate their system for public health, safety, and efficiency. They must recognize that contact with the reclaimed wastewater from treated domestic sewage poses potential exposure to pathogenic organisms which commonly cause infections diseases (bacteria, viruses, protozoa, and halminths or worms).

   b. General Recommendations

      1) Irrigated areas should be no closer than 500 feet from potable water wells and reservoirs.

      2) Irrigated areas should be no closer than 200 feet from any private residence.

      3) Application rates should be controlled to minimize ponding. Excess irrigation tailwater in the reclaimed wastewater irrigation area shall be contained and properly disposed. An assessment should be made of the acceptable time and rate of application based on factors such as type of vegetation, soil, topography, climate and seasonal variations.

      4) Effluent holding/mixing ponds shall be designed to prevent the infiltration of the wastewater into the subsurface. The holding/mixing ponds shall be made impervious.

      5) Irrigation shall be scheduled such that the public is not in the vicinity and the soil is sufficiently dry to accept the irrigation water.

      6) Permanent fencing or barriers shall be erected around polishing or holding ponds to prevent public entry or stray feral and tame animals from gaining access to the ponds.

7) Adequate irrigation records shall be maintained. Records should include dates when the fields are irrigated, rate of application, total application and climatic conditions. Records should also include any operational problems, diversions to emergency storage or safe disposal and corrective or preventive action taken.

8) The holding/mixing ponds shall be periodically monitored for the purpose of detecting leakage into the subsurface. If leakage is detected, corrective action shall be immediately taken.

c. Adequate Notice. Appropriate means of notification shall be provided to inform the employees and public that reclaimed wastewater is being used for irrigation on the site.

1) Posting of conspicuous signs with sufficient letter size for clear visibility with proper wording should be distributed around the use areas.

2) Signs shall be securely fastened. Periodic surveillance shall be conducted to assure permanent posting at all times. Immediate replacements shall be made when necessitated by deterioration, vandalism or misuse.

d. Adequate Employee Education. Employees or users should be cautioned and warned of the potential health hazards associated with the ingestion of reclaimed wastewater being used at the site.

1) Employees should be warned that the ingestion of reclaimed wastewater is unsafe.

2) Employees should be protected from direct contact of the reclaimed wastewater. If necessary, protective clothing should be provided.

3) Employees should be informed of the following:

- The irrigation water is unsafe for drinking or washing.
- Avoid contact of the water or soil with any open cuts or wounds.
- Avoid touching the mouth, nose, ear or eyes with soiled hands, clothes or any other contaminated objects.
- Be aware that inanimate objects such as clothes or tools can transport pathogenic organisms.
- Always wear shoes or boots to protect feet from the pathogenic organisms in the soil or irrigation water.

6. Releases from underground storage tanks (USTs) used to store petroleum products for fueling golf carts, maintenance vehicles, and emergency power generators pose potential risks to groundwater.

Should the owner/developer/operator plan to install USTs that contain petroleum or other regulated substances, the owner/developer/operator must comply with the federal UST technical and financial responsibility requirements set forth in Title 40 of the Code of Federal Regulations Part 280. These federal rules require, among other things, owners and operators of USTs to meet specific requirements in the detection, release response and corrective action. Also, the owner/developer/operator must comply with all State UST rules and regulations pursuant to Chapter 342-L 'Underground Storage Tanks' of the Hawaii Revised Statutes.

In consideration of the above-mentioned remarks, the Department of Health recommends that the owner/developer/operator implement facility plan alternatives that exclude the installation and operation of UST systems (e.g., the preferential use of electric golf carts, use of above-ground storage of fuel oil for emergency power generators, etc.), or, if USTs are utilized, that secondary containment be considered.

7. Buildings designated to house the fertilizer and biocides shall be bermed to a height sufficient to contain a catastrophic leak of all fluid containers. It is also recommended that the floor of this room be made waterproof so that all leaks can be contained within the structure for cleanup.

8. A golf course maintenance plan and program will be established based on "Best Management Practices (BMP)" in regards to utilization of fertilizers and biocides as well as the irrigation schedule. BMP's will be revised as an ongoing measure. The golf course maintenance plan will be reviewed by the State Department of Health prior to implementation.

If there are any questions regarding the eight (8) conditions mentioned here, please contact Mr. James K. Ikeda at 543-8304. We ask you cooperation in the protection of Hawaii's valuable groundwater resource.

BELT COLLINS
& ASSOCIATES
Engineering • Planning
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September 30, 1991
91P-454 (044.03)

Dr. John C. Lewin, Director
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Dr. Lewin:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

We received your January 17, 1991 letter to Maui County Planner, Mr. Philip Ohta concerning the above project. Following are our responses to your comments.

Wastewater Disposal

1. As stated on both pages I-4 and IV-112 of the Draft EIS, 425 resort-residential units are planned for Manele, with an estimated rate of development of fewer than 50 units/year.

   Also as stated in the Draft EIS, an incremental 50 units a year would require 22,500 gpd capacity for maximum daily flow. The plant, designed to process 70,000 gpd, would accommodate more than 3 years of residential development. The expanded 140,000 gpd plant would accommodate over 6 years of residential development. The applicant will build further wastewater facilities as needed.

2. Current plans do not include the use of treated effluent on the golf course. However, use of effluent mixed with brackish water for golf irrigation might be considered if deemed acceptable by the State Department of Health. If the effluent is not used to irrigate the golf course, it will be disposed of through standard methods approved by the Department of Health.

Water Pollution

The applicant intends to comply with applicable water quality standards. As stated in Chapter IV, section 3.2.4.3, the marine resource consultant has an agreement with Lanai Company to perform long-term monitoring in offshore waters as mitigation, during both construction and operations.

Drinking Water

The applicant intends to comply with all 6 points in this section of your letter.

Thank you for your comments and participation in the EIS review process. Your letter and this response will be incorporated into the Final EIS.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke Properties
Mr. Philip Ohta, Maui County Planning Department

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JAN 18 1991
BELT, COLLINS & ASSOCIATES

January 17, 1991

Anne Mapes
Vice-President
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Re: Manele Golf Course and Golf Course Residential Project

Dear Ms. Mapes:

Thank you for your inquiry about our comments to the Draft Environmental Impact Statement for the above-referenced project. I appreciate your willingness to consider our comments beyond the January 7, 1991 deadline. For brevity, I have outlined the concerns of my client below. These comments supplement the earlier submission by Martha Evans.

I. Impact of New Worker In-Migrants

The impact of construction workers was a major problem during the construction of the Manele Bay Hotel (page IV-85). However, the discussion of off-island worker in-migration is inadequately addressed (page IV-54). While the DEIS mentions the recent experience with the 500-plus construction workers on an island of 2,000 residents (page IV-47), there is little or no discussion about the very serious social impacts that construction worker populations can have on a small, rural community like Lanai. It is not enough to calculate the number of workers without discussing what those numbers mean to the quality of life and community cohesion on the island. Similarly, even after the construction workforce departs, a significant in-migration will occur with the resort-related job creation.

A. How will this major influx of new workers and residents affect the lifestyle, economic balance and cohesion of the Lanai community?

B. What do the numbers on pages IV-52 and IV-53 mean for the island?

C. Where will workers come from?

D. Will they be English-speaking or from some other culture like those imported from California who could not speak English?

E. What cultural conflicts occurred with the importation of those Spanish-speaking workers? How will these impacts be mitigated?

II. Upward Mobility for Local Residents

One of the major concerns of my clients is the lack of upward professional mobility for local residents. It is insufficient to simply discuss only the numbers of jobs which would be available to Lanai residents. Lanai Company should be instituting such a program for upward social mobility within its own ranks. That model may serve as an example for Rock Resorts and other concessionaires who may become involved with the proposed project. I commend you for recognizing the serious concerns expressed by existing unionized hotel workers statewide that not enough Hawaii residents are promoted to high managerial positions and that current supervisors from outside Hawaii don't understand employee needs (page IV-58). However, mitigation measures that only address literacy programs are not the kinds of skill training that would enhance such opportunities. To be sure, these programs and those efforts being made by the state and county as explained on page IV-59 are needed. However, the commitment to enhance upward mobility is not specific as to how Lanai residents can benefit or what mechanism will assure that this policy (page IV-84) is actually implemented.

A. What is the current ratio of locals to non-locals at Koele Lodge?

(1) Were specific promises made to retain a certain percentage of local managers prior to the opening of the Koele Lodge?

(2) Were the commitments in those promises, if made, fulfilled?

B. What lessons have been learned from recent managerial experiences at Koele Lodge?

(1) Can any of these experiences relate to potential problems which might be encountered at Manele?

(2) What has been the length of retention of jobs held by local residents at the Koele Lodge?

III. Labor Force Transition

My clients are concerned about the statements made about the ability of the local population to switch between pineapple work and golf course maintenance work (page IV-56). That conclusion was apparently based on an assessment contained in an interview with a Lanai Company manager.

A. How can a conclusion about the interests of workers in certain benefits and wages from golf course jobs be attributable to workers based on an interview with a management person?

B. The "high satisfaction" score (reference to Matsuoka and Shera study) was for all industry workers (primarily Dole), not for hotel work (page IV-57).

C. What will happen to all those who would have to seek alternative employment because they would not be able to fit into the resort economy? What social and mental health problems will this apparent unemployment cause (page IV-57)?

D. How will Hawaiiana classes every two months truly mitigate against the social disruption and potential inter-cultural problems that can be generated by the influx of new visitors and residents to the resort economy of Lanai? Who will conduct these training sessions? Will a community group like LSG be afforded the opportunity to participate in and design these workshops (IV-60)?

IV. Resident Population and Housing Impacts

Assuming the validity of the study's projections, Lanai's population will nearly double in five years (page IV-65). Of this increase (2,071), the DEIS attributes only half of that to be generated by the resort (1,172) (page IV-67). It seems unlikely that slightly less than half the projected population impact would be attributable to non-resort-related causes of population growth. With the decline of pineapple, one would envision a possible stagnation if not reduction in population without the resort projects.

A. How were the without project figures derived? Were these figures based on the assumption that the Koele project was excluded from the impacts of the "project."

B. What were the assumptions of the 1987 CRI study of newcomers in the Kohala luxury resort workforce (page IV-63)?

C. Why have the population figures decreased between 2001 and 2006?

D. What mitigation measures regarding housing would the company propose in recognition of your statement that under the ultimate impact scenario, demand for housing would exceed the available supply? Are these mitigation measures sufficient to overcome this gap in housing? Your discussion on mitigation matters is unclear on this point (page IV-67).

V. Recreational Impacts

The interviews conducted for this section of the DEIS appear to be heavily skewed toward resort personnel, constituting five out of the 13 informants. In addition, the two firemen apparently are not from the island of Lanai. More important, the list of informants seems to exclude regular resident fishermen and hunters who heavily use the island's resources for recreation.

A. On what basis do you make the conclusion that the majority of visitors and new residents will not be increasing the user populations for hunting and shoreline fishing (page IV-71)?

B. To the extent that spear fishing and scuba diving would impact on the lobster and food fish species in the nearshore waters on the western end of the project site, how will these impacts environmentally affect other populations of species upon which local residents are dependent (page IV-72)?

C. What imposition of regulations restricting consumptive activities will be enforced and by whom, if this form of mitigation is implemented (page IV-72)? Who will enforce them? How effective would such regulations be in light of current government resources on Lanai?

D. Isn't it reasonable to assume that the Manele Bay Hotel will probably generate more than twice as many people on the beach at Hulapoe as does the Koele Lodge, given its proximity to this fabulous recreational resource (page IV-73)? Won't the significant increase in beach population drive local residents away from this normally isolated beach facility? Won't these increases lead to the kinds of concerns that led to the closing of Hanauma Bay on Oahu? Will there be restrictions on hotel guest use of Hulapoe if competition for beach resources require limitation on usage?

E. Does the lack of mitigation measures suggested for the increased use of Hulapoe beach mean that the crowding of the beach is unavoidable? How will this failure to mitigate the crowding of Hulapoe beach affect the polarization that some critics predict will be worsened by the competition for recreational resources as important as Hulapoe Bay? What social services will be financed by the company to mitigate against these impacts? Have the social service costs of this impact been quantified and included in your project costs? Do you recognize the unique value of Hulapoe to current Lanai residents and lack of suitable alternatives?

F. Have you determined what decreases in recreational time will be available to the newly employed local residents of Lanai, given the need to increase income with higher costs of living and mortgage payments for new housing? How will social service agencies deal with any decreases in recreational time available to these residents? What impact will there be on mental health, the quality of life and the cultural cohesion of the island?

VI. Socio-Cultural Impacts

While judgments in this area may be subjective, there is a body of credible social science theory and data which suggests that severe impacts will occur on Lanai because of the sudden transition between agriculture and the contemplated resort economy. Your DEIS does not document the past instances of impacts caused by sudden increases in population and development in small, rural communities in Hawaii. The social structure

section does not adequately discuss the special social environment of Lanai, although the discussion is an important beginning. Does your dismissal of the "boomtown" studies done suggest that there are no such studies or empirical data which apply to Lanai?

A. How severe will the increased competition for the use of Hulapoe beach be, especially for currently revered traditional uses of this area, e.g., overnight camping, community gatherings?

B. Why were only the Dole supervisors and managers mentioned in the discussion of allocation of wealth and power, to the exclusion of Lanai Company and Rock Resorts personnel (page IV-81)?

C. On page IV-82, you state that substantial shifts in Lanai's social structure will occur with or without the project, mentioning the 325 resort residential units at Koele. Is this reference designed to exclude Koele from the impact analysis of "the project"? Throughout this document, it is unclear whether the impacts being assessed are being made attributable to only the Manele project as opposed to the impacts from the Koele project. Your statement should clearly set forth the extent of the impacts being assessed and break out the specific impacts from each project district. Would the impacts from the 325 Koele units be different in nature and scope than the impacts and issues raised by the 425 luxury units at Manele?

D. How will the Koele project have a greater psychological impact than that of the more distant, self-contained Manele area (page IV-83), when the physical separation alone contributes to the perceived polarization of the Lanai community?

E. Your DEIS makes continued reference to expansions to the Manele area. What are the future expansions projected for the Manele Project District (page IV-84)? These plans, if any, should be identified clearly to make the analyses of impacts comprehensive.

F. What is the objective basis for your subjective statement that "project impacts on social structure will probably be fairly small in light of the cumulative impacts expected with or without the Manele golf course and expanded Project District" (page IV-85)? This statement leaves one of the essential issues about social impact concerns unaddressed and inadequately documented. If actual data is not available to confirm this speculation, how can the statement be made at all? How can the impact of increased crack use and domestic violence cases be ignored? Haven't new conflicts and violence on Lanai pointed to a different conclusion as you reported from interviews with your social agency informants (page IV-85)?

G. The conclusions on the future levels of "Lanai's current high stress" (page IV-86) are puzzling, in light of the lack of any objective data or analysis. The discussion in this section appears to merely speculate about the potential direction of stress levels, without any true analysis of how in fact the pressures of growth and change would alter

or exacerbate stress levels. What other more "more complex conclusions" reached by later studies of growth impacts (page IV-88)? Is the test of severity of impacts based on the degree of interference with "life-functioning"? That appears to be a rather severe test for assessing residents' dissatisfaction and community decline. I found it curious that community efforts to forestall the negative impacts of growth by community groups is now viewed as "empowerment" that is beneficial for Lanai. Many of these activities have placed increased stress on the organizers of such groups like LSG. Perhaps you should interview these individuals to determine their level of stress during recent LUC proceedings and relations with the company.

H. What is the "alternative Manele residential development plan" (page IV-89)?

I. Your section on other socio-cultural impacts is peppered with references to personal communications with Castle & Cooke Properties' president Thomas Leppert. Perhaps a more balanced approach would be to include communications with members of LSG, Decisions Lanai, the Lanai Advisory Committee and other community groups so the scope and extent of concerns can be broadened to more fairly represent the scope of the community's concern. Many points of criticism were omitted from the list contained on page IV-90. This characterization of the current socio-cultural conflicts between the company and the community appear to be understated. More input should be obtained from a broader cross-section of the Lanai community.

J. A short bi-monthly orientation workshop for near resort residents will not supplant a lifetime of development of the attitudes of upscale resort residents. True integration with the community will not occur without greater sensitivity and interaction between new and old residents. What objective results have been experienced with such programs elsewhere? How will you measure the effectiveness of such programs?

K. The company should reveal its offer to the state of the number of acres and the location for the proposed agricultural park so readers of the DEIS can better understand the extent to which the company is willing to diversify the political-economic system on the island. LSG notes that the company's experiment with organic farming and "plans for diversified agriculture would be largely linked to tourism success on Lanai" (page IV-93). The concept of diversification is to create economic opportunities independent of tourism, or at least not directly linked to it. Perhaps this suggestion reveals the difference in understanding between the company and LSG about who should determine the direction and nature of growth in diversified agriculture. Further diversification could occur if Castle & Cooke spunoff property management of its commercial space to independent owners. Will the company consider releasing land and resources of this type to enhance economic and political diversification of the island?

VII. Relationship to Land Use Plans and Cultural Cohesion (Page VI-3)

In short, I commend your attempt to cover the scope of social impact concerns raised by encounters with community representatives. However, your analysis of the negative impacts of the project is unbalanced and does not focus on some of the core concerns raised by community leaders about the loss of community and cultural cohesion. For example, many of the applicable objectives and policies you cited, even the human services plan, are discussed exclusively in a positive light. There is no weighing of the negative aspects of the project, many of which are mentioned in earlier parts of your DEIS (pp. V-1 through VI-2). Thus, the crowding of Hulapoe Beach is ignored in your discussion of the special management area (p. V-12). While other examples exist, my clients intend to reserve their comments about the lack of this objective analysis for the meetings contemplated by our 1990 agreement with your client.

VIII. Cost Considerations

Under your average cost approach (page IV-67), your costs are estimates on a per capita basis, which are assertedly overestimates. Does this approach fairly account for major cost items being borne by the state and county, like the $50 million Lanai airport improvements, the airport-Manele highway realignment being proposed by our client's highway consultant, etc.? How have you accounted for the repayment of mortgage loans in listing the $50 million listed for company contributions to the Lanai Community (page V-24)? How was the donated land value estimated? What portion of the Hulapoe improvements will benefit hotel and resort residential guests of Manele? How would all of these adjustments affect your analysis?

I hope these comments will assist you in performing the difficult tasks ahead. I offer them in anticipation of the serious discussions contemplated in our mutual commitment to open dialogue between the principal parties. Thank you for this opportunity to express our additional concerns.

Sincerely,

Alan T. Murakami
Attorney for Lanaians for Sensible Growth

ATM:klg/d:\gfm\mapes
cc: Tom Leppert
James E. Pierce
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September 30, 1991
91P-453 (044.03)

Alan T. Murakami, Esq.
Attorney for Lanaians for Sensible Growth
Native Hawaiian Legal Corporation
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Honolulu, Hawaii 96813

Dear Mr. Murakami:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Course Residential Project

Thank you for your extensive comments of January 17, 1991 regarding the Draft Environmental Impact Statement (Draft EIS) for the Manele Golf Course and Golf Course Residential Project. Responses below are organized according to the same outline and general headings as your comments. As in the case of the Draft EIS section on SocioEconomic and Socio-Cultural Factors (Chapter IV, Section 5), these responses were prepared based largely on input from Community Resources, Inc.

I. Impact of New Worker In-Migrants

In your introductory comments to this section, you referred to the potential social impacts of construction workers, noting Draft EIS references to the recent impacts of hotel construction workers. The Draft EIS discussion of Socio-Cultural Impacts (Section 5.7) essentially focused on the cumulative impacts of all types of "newcomers" to Lanai -- whether visitors, resort residents, in-migrant operational workers, or construction workers. However, in response to your concerns about specific impacts of construction workers, some discussion on this topic will be inserted in the Final EIS at the end of Section 5.7.4.3.

Indirectly, the project will eventually provide market support for expansion of both hotels, resulting in additional periods when off-island construction workers stay on Lanai during the week. As previously noted, the initial importation of up to 500 construction workers has resulted in significant actual or perceived community stress. Future hotel expansion and residential housing work is expected to require fewer construction workers (a projected maximum of about 360 in 1996 -- see Section 5.3.1.3), and Lanai at that time will have become a less isolated community. Nevertheless, there is the potential for recurrence of some social problems, depending largely on (1) whether many construction workers are again lodged in Lanai City, and/or (2) where and how they spend their off-work time on Lanai.

A. Effects of the "major influx of new workers and residents [on] the lifestyle, economic balance and cohesion of the Lanai community" were addressed in Draft EIS Section 5.7, which was organized around such topics as crime, stress, newcomer interactions with longtime residents, income distribution and levels, etc.

B. The meaning of employment figures on pages IV-52 and IV-53 can be considered in terms of population and housing impacts (Draft Section 5.4), public costs and revenues (Section 5.5), recreation (Section 5.6), and other socio-cultural impacts (Section 5.7). In general, Tables IV-7 and IV-8 show that the island would have a larger labor force with the project than without for the years from 1991 to 2006.

C. "Labor Supply and Sources" was discussed at some length in Section 5.3.2.4. However, from the vantage point of the present, there cannot be complete certainty on the ultimate source of labor, particularly for hotel expansions in the late 1990's. Our socio-economic consultants have suggested that this be mentioned among the "Unresolved Issues" in the Final EIS at the end of Section VI-3, "Unresolved Issues".

(3) Additionally, most of the indirect or long-term social impacts of resort development can almost always be considered "unresolved issues." This is because exact outcomes can never be predicted and/or because programs to deal with social issues are best devised closer to the actual time of the impact. For example, the project is expected to provide market support for Lanai hotel expansions later in the 1990's, and many of the associated social concerns (construction worker housing, operational labor sources, and permanent housing for in-migrant hotel workers) will have to be resolved at that time. Also, the extent to which population growth proves socially beneficial vs. detrimental to current residents will ultimately depend on the outcome of current discussions between the community and Dole Company about topics such as increased political and economic diversification on the island (e.g., more opportunities or leasehold security for independent Lanai business people).

Similarly, there is potential social conflict over increased visitor use of Hulopoe Beach. However, actual impacts depend on park management decisions yet to be made.

Dole Company's policy for hiring on Lanai is to give priority first to Lanai residents, second to returning Lanaians, third to other Hawaii residents, and last to all others. As of April 2, 1991, 78% of the positions at the Manele Bay Hotel were filled by Lanai residents.

D. The relatively few in-migrant hotel workers on Lanai to date have been English-speaking. It is possible that some migrant pineapple workers during the Dole phase-down may be Mexican or (as appears more probable at present) Filipino migrants already working as ILWU members on the West Coast.

E. Based on discussion with Dole Company personnel officers, problems with Spanish-speaking migrant agricultural workers in the past were less "cultural" than they were a function of limited non-work recreational activities and a tendency by

some individuals for excessive alcohol consumption. This could be mitigated by Dole Company's plans for the Activities Coordinator to develop programs for all segments of Lanai's population. The following will be inserted in the EIS at the end of Section 5.7.5.3:

(6) Dole Company's new Activities Coordinator (Section 5.7.6.1) should be given responsibilities for providing effective recreational activities for temporary workers whose past presence on Lanai has sometimes been associated with real or perceived social problems -- e.g., construction workers or migrant farm workers hired to replace Dole employees transferring to resort jobs.

The Activities Coordinator presumably will also be involved in assuring adequate structured youth programs for older children of service workers.

II. Upward Mobility for Local Residents

In your introductory comments, you suggested that the Lanai Company should institute a program for "upward social mobility within its own ranks." We have forwarded this recommendation to senior Castle & Cooke officials, who indicated general agreement with the concept even as they noted that there are relatively few on-island managerial positions at the Lanai Co. Perhaps this topic could be incorporated into ongoing talks between the company and Lanaians for Sensible Growth (LSG). In terms of RockResorts, the company already provides a number of in-service upgrade training programs, including both general educational programs and also occupation-specific training so that line workers can obtain needed skills to become supervisors or managers within a given department. It deliberately brought in many start-up managers on short-term contracts so that local residents could be fairly assured of rapid promotion, which has occurred in many cases. Some examples of Lanai residents who have been promoted in the past few months include Victor Macabio, Chief Engineer; Cora Garcia, Assistant Manager; Helen Tabura, Dining Room Captain; and Evelyn Allas, Gift Shop Supervisor.

A. In regard to "the current ratio of locals to non-locals at Koele Lodge," please see Draft EIS page IV-49: "The company now employs 212 workers on Lanai, around 70% of whom are estimated by RockResorts management to be longterm Lanai residents." According to RockResorts officials, the percentage in late January 1991 had increased to about 75%.

Representatives of both Castle & Cooke and of RockResorts can recall no specific promises to "retain a certain percentage of local managers prior to the opening of the Koele Lodge." However, as previously indicated, the company has consistently and successfully worked toward increasing representation of Lanai residents at all levels.

B. We are uncertain if you are referring to any particular "recent managerial experiences at Koele Lodge." RockResorts officials to whom this question was

referred said they felt they have learned many things, but perhaps one critical thing was that Lanai residents have not been as interested in tipping-related jobs as they expected -- perhaps due to lack of experience with compensation at such jobs and/or to low initial occupancies.

At Koele, Lanai Resort Partners subsidized most tipping positions for a number of months after opening by continuing to pay the original training wage. There is no present policy on whether this will occur at Manele, since the level of initial business remains to be seen. It should be noted that some tipping positions at Manele (all the food and beverage positions) have been filled.

In regard to turnover and retention of Lanai residents, please note the previous comment about the percentage of Lanai residents increasing in recent months. According to the Lodge's general manager, turnover among Lanai residents has been more rapid than among in-migrants for tipping positions, equally or less rapid than for in-migrants among non-tipping positions. However, even among residents in tipping positions, turnover has been lower than it usually is for typical hotel situations.

III. Labor Force Transition

In your introductory comments, you state that the conclusion about "ability of the local population to switch between pineapple and golf course maintenance work (page IV-56)" was "apparently based on an assessment contained in an interview with a Lanai Company manager."

The passage to which you refer actually focused on similarities in the nature of the two types of jobs, an historical Hawaii example of plantation workers taking golf course jobs, and data on recent Dole worker applications for golf course job openings. The comment by the Lanai Company manager was incidental to these main points.

A. The Lanai Company manager cited in this passage works closely with golf course employees and is involved in personnel selection and interviews. Please also note that the comment was actually a caution that the most recent figures on golf course job applications may have somewhat overstated the actual extent of worker interest, although previous job application numbers still indicated substantial interest.

B. You are correct that the reference on page IV-57 to high worker satisfaction figures on recent surveys would apply to workers in all industries. The intent was to provide a comparison; the Final EIS will clarify this.

C. The Draft EIS projects more widespread overall unemployment without the Project District 1-Manele Amendment than with it. Your concern about individuals who might not be able to fit into a resort economy is well taken, and is the basis for various programs now being undertaken (by both government and the private sector) to provide workers with the skills to make this transition. Some

of these programs were discussed in the Draft EIS in Section 5.3.2.7; this section has been substantially updated in the Final EIS to describe the March 1991 Dole pineapple worker retraining effort designed by Maui Community College, Hawaii Human Development, the State Employment Service, and others. Please see this section of the Final EIS for a discussion of some apparent successes in dealing with concerns about residents fitting into the economy, as well as remaining needs and questions related to this topic.

D. Please note that the Po`okela Program was discussed on page IV-60 as a mitigation measure related to employment impacts and labor force transitions; mitigations related to your concerns about "the influx of new visitors and residents" were discussed in Section 5.7.6 of the Draft EIS.

However, please also note that the Po`okela Program extends far beyond "Hawaiiana classes." Hawaiian values and history are used as a mechanism for encouraging worker-manager communication on an equal level to develop a common sense of goals and operating philosophy.

The program was pioneered with great success at Maui's Kaanapali Beach Hotel and is now being implemented by many other Hawaii resorts. Training sessions are generally conducted by Waiaha Foundation staff such as Dr. George Kanahele and Barbara Mills. All community members are free to participate in these workshops. LSG's interest in helping to design future classes could be a topic in its ongoing discussions with Dole Company.

IV. Resident Population and Housing Impacts

In your introductory paragraph, you state that the Draft EIS "attributes only half of [projected Lanai population growth] to be generated by the resort." This is a misreading of the DEIS. First, it should be clarified that the figures you cited (2,071 and 1,172) were estimated total de facto population numbers, not numbers of full-time residents.

Second, the numbers include theoretical delayed effects of family formation and natural population increase among in-migrants. The expected immediate population impacts for 1996 were given as 1,707 and 884 (theoretically increasing in later years to the 2,071 and 1,172 numbers you cited); thus, your comment that the study projects "Lanai's population will nearly double in five years" is an inadvertent overstatement.

Third, and most importantly, the 1996 project impact figures (884 immediate de facto population; 1,172 ultimate) were defined as the increment caused by the Manele Golf Course and Golf Residential Project alone -- not effects of all resort development. (However, the DEIS does also provide effects of all resort development, including the Manele Expansion area. These are given by the other number you cited: 2,071 ultimately, although just 1,707 of that is projected actually to have occurred by 1996 itself.)

A. The "without project" future was defined on DEIS pages IV-44 and IV-45. It includes the Koele and Manele hotels which are already open or under construction (but with lower occupancies and no future expansions of these hotels) as well as construction of the Koele golf course and residential units. Manele residential development would take place under Castle & Cooke's old development scenario, reflecting constraints of the existing Lanai Project District 1 for the Manele area.

We are uncertain if your letter implies an expectation that the "without project" future would consist of a baseline scenario that assumes no pineapple and no tourism, even the resort activity already in place. To our knowledge, no EIS has ever used a theoretical "without project" future which assumes that current reality had not taken place.

The EIS is required by law to discuss the impacts of the particular project for which permits are being requested -- i.e., the Manele Golf Course and Golf Residential Project. The EIS is also to include an analysis of the cumulative effects of development (including both already-approved development and the proposed expansion), compared to existing conditions. These three sets of circumstances -- existing conditions, expected future without project, and expected (cumulative) future with project -- provide the basis of a sound socio-economic impact assessment. For these reasons, the DEIS did not attempt to describe a hypothetical present or future in which no resort development had ever been approved or taken place. (However, we would agree with your own assessment that "With the decline of pineapple, one would envision a possible stagnation if not reduction in population without the resort projects.")

B. As currently worded ("What were the assumptions of the 1987 CRI study of newcomers in the Kohala luxury resort workforce (page IV-63)?"), this question is unclear to us. However, the passage to which you refer mentioned DEIS assumptions based on the 1987 CRI study. Therefore, we interpret your question as being: "What were the DEIS assumptions as based on the 1987 CRI study?" These assumptions were set forth in footnote (3) of Table J-8 (which was referenced in preceding text on page IV-63): 1.46 persons per in-migrant resort worker; household size of 4.1 persons/household.

C. The very slight decline in projected population from 2001 to 2006 reflects underlying assumptions of continued gradual decline in average household size, as has been the case in Hawaii and nationwide for many years. These assumptions were applied to resort resident households, which are expected to decline slightly in population in years following the initial build-out and occupancy.

D. You are correct that the very long-term additional housing needs which may arise "if new workers on Lanai are encouraged to settle down and have families" (DEIS page IV-66) remains a somewhat uncertain issue. The Mitigations discussion on page IV-67 does note that eventual solutions could result from what to date have been very preliminary talks between Dole Company and the State of Hawaii

about additional corporate land contributions for more affordable housing. (Dole Company recently offered both the State and the County their choice of several parcels of land below the community recreation center, on the outskirts of town; the company is now waiting for a reply.) However, we feel it is probably appropriate to include some mention of additional possible long-term housing need in the Final EIS's "Summary of Unresolved Issues." Thank you for bringing this to our attention. (See insert as proposed in I.C above)

V. Recreational Impacts

In your opening comments, you express concern that the list of recreational informants was skewed toward resort personnel; that two firemen were not from Lanai; and that the list excluded resident fishermen and hunters. First, please understand that our recreational consultant, John R.K. Clark, is generally considered an expert in his area and was supplementing existing knowledge by contacting some informants, not basing his assessment solely on these interviews. The interviews with the three people identified as Lodge employees were for the purpose of obtaining objective information about recreational activities, not personal opinions. Regarding the firemen, one commutes from Molokai and the other lives on Lanai; both are employed on Lanai and are responsible for emergencies and ocean rescues in the project area.

Finally, Mr. Clark believes that information on hunting and fishing provided by his informants (particularly Ron McOmber of Lanaians for Sensible Growth and Derwin Kwon, one of Lanai's Fish and Wildlife agents) was factual and trustworthy. However, in response to your concerns, the Final EIS will reflect input from some additional Lanai hunters and fishermen.

A. The basis for the conclusion that the majority of visitors and new residents would not be increasing hunting and shoreline fishing populations was given in DEIS Section 5.6.1.2. Visitors and new residents in other island communities do not ordinarily participate in these types of local activities.

B. The following response was provided by Dr. Richard Brock, who prepared the quantitative assessment of the marine communities in the offshore area fronting the project site. This report is included in the EIS as Appendix B.

A basic premise in the ecological literature is that any change in the abundance of predators will result in changes in the abundance of prey. The dogma states that removal of predators will frequently allow the populations of prey species to increase. The reverse (i.e., an increase in the abundance of predators can decrease prey populations. Thus, in a theoretical sense, any removal of fish from a population will have an impact on the remaining fish (all fish east some other species). Whether this impact is discernible is arguable. Usually impacts have to be large to result in a quantifiable change that can be seen; this is due to the fact that the methods of measurement are not precise and we are dealing with biological systems that have inherent high variability, making data analysis difficult.

To unequivocably answer your question would be impossible -- if the growth of tourism in Lahaina continues, there will be greater use of the reef resources around Lanai by charters, etc. The question of growth and impact to Lanai reef resources should not be restricted to just growth on Lanai. People from other islands are making increasing use of the resources around Lanai as well as the other islands. We cannot quantify the impact without having much more information.

We believe that your question focuses on change -- what changes could be expected in the reef resources around Lanai with greater use? The answer is that these resources have probably undergone some of the greatest changes imaginable before any of us were born and that the changes that we may witness in the next 50 to 100 years will be small in comparison to those already experienced in fish communities around the high Hawaiian Islands.

In an unfished population, fishing usually begins with the catching of the oldest and largest individuals in a population. In many coral reef fisheries, the primary target species are the larger predaceous fishes such as the jacks or uluas (Family Carangidae). These large predators feed on a wide range of other coral reef fishes and invertebrates. In coral reef fisheries to the south and west of Hawaii, other large predators that are targeted besides uluas include the groupers and snappers -- families of fishes that had few shallow water representative species in the Hawaiian Islands.

There are few areas in the high Hawaiian Islands where humans have not had an impact on resident coral reef fishes. This became particularly evident when the multi-agency (State, NMFS, University) sponsored studies were carried out in the Northwest Hawaiian Islands (NWHI) in the late 1970's - early 1980's. As you probably know, the fish communities in the NWHI are for the most part considered to be undisturbed. Researchers found that the inshore fish communities were dominated by large uluas in the NWHI. These fishes appear to be the top predators in these relatively undisturbed Hawaiian coral reef fish communities. If this is indeed the case, it would suggest that these same species of jacks may have been the top predators around the high Hawaiian Islands prior to the advent of human impact. Today the dominant top predator in many inshore fish communities around the high islands are moray eels. Moray eels are a favored prey species of large jacks (and groupers as well) and many eels and jack species feed on many of the same prey species. Interestingly, researchers in the NWHI found that moray eels were a very rare component in the fish communities there.

The point we wish to make is that fish communities resident to our reefs around the high Hawaiian Islands have been heavily impacted by fishing for a considerable period of time and more recently in specific localities by other perturbations as well (i.e., runoff, sewage, infilling of shallows, etc.). The net result of all these changes is manifested in the species composition and abundance of fishes that we see in these communities. Today the coral reef fish communities

around the high islands appear to be very much different than those in the NWHI and the absence of large uluas may be one of the most striking differences. If this is correct, these large changes probably occurred long ago, but change in these communities is continuing today because of the dynamic nature of the system.

C. In regard to regulations restricting consumptive activities, fishing regulations are written and enforced by the State Department of Land and Natural Resources, Division of Fish and Wildlife. The problem of enforcement of regulations is a longstanding problem in Hawaii, a result of a lack of enforcement personnel. The mitigation would be effective only if the State provides sufficient manpower consistently to enforce the regulations, and this will be acknowledged in the Final EIS.

D. A number of questions were asked in this paragraph. First, you ask if it is reasonable to assume the Manele Bay Hotel will generate more than twice as many Hulopoe Beach users as The Lodge at Koele. In the DEIS, this statement is in fact made on page IV-73.

You then ask if this will drive residents away from this "normally isolated" beach. It is possible that increased visitor use may make the beach less attractive to some Lanai residents. (The beach would still not be "crowded" by most standards.) However, given Hulopoe's longstanding use by the local community, its pre-eminence as Lanai's best beach, and its relative proximity to Lanai City, it seems reasonable to assume local residents will continue to use it even with significant visitor beach population increases.

As to whether these increases "will lead to the kinds of concerns that led to the closing of Hanauma Bay on Oahu," the volume of traffic at Hanauma Bay leading to its closure was thousands of people per day. It is unlikely that such densities will occur at Hulopoe.

As for possible restrictions on hotel guest use of the beach, there is no precedent in Hawaii for restricting anyone's access to a public beach. This would be illegal.

E. Increased usage of Hulopoe Beach is a near-certain impact of resort development. Whether this is perceived as "crowding" is largely a subjective question. Objectively, Hulopoe will not be as densely populated as, say, Waikiki; however, many Lanai residents will doubtlessly find it more "crowded" compared to pre-1990 memories. If your reference to "polarization" means a disparity between the resident and visitor populations, the increased usage of the beach will eventually exacerbate the situation. This type of impact is mentioned in DEIS Section 5.6.2.2 under "Bodyboarding and Surfing."

In regard to your questions about "social services," we feel the more critical concern is to assess opportunities and dangers related to social change at Hulopoe, and to manage them effectively. While our socio-cultural and recreational consultants do not feel that social trauma is an inevitable impact and

must be mitigated by hiring more social workers, they do feel that the basic question of social competition for Hulopoe Beach merits more examination in the Final EIS. This has been done in the Final EIS, in a new Section 5.6.3, 'Social Conflict at Hulopoe Beach.'

We recognize the unique value of Hulopoe and characterize it in the Draft EIS (5.6.2.2 on page IV-73) as "the only beach park on the island."

F. We are somewhat confused by your questions regarding "decreases in recreational time ... [for] the newly employed local residents of Lanai" and associated mental health or social service costs. If the phrase "newly employed" means people who would otherwise be unemployed, then we would suggest that all "costs" of employment -- decreased recreational time, mental health, cultural cohesion, etc. -- are significantly less than the costs of unemployment. If the actual intent was to compare the recreational time available to agricultural workers vs. time available to resort workers, we are unaware of any specific studies in this regard.

VI. Socio-Cultural Impacts

In your opening comments, you express concern over the amount of discussion in the DEIS related to (1) historical impacts of population increases on small rural Hawaii communities, (2) describing Lanai's special social environment, and (3) academic literature on "boomtowns" outside Hawaii. (NOTE: We do not feel the boomtown literature was "dismissed." Rather, the DEIS cited boomtown results felt to be of relevance to Lanai.)

Since all three of these topics were addressed in the DEIS, the concern seems to be over the appropriate extent of discussion. We believe the DEIS addresses socio-cultural impacts to as great an extent (and perhaps greater than) almost any other Hawaii EIS of which we are aware. An EIS does not typically provide a voluminous "review of the literature," but attempts to summarize major facts in a length and format accessible to the average reader. If LSG desires a more comprehensive review of academic literature than is appropriate for an EIS document, this might be suggested to Castle & Cooke in LSG's ongoing discussions with the company -- subject to your acknowledgment that "judgments in this area may be subjective" and to the understanding that much of the literature is contradictory and open to selective interpretations.

A. We do not think it is possible to say exactly how "severe" will be the increased competition for use of Hulopoe Beach. We believe it is reasonable to assume there will be some sense of competition, at least during a transitional period. Your question referred to camping. The DEIS inadvertently omitted substantial mention of camping impacts, and this will be corrected in the Final EIS. Additionally, as previously indicated, the Final EIS will contain additional discussion of the broader issues of social competition for Hulopoe Beach resources. The following will be added (page IV-75, just before "Manele Small Boat Harbor:").

Picnicking and Camping -- Hulopoe Beach Park is the most important picnicking and camping site on Lanai. Picnicking and camping at the beach are traditional activities for Lanai residents, especially on weekends and holidays, and the beach park is the most popular site on the island for these activities. Park improvements include picnic facilities and camping sites.

For off-island visitors, Hulopoe Beach Park is the only authorized camping site on the island. Camping permits are issued by the Lanai Company. The present commercial camping site located at the west end of the park will be relocated inland of the parking lot as part of the park renovation.

The matter of resident camping in the beach park, however, is an unresolved issue. Although non-residents have been restricted to camping in one designated area, residents have customarily camped throughout the park. Lanaians for Sensible Growth (LSG) has requested that this use be allowed to continue, but no agreement has yet been reached between LSG and the Lanai Company.

The increased beach attendance will create additional competition for the picnic facilities. Visitors and new residents will also use the picnic tables and barbecue pits. The increased beach attendance, however, will probably have a minimal short-term effect on the camping sites. Most of the visitors and new residents will be in a hotel room or a home, and will not need a camping site for accommodation. However, in the long term, camping at the park will probably increase due to the development and marketing of Lanai as a visitor destination.

B. The presentation of data on Dole managers' place of birth was given for two reasons: (1) it was given in the context of the University of Hawaii Social Work study finding that some Lanai residents felt the Dole Company historically had not provided some groups with adequate opportunity at managerial jobs (and Dole Co. represented the actual culmination of historical processes in this regard on Lanai); (2) data on this topic were readily available from a recent survey of Dole managers, and this survey had not been taken among Lanai Co. or RockResorts managers. We will advise the Lanai Co. and RockResorts of LSG's interest in similar data for their companies.

C. One of the foregoing responses (IV-A) hopefully addresses your sense of confusion about "the project" -- i.e., it is the Manele Golf Course and Golf Residential Project, for which a Project District Amendment is being requested and is thus by law the focus of the EIS.

You are correct that some of the socio-economic impact analyses do not distinguish between impacts associated with the Koele vs. the Manele Project District (including both approved and new Manele activities). The main reasons for this are as follows:

- The principal focus of the EIS is on assessing impacts from "the project." The other major purpose is to present cumulative effects of development from all resort components. This did not necessarily require a separate accounting of Koele vs. Manele numbers (except for that portion of the Manele impacts associated with on-site consequences of "the project" -- e.g., golf course jobs).

- Whether or not "the project" is built (particularly the golf course) is expected to affect occupancies and eventual hotel expansion plans -- and thus employment, population, etc. -- at both Koele and Manele, as summarized in DEIS Table IV-6. Thus, what happens at Koele is not independent of "the project."

- Disaggregating all tables to show impacts flowing from or through the Koele portion vs. the Manele portion would have greatly increased the length and complexity of an already complicated analysis. For example, Table J-2 does show separate Manele and Koele figures for on-site population. This required a two-part, two-page table, plus combined summary figures in the text. After producing this initial table, the socio-economic consultants opted for briefer and simpler tables combining all resort impact information.

- At the time of the EIS Preparation Notice, no interested parties requested such a disaggregated analysis. To conduct such a disaggregated analysis now would require extensive reworking of almost all analytic spreadsheets; a doubling or tripling of the number of tables about quantitative impacts; and the result would provide no additional information about the basic questions of impacts from "the project" and from cumulative Lanai resort development.

D. The reference to the greater psychological impacts of upscale Koele vs. Manele residents and visitors was made in the context of a DEIS paragraph on "perceived income gaps." The logic of the statement relates to greater levels of personal exposure of Lanai City residents. While Manele visitors and residents will occasionally drive to Lanai City, Koele residents and visitors are within walking distance. The so-called "demonstration effect" of more affluent people demonstrating heavier consumption and expenditure patterns to less affluent people would therefore occur more frequently with Koele residents and visitors.

E. The expansions referred to on page IV-84 would actually take place at both the Koele and Manele hotels, and the text there will be revised in the Final EIS to clarify that point. The expansions in question are those referred to on page I-3: "The Koele Resort, a 102-room country lodge (with expansion planned to 250 rooms) ... The Manele Bay Hotel, 250 rooms with expansion to 400 ... "

These expansions are permissible under current Project District approvals but are considered far less likely to occur without approvals for the Manele golf course, as

stated in Section 5.1.3 and accompanying Table 4.6. (NOTE: Table 4.6 will be amended in the Final EIS to reiterate the expansion figures from page I-3.)

F. The page IV-85 quote to which you refer will be adjusted in the Final EIS to read:

(replaces 2nd paragraph on p. IV-85)

In general, direct and immediate project impacts on social structure will probably be fairly small since there will be relatively little impact in the next five years on the number of resort residents on Lanai. However, delayed indirect impacts -- by facilitating eventual future demand for expanded hotels and thus encouraging more in-migration at a later date -- will be more substantial.

Your concerns about social problems such as crack use and domestic violence are well taken. The DEIS does make the point that cause-effect relationships with resort development are not always clear-cut -- e.g.:

> "Some of the social agency observers who were interviewed for this report ... said Lanai probably had more problems than the [pre-resort social] data indicate, particularly in regard to family concerns. Additionally, both drug use and spouse abuse problems predated resort construction on Lanai" (page IV-85).

G. This paragraph of your letter contained two questions and some comments. In regard to the specific questions:

- The "more complex conclusions" referred to on page IV-88 include the three bulleted points immediately following that statement.
- The reference to "life functioning" on page IV-88 was not intended to refer to medical survival but rather to the ability to function in everyday life. The Final EIS will hopefully clarify this by revising the phrase to read "everyday normal life functioning."

In regard to some of your comments:

- You felt the discussion did not contain "any true analysis" about how growth pressures would affect stress levels. Perhaps the problem involves differing ideas or definitions of "true analysis." We would be interested to know more about your expectations in that regard. Our own definition of "analysis" would involve a systematic exploration of clear cause-effect relationships and the extent to which they can be reliably predicted.

  Based on extensive review of available evidence and literature, our socio-cultural consultants believe that reliable prediction of such impacts is very difficult; socio-cultural impacts are too indirect, too complex, and too subject to intervening variables and idiosyncratic local conditions to allow

anyone to say with certainty what will or will not happen. At the same time, it is possible to point out opportunities and dangers, and to identify some of the critical intervening variables which can help affect outcomes, with an eye to mitigation programs. This is why the DEIS began the socio-cultural impact section with the statement that "for many social impacts, it is both more possible and more important to control the outcomes than it is to predict them" (page IV-76). These were the principles underlying the organization and writing of DEIS Section 5.7.4 on "Indicators of Social Stress/Harmony."

- Because of the foregoing conclusions, our socio-cultural impact consultants also believe it would be appropriate to add some discussion of socio-cultural factors to the section on "Unresolved Issues" (Section 6.3). This will be done in the Final EIS. (See insert as proposed in I.C above.)
- We agree that community discussions about future growth are often stressful. However, the point of the DEIS comment was that various studies have indicated that the nature of community reaction to such stress -- active organization vs. passive acquiescence -- is "a critical factor in determining whether residents are diminished or helped to grow by change" (page IV-89).
- We also agree that the Final EIS would be strengthened by a broader community interview process, and this will be done. Our socio-cultural impact consultants plan to contact representatives of LSG, along with other community groups, for these interviews.

H. The "alternative Manele residential development plan" mentioned on DEIS page IV-89 refers to residential development under the current Project District approvals -- i.e., 416 units on 151 acres rather than 425 units on 408 acres. (See DEIS Sections 5.1.3 and 5.2.2 for further details.) In the Final EIS, the phrase on page IV-89 will be slightly rewritten to assure clarity on this point.

I. We would acknowledge that the summary discussion on page IV-90 (regarding relationships between the Dole Company and the Lanai community) does not provide an exhaustive list of all possible complaints from all community members. It also probably does not provide an exhaustive list of all points of community appreciation for the company, nor an exhaustive list of all possible corporate responses to these issues.

However, we do not believe it is the function of an EIS to do this. The purpose of the section was to point out that the overall resort development will eventually alter the general relationship between the company and the community and to give a general (if not exhaustive) sense of some of the concerns and potential directions for change.

Still, as previously stated, we agree that the Final EIS should contain more information from community interviews. We appreciate LSG's cooperation in that process.

J. We are unaware of programs elsewhere in Hawaii to integrate new resort residents into a larger existing community. It would undoubtedly be possible to research the literature and find examples from places such as Arizona or Florida, but we question the applicability of any such program to the island of Lanai. Thus, the Dole Company would be a pioneer in such Hawaii efforts, designing programs tailored to Lanai. As indicated in the DEIS, there would have to be multiple activities, including written materials on Lanai, informative workshops, and social events bringing together diverse people. Obviously, nothing could be compulsory; no outcome can be guaranteed; and social integration would require accommodations and change on the part of longtime residents as well as newcomers. Evaluation would be built in if possible. The UH Social Work study was intended to provide "baseline" information on social attitudes and community satisfaction, so that possible future surveys can detect critical changes in these areas.

K. The "Mitigations" section of the Final EIS, particularly Section 5.7.6.2, will provide an updated discussion of the issues raised in this paragraph of your letter. The Dole Company has indicated its willingness to provide a 55-year lease (at little or no cost) of 100 acres at Kaunolu to the State of Hawaii for establishing an agricultural park there. The site includes ten acres now under intensive cultivation by the Lanai Company for truck crops. Additionally, the Dole Company has agreed to convey a total of 25 acres to the State for development as a commercial business park (ten acres adjacent to Lanai City) and as an industrial park (15 acres, site not yet determined).

VII. Relationship to Land Use Plans and Cultural Cohesion

Chapter V will be revised taking your comments into consideration. Concerns such as the increased use of Hulapoe Beach will be addressed.

VIII. Cost Considerations

Your paragraph under this heading contained a number of separate but interrelated questions.

Does Average-Cost Approach Fairly Account for Airports, Highways?

The average cost approach fairly accounts for government expenditures, including capital improvements, in response to resort developments. A few extraordinary capital expenditures, such as the Lanai Airport Expansion or Airport-to-Manele highway, are potentially exceptional and might sometimes be separately accounted for in a fiscal impact analysis. The reason this was not the case for the Lanai analysis is as follows:

(1) In regard to the Manele Golf Course and Golf Residential Project (the major focus of the EIS), the State's decision to expand the Lanai Airport was made independently of the current project. These expenditures cannot be ascribed to that project. The airport expansion responds in part to the fact that existing facilities do not meet current needs, in part to anticipated new demand with resort expansion on Lanai (Park Engineering et al., 1990 -- Lanai Airport EIS).

(2) In regard to the cumulative Lanai resort development, it would have been possible to have included the airport in the fiscal analysis. However, doing so would not have affected the outcome of the analysis, since Hawaii taxpayers are not paying for the visitor-industry-driven part of the expansion i.e., both the visitor-related airport revenues and government expenditures are independent of the other revenue flows in the fiscal impact analysis. In Hawaii, visitor-related airport revenues clearly exceed expenditures.

Airport improvements are supported in Hawaii by a special fund, which has run an impressive positive balance in recent years. This fund receives revenue indirectly from airport users, above all from visitors to Hawaii. In Fiscal Year 1989, some $213 million -- 77.7% of Airports Division revenues -- came from concession fees, not taxes. This figure is more than double the size of the division's capital outlay in that year. Airport concession fees derive in large part from visitor spending. Hence, airport capital outlays are made possible above all by continuing visitor spending. (Presumably, Lanai-bound visitors will contribute to such spending in future years.)

The special fund is so well endowed that the State is now transferring some $250 million to the State Highways Fund. At the time of writing, it is uncertain whether the Dole Company, the State, or both would pay for an Airport-to-Manele road. Any State expenditures for that road would come from money transferred from the special airport fund.

The DEIS did not include an estimate of contributions to the fees and taxes that go into the State's Airport Special Fund. Even without those contributions, it showed a positive balance of State revenues over costs in the range of $50 million to $128 million (depending on resident population and visitor spending assumptions) over 20 years. Therefore, we are confident that both estimated State revenues and that portion of visitor spending which eventually supports the Airport Special Fund would amply offset State costs, including extraordinary expenses.

How Would Analysis Be Affected by Repayment of Mortgage Loans? by Method of Estimating Donated Land Value? by Allocation of Hulopoe Improvements to Use by Visitors, Not Residents?

In EIS Table J-21, note was made of Dole Company contributions. However, these contributions were not included in the fiscal analysis. They simply illustrated the point that the Dole Company has committed itself to community improvements.

any of the adjustments you mention -- e.g., discounting of contributions as supporting visitors and residents, rather than existing Lanai residents alone -- would be immaterial with regard to the fiscal analysis.

However, with specific regard to your question about "the $50 million listed for company contributions to the Lanai Community," we would refer you to the $50 million item in Table J-21. The table indicates that $50 million was advanced for affordable housing construction. However, the company may ultimately recover some of this money. That is why the table also specifies the subsidies (which the company does not expect to recover) for the four indicated housing projects.

Thank you for your comments and participation in the EIS review process. Your letter and this response will be incorporated into the Final EIS.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

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January 17, 1991

County of Maui, Planning Department
200 South High Street
Wailuku, Maui, Hawaii 96793
Attn: Mr. Philip Ohta, Planner

Re: DEIS Manele Golf and Golf Residential Project

Dear Sir:

Thank you for the opportunity to review the above-referrenced draft environmental impact statement. We found this DEIS to be a comprehensive effort to address the issues that will affect the island of Lana'i as it moves from an agricultural based economy to a resort based economy. We have the following comments and concerns about the report.

In general the Summary section of the report described mitigation measures better than the corresponding section in the full report. An example is Section 3.1.2.1 Flora. That section deals in part with the plant Canavalis Pubescens. A plant which was formerly on the endangered species list. Unfortunately, the following mitigation section of the flora report is silent on the Canavalis Pubescens. Mitigation measure regarding this plant are only found in the Summary section on Page I-10 where it states that the plant populations will be monitored and avoided when excavating for home sites. That information, in more detail, should be included in the Mitigation Measures portion of the Flora report.

The tone of the report is sometimes uncertain. A mitigation measure described on Summary page I-18 states: "Landscaping and water conservation measures include using natural plants that have low water requirement is an excellent way of reducing the irrigation needs in landscaping...." Is this is is a philosophical statement about the preference for using low water requirement plants or a statement as to what type of landscaping will be used to reduce stress on the Lana'i water system?

Section 4.2.2 states: "Most of the potential direct impacts have been avoided through modification of the project design following the initial archaeology inventory. If any of the sites recommended for preservation cannot be incorporated in the project design (and wholly protected), a data recovery plan and proper mitigation will be required." This raises questions as to which direct impacts to which features will not be avoided, what in this particular instance, constitutes "proper mitigation" and how will that be monitored? We suggest that some of these questions could be referred to the Lana'i Archaeology Committee and the use of the committee to deal with issues as they arise could be noted in the report.

Again thank you for the opportunity to comment on this DEIS. We have no other comments or concerns at this time.

Sincerely,

Richard K. Paglinawan

Richard K. Paglinawan
Administrator

cc: The Lanai Company
Belt Collins & Associates

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, Suite 200, Honolulu, Hawaii 96813
Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Saipan • France • Thailand

September 30, 1991
91P-269 (044.03)

Mr. Richard K. Paglinawan, Administrator
Office of Hawaiian Affairs
State of Hawaii
1600 Kapiolani Blvd., Suite 1500
Honolulu, Hawaii 96814

Dear Mr. Paglinawan:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

We received your January 17, 1991 letter to Maui County Planner, Mr. Philip Ohta concerning the above project. Following are responses to your comments.

Mitigation Measures Regarding *Canavalis Pubescens*

Section 3.1.3.1 (Mitigation Measures) of Chapter IV of the Final EIS will be revised to address your concerns and will include suggested mitigation measures to protect the plant Canavalis Pubescens.

Landscaping and Water Conservation Measures

The use of low water maintenance plants is a recommendation. However, although guidelines for water conservation will be promoted by the developer, resort unit owners, hotel operators and homeowners also have some responsibility in pursuing the common goal of water preservation. To the extent possible, Castle & Cooke will control water use.

Potential Impacts to Archaeological Sites

Thank you for your suggestion. The applicant agrees to consult with the Lanai Archaeology Committee and use the committee to assist its archaeologist and appropriate government agencies in dealing with issues pertaining to archaeology as they arise.

Thank you for your comments. Your letter and this response will be included in the Final EIS for the Manele project.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

JOHN WAIHEE
GOVERNOR

RECEIVED
JAN 17 10:1
BELT, COLLINS & ASSOCIATES

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
SEVEN WATERFRONT PLAZA, SUITE 300
500 ALA MOANA BOULEVARD
HONOLULU, HAWAII 96813
FAX (808) 543-8841

JOSEPH K. CONANT
Executive Director

IN REPLY REFER TO:

91:PLNG/216 jt

January 14, 1991

TO: County of Maui, Planning Department
Attn: Mr. Philip Ohta, Planner

FROM: Joseph K. Conant
Executive Director

SUBJECT: Draft Environmental Impact Statement for the Proposed Manele Golf Course and Residential Project

Policies A(3) and B(3) of the State Housing Functional Plan seek to ensure that (1) housing projects and (2) projects which impact housing provide a fair share/adequate amount of affordable homeownership and employee rental housing opportunities. The applicant notes that it has entered into a contractual agreement with the County of Maui to supply affordable housing associated with the needs of the project and which is in compliance with the objectives and policies of the State Housing Functional Plan. In order to assess compliance with the State housing plan, it would be helpful if this information were made available.

Thank you for the opportunity to comment.

JT:eks

c: Thomas C. Leppert, The Lanai Co.
Anna L. Mapes, Belt Collins & Associates
Office of Environmental Quality Control

IX - 50

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September 30, 1991
91P-270 (044.03)

Mr. Joseph K. Conant
Executive Director
Housing Finance and Development Corp.
Seven Waterfront Plaza, Suite 300
500 Ala Moana Boulevard
Honolulu, Hawaii 96813

Dear Mr. Conant:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

We received your January 14, 1991 memorandum to Maui County Planner, Mr. Philip Ohta concerning the above project. We assume that Maui County will supply you with the appropriate information on its agreement with the applicant concerning housing. By copy of this letter, I am deferring response to your comment to Mr. Ohta.

Thank you for commenting on the Manele project. Your letter and this response will be included in the Final EIS for the Manele project.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

RECEIVED
JAN 21 1991
BELT COLLINS & ASSOCIATES

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
KEITH W. AHUE
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:OCEA:JN

File No.: 91-224
Doc. No.: 9571E

JAN 18 1991

The Honorable Brian Miskae, Director
Department of Planning
County of Maui
200 S. High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Hart:

Subject: DEIS Manele Golf Course and Golf Residential Project, Manele, Lanai, TMK: 4-9-02: 01

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the material submitted to us by the State Office of Environmental Quality Control.

In reference to the sections referring to Historic Preservation concerns: 4.1 - existing conditions, 4.2 - probable impacts, and 4.3 - mitigation measures.

4.1 Existing Conditions. This document refers to three archaeological surveys conducted in the proposed project area. However, only one report (Cultural Surveys Hawaii 1990) is included in Appendix C, Archaeological Resources Inventory and Mitigation Plan. Although our office has copies of the other two reports (Cultural Surveys Hawaii 1989 and Kaschko and Athens 1987), we recommend that these reports be also appended to the Final EIS or their archival location be noted, so other reviewers and the general public can have access to them. All three reports were previously reviewed by our office and have been determined adequate in presenting results of the surveys. The summary description of the different types of sites and features based on function appears to have been adequately discussed in 4.1.1. Figure IV-6 also clearly shows the location of all the sites in the project area.

4.2 Probable Impacts. Site significance assessments (4.2.1) are clearly presented in Table IV-5. We concur with these significance evaluations.

4.3 Mitigation Measures. For a detailed discussion of the mitigation measures, this subsection refers to the Data Recovery and Preservation Plan prepared by Cultural Surveys Hawaii. We have reviewed this plan, and we concurred with the recommended measures. These have been incorporated in Table IV-5.

In paragraph 2 of IV-41, we disagree with the number of sites that do not need further work. Instead of 38 sites, only one site, site 2, is no longer significant (Table IV-5). The rest of the 54 sites are recommended for either preservation and/or data recovery. We recommend that the second sentence in paragraph 2 be revised.

Specific sites that will undergo data recovery are listed in 4.3.2. This list is incorrect and is contradictory to the recommended mitigation treatments for a number of the sites as given in Table IV-5. The following sites/features should not undergo archaeological data recovery: 6, 7, 12C, 19C, 21, 22A, 22B, and 22C. These sites have been committed to preservation, so they should be deleted from this data recovery list.

The following comments are made concerning rare, native plants and coastal trails:

1. The rare native plant, Boerhavia herbsii, which grows within the poorly developed coastal strand vegetation community (Appendix A), has not been addressed per say in the draft EIS. Although its official taxonomic status and range is not precisely understood, it originally was found and described from specimens observed in the Manele-Kaluakoi area of Lanai. Efforts to preserve this species and the coastal strand community of which it is a part should be made. What are the probable impacts, protection and mitigation measures for this species?

2. The rare native species, Canavalia pubescens, (currently a Category 2 candidate species for listing as threatened or endangered by the U. S. Fish and Wildlife Service) occurs on the proposed project area. Protection of these plants in situ with compatible land use and buffer zones around the plant colonies should be a condition of the EIS.

3. It is stated in Chapter IV-17, "Portions of the site will be left intact where feasible, especially along the shoreline. Potential impacts to the vegetation of the site will be significant in that much of the existing vegetation will be lost". The draft EIS does not define which areas and what species will be preserved in situ.

Both rare species, C. pubescens and B. herbsii, should be addressed for preservation in situ. Supplemental planting are to be encouraged, in addition to, but not taking the place of, in situ management.

4. Figure IV-7 illustrates an alternative road route to the project site from the airport. A listed endangered plant species, Abutilon menziesii, occurs in the vicinity of the proposed road. The proposed route should widely avoid these plants and their habitat, due to the increased chance of dryland fires starting along the roadsides.

5. The Statewide Trail and Access System, Na Ala Hele, recommends that in addition to the public easement along the coast to the westernmost boundary of the project, a continuous, public pedestrian access be dedicated that would extend from Hulopoe Beach, along the coast to Manele Harbor, and through the park space to the easternmost boundary of the project. Additionally, mauka/makai accesses to the coastal trail should utilize historic pathways that may be found in the project area. Historic trails should be restored with supervision by the State's Historic Preservation Division.

We have major concerns in three other areas 1) nutrient level increases, 2) erosion runoff, and 3) shoreline access. We note that the proposed development may increase the nutrient levels in the waters of the Manele-Hulopoe Marine Life Conservation District (MLCD). The adverse impacts of these increases cannot be fully assessed at this time because they would be dependent upon the procedures and amounts of chemicals used. There should be some level of chemical use that does not increase the nutrient levels in the basal water lens or the ocean waters. The Applicant should be required to determine this level and to adhere to the reasonable use of these chemicals.

The area above the Manele Bay Hotel has continually been a source of soil run-off into the nearshore ocean waters. The bay's users claim that this "dirty" water degrades the quality of their recreational experience and threatens marine life in the MLCD. To answer these concerns, we recommend that the Applicant be required to control this run-off, even during periods of heavy rainfall, to maintain acceptable water quality. Because of the MLCD's great recreational value, runoff should not be allowed to enter the MLCD.

The shoreline fronting the proposed golf course is a 15-foot high cliff that does not provide a safe, natural public access along the water's edge. In addition, Figure II-4 in the draft EIS illustrates that the proposed golf course would not provide shoreline access between Kaluakoi Point and Huawai Bay.

Because there is no natural public access (and none is to be provided by the Applicant), we recommend that the Applicant provide and maintain public access along the Huawai Bay-Kaluakoi Point shoreline.

Should the project be approved, we suggest that the mitigative measures (incremental clearing & grading, judicious use of fertilizers and pesticides, landscaping, long-term water quality monitoring) mentioned in the draft EIS and above, be required as conditions of the Permit.

Our Division of Water Resource Management will respond directly to you if they have comments regarding this project.

Thank you for your cooperation in this matter. If you have questions, please call me or Bob Johnson at our Office of Conservation and Environmental Affairs, at 548-7837.

Very truly yours,

William W. Paty

cc: The Lanai Company
Belt Collins & Associates
Office of Environmental Quality Control

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September 30, 1991
91P-271 (044.03)

Mr. William W. Paty, Director
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96808

Dear Mr. Paty:

Manele Golf and Golf Residential DEIS

Thank you very much for your comments to Maui County Planning Director Brian Miskae on the subject DEIS. We acknowledge your concerns regarding archaeological and biological resources. Each of your comments is addressed in the following paragraphs.

1. Kaschko and Athens (1987) Archaeological Inventory Report. Due to the size and difficulty in adequately reproducing the original Kaschko and Athens study, the report has not been included as an Appendix to the FEIS. For those who are interested, copies of the study may be obtained from the State of Hawaii, Department of Land and Natural Resources, Division of Historic Preservation or the University of Hawaii. Copies are also available from the libraries of the State of Hawaii, County of Maui, and on Lanai. This archival reference will be included in the FEIS document.

2. Archaeological site significance assessments are clearly presented and we concur with the findings. Thank you for your comment.

3. We agree with the Data Recovery and Preservation Plan and we concur with the recommended measures. Thank you for your comment.

4. Number of archaeological sites that do not need further work. At your suggestion, the paragraph regarding the number of sites recommended for preservation and data recovery (pg. IV-41, para. 2) has been changed to read:

> Of the 54 identified sites, all but one have been assessed as significant for information content. Site 2, an Ahu or possible trail marker, is considered no longer significant. The remainder of the sites are recommended for either preservation or data recovery. The majority of the known sites will be preserved and interpretive signage or displays will be used where appropriate to encourage the public to respect the resources. The remaining sites not recommended for preservation will be tested and data recovery will be performed if the excavation or construction activities occur in or adjacent to the site (Figure IV-6).

For Section 4.3.2, Data Recovery, specific sites recommended for data recovery is incorrect. The paragraph has been modified to read:

> Sites outside of the designated preserve areas (Figure IV-6) ... Therefore, it is recommended that data recovery be conducted on the significant features of the following sites:
>
> - Permanent Habitation Sites - Site 5
> - Temporary Habitation Sites - Site 3, 4, 8
> - Quarry Sites - Sites 8, 9, 10, 11, 7 (surface testing only, site will be preserved)
> - Agricultural Features - Sites 4, 5, 14
> - Site 21 possible petroglyph may be relocated

These amended paragraphs will be included in the FEIS.

5. What are the probable impacts, protection, and mitigation measures for the rare native plant, Boerhavia herbsii?

The following response is based on the biology studies that were prepared for the Manele "Rural" Development and the Manele PD Extension included as Appendix A of the DEIS. The representation of Boerhavia herbsii as a rare plant is somewhat misleading. It is found within the project site; however, it is also found on Oahu, Maui, Kahoolawe, Hawaii (the island), Pearl and Hermes Atoll and Lisianski (Fosberg, F.R. and D. Herbst. 1975).

The letter states efforts should be made..."to preserve this species and the coastal strand community of which it is a part...". If indeed the native strand community at Manele was reasonably intact and in good condition, efforts could be made to preserve the community together with the Boerhavia herbsii present in the strand. As indicated in the 1988 report (page A-3, Appendix A), however, the strand community at the Manele project site is poorly developed and is not a good representative native plant community for Lanai.

6. Protection of the rare native species Canavalia pubescens will be provided to the extent possible during the design and construction phases of the project. This species is not as rare as once thought for it is found on Lanai, Kauai, Niihai and Maui. Further, as stated in Section 3.1.1.1 of the Draft EIS, ". . . the U.S. Fish and Wildlife Service (USFWS) has reevaluated the status of the species and has listed it as a Category II plant. Category II describes the class of plants proposed for listing as threatened or endangered that the USFWS does not have sufficient information to warrant listing as an endangered species. Additional information is required about the species prior to determining if the plant should be listed or should be dropped from the endangered listing consideration."

   Several suggestions are made in the biological reports, Appendix A, which address the preservation issue. Suggested mitigation measures include:

   - realignment of the golf tees and fairways to avoid disturbance of the Canavalia populations
   - channeling the surface runoff away from the Canavalia colony

   Another protection measure that is recommended is to prevent construction rubble and soluble and particullate runoff from spilling into the Manele Gulch. Attention should be paid to maintain the gulch free of construction material, soil, surface runoff and other disturbance.

7. Preservation in situ of the Canavalia and Boerhavia populations. Recommendations offered in response #6 above and on Pages A-4 and A-12 of Appendix A, Biological Resources Studies address the concerns of preservation in situ. In addition, the majority of the archaeological sites are proposed to be preserved intact and the present population of Canavalia pubescens is located within this preserve. This preserve includes the largest Canavalia population found on the project site and it will preserve an entire plant association that includes such native species as pili, ilima, uhaloa, hoary abutilon and Boerhavia.

8. Protection of the endangered plant Abutilon menziesii. The vegetation surveys conducted for the proposed golf course and residential development did not include specific surveys of the alternative access road route, for the alternative access road is not an element of the proposed action for the Manele Golf Project. If the alternative route is selected and the State of Hawaii elects to provide an alternative access, a detailed botanical survey should be conducted along the proposed alignment as part of the route selection process. Abutilon menziesii does occur in the area shown as a proposed alternative access route and the survey is required to verify the location and potentially avoid disturbance of any of these endangered plants.

9. Statewide Trail and Access System, Na Ala Hele. We acknowledge and support this proposal for continuous, public pedestrian access extending from Hulopoe Beach along the coast to Manele Harbor and interconnecting with the proposed park areas. Restoration of historic trails and use of mauka/makai accesses to the coastal trail are objectives of the Statewide Trail and Access system and are consistent with the objectives of the Manele Development. Please contact Mr. Tom Leppert, Castle & Cooke Properties, to describe your proprosal more fully.

10. Potential increase in nutrient levels in the waters of Manele-Hulopoe Marine Life Conservation District (MLCD). Thank you for your comment. We acknowledge the concern for protection of the Manele-Hulopoe MLCD waters. A key objective in the ongoing monitoring study, described in Appendix B, Quantitative Assessment of the Marine Communities and Water Quality in an Area Affronting the Proposed Hulopoe - Manele Bay Gif Course Development, is to establish and monitor the potential long term effect of the operation of the facilities (Manele Golf and Residential Project) on water quality. As described in the DEIS, numerous physical, meteorological, and chemical factors influence the rate and direction of movement of chemicals applied to the ground surface. Infiltration rates, surface runoff, and chemical reactions vary from site to site and the effects can not be immediately measured. Therefore, long term studies are required to determine the nutrient level increases that may be characteristic of any specific location. These characteristics have not been determined for the Manele shoreline.

    The marine water quality study currently being employed at Manele was designed to provide the basis for determining the threshold for chemical applications during different seasons and to eventually arrive at the "level of chemical use that does not increase the nutrient levels in the basal water lens or the ocean waters". In addition, the monitoring study will provide valuable information regarding the MLCD resources over time.

11. Potential for Soil Erosion Runoff. We acknowledge the natural potential for soil erosion in the dry southern coast of Lanai. The deep gulches cut during storm events are evidence of this being a continual problem. The present construction of the roadways and facilities associated with the Manele Hotel may have temporarily exacerbated the soil loss. However, soil erosion control measures are a major component of the construction

practices for the golf course and residential project. After the development project is constructed, the additional landscaping in and around the golf course and residences will also control the erosion process.

12. Public access along the Huawai Bay - Kaluakoi Point shoreline. Thank you for your comment. The issue of providing public access along the shoreline has been discussed throughout the project planning. Through a Memorandum of Agreement among the County of Maui, the Lanaians for Sensible Growth and the Office of Hawaiian Affairs, the current proposal for shoreline access includes "a public easement along the accessible cliff coastline from Hulopoe Bay to the intersection of the coastline with the westernmost boundary of the project area . . ."

13. Mitigation as a Condition of the Permit? We note your suggestions to Mr. Miskae on permit conditions.

Thank you for your comments and participation in the EIS review process. Your letter and this response will be incorporated into the Final EIS.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department
Mr. Don Hibbard, DLNR, State Historic Preservation Division
Mr. Michael G. Buck, DLNR, Division of Forestry and Wildlife

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director

RECEIVED
FEB 19 1991
BELT, COLLINS & ASSOCIATES

AARON SHINMOTO, P.E.
Land Use and Codes Administration
ASSIE MILLER, P.E.
Wastewater Reclamation Division
RALPH M. NAGAMINE, P.E.
Engineering Division
BRIAN HASHIRO, P.E.
Solid Waste Division
MELVIN HIPOLITO
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS

250 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

February 12, 1991

MEMO TO: Brian Miskae, Planning Director

F R O M: George N. Kaya, Acting Director of Public Works George N Kaya

SUBJECT: Draft Environmental Impact Statement for the Proposed manele Golf Course and Golf Residential Project at Manele, Lanai, TMK:4-9-02:Portion of 01

We have reviewed the above request and offer the following comments:

1. That paved parking spaces, appropriate landscaping and fencing shall be provided per the County's Off-Street Parking and Loading Ordinance.

2. That a final detailed drainage and erosion control plan including, but not limited to, hydrologic and hydraulic calculations, scheme for controlling erosion and disposal of runoff water, and an analysis of the soil loss using the HESL erosion formula, be submitted for our review and approval. The plan shall provide verification that the grading and runoff water generated by the project will not have an adverse effect on the adjacent and downstream properties. The applicant shall also address the potential of nonpoint source pollution upon groundwater and off-shore coastal waters arising from frequent watering of exposed ground during construction, leaching of pesticides and fertilizer from the golf course, etc.

3. That a drainage master plan be provided for the entire project.

4. That a traffic and roadway master plan be prepared. The developer shall provide improvements and/or contribute a pro-rata share to improvements to be determined by the County and Master Plans.

5. That no clearing and grubbing material shall be disposed of at the County sanitary landfill. The developer shall submit a solid waste management plan acceptable to the Department of Public Works. For additional information, the developer is requested to contact the Solid Waste Division.

AS:mhl

cc: The Lanai Company

IX - 56

BCA
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September 30, 1991
91P-272 (044.03)

Mr. George N. Kaya
Acting Director of Public Works
Department of Public Works
County of Maui
250 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Kaya:

Draft Environmental Impact Statement for
Manele Golf Course and Golf Residential Project

We received your February 12, 1991 memorandum to Maui County Planning Director, Mr. Brian Miskae concerning the above project. Following are our responses to your comments in the order that they appear in your letter.

1. The project will abide by required standards.

2. The applicant fully intends to provide a detailed drainage and erosion control plan at the appropriate time. This will be done during the preparation of construction plans after the necessary discretionary permits are obtained for the project.

3. The drainage master plan will be provided at the construction plans stage of the project.

4. The traffic and roadway master plan will be provided at the construction plans stage of the project.

5. The applicant agrees not to dispose of clearing and grubbing material at the County sanitary landfill. A solid waste management plan acceptable to the Department of Public Works will be submitted for review at the appropriate time.

Thank you for your department's comments. Your memorandum and this response will be included in the Final EIS for the Manele project.

Sincerely,

Anne L. Mapes

ALM:lf

cc: Mr. Thomas C. Leppert, Castle & Cooke
Mr. Philip Ohta, County of Maui, Planning Department

APPENDICES

A: BIOLOGICAL RESOURCES STUDIES

BIOLOGICAL SURVEY

MANELE "RURAL" DEVELOPMENT

LANAI

A-1

Prepared for: M & E Pacific, Inc.

By: Kenneth M. Nagata

Date: 26 March 1988

FLORA

INTRODUCTION

The project site encompasses approximately 350 acres along the coast west of Manele, Lanai Island. The elevation ranges from approximately 400 feet (121 m) on the highest slopes, to the sea cliffs which vary from 20 feet (6 m) to nearly 200 feet (60 m). According to Ripperton and Hosaka (1942) the vegetation of the region consists of lowland xerophytic shrubs with a fringe of trees along the coastal areas (Zone A). Because of the arid conditions, the ground cover is sparse. The most conspicuous species in this vegetation type is kiawe (Prosopis pallida) which becomes less abundant in the upper slopes but forms dense stands in moist areas along the beach. Klu (Acacia farnesiana), koa-haole (Leucaena leucocephala) and 'ilima (Sida fallax) are the dominant shrubs. Herbaceous cover is primarily restricted to annual grasses such as bristly foxtail (Setaria verticillata), native Panicum species, pili grass (Heteropogon contortus), swollen fingergrass (Chloris inflata) and feather fingergrass (C. virgata).

A recent (1985) biological survey of the slopes behind Manele and Hulupoe indicates that the present vegetation closely resembles that described by Ripperton and Hosaka (M & E, 1986). The region was found to be dominated by xerophytic scrub consisting of koa-haole, 'ilima and kiawe which forms closed-canopied forests in certain coastal areas. The herb layer consisted of such annual grasses as bristly foxtail, feather fingergrass, pili grass, buffelgrass (Cenchrus ciliaris) and an unidentified native Panicum. Spanish needle (Bidens pilosa), wild zinnia (Zinnia pauciflora), hairy merremia (Merremia aegyptia), 'uhaloa (Waltheria americana), partridge pea (Cassia leschenaultiana) and hoary abutilon (Abutilon incanum) were also common in the area.

METHODS

Walk-through field surveys were conducted between 5 March and 10 March 1988 to determine the floristic composition of the project site. Transects with approximately 75% cover were established throughout the site and careful search was made for rare and endangered species.

RESULTS

The vegetation in the project site was found to be similar to that of the adjacent region surveyed in 1985. It generally consists of scattered, scrubby kiawe trees and a well developed shrub layer of native 'ilima, hoary abutilon and 'uhaloa. Several grasses are important components of the vegetation, including feather fingergrass, buffelgrass and the native pili grass. In addition, two native panicums, Panicum torridum and an unidentified species, are found in moderate numbers. Considering the extent of the site, comparatively few species are present despite the heavy winter rains. Of the 44 recorded species, 14 are native and four of these - 'ilima, hoary abutilon, 'uhaloa and pili grass - constitute a significant portion of the total vegetation cover. One of the native species is considered rare and is discussed in the Endangered Species section of this report. Four vegetation types were recognized and delineated on the accompanying vegetation map. It must be remembered, however, that in nature no sharp boundaries exist. Rather, the vegetation exists as a continuum with one type gradually grading into another.

Kiawe-'Ilima Scrub (KIS)

The predominant vegetation type in the project site is the Kiawe-'Ilima Scrub which is characterized by widely scattered kiawe trees (less than 50% canopy cover) generally 2-5 m (occasionally to 7 m) tall and a well-developed shrub layer if 'ilima 0.3-1 m tall. Included in this community are scattered

closed-canopied clusters of kiawe too small to be feasibly mapped and extensive rocky outcrops and extremely stony soils nearly devoid of vegetation. 'Ilima accounts for 50-100% of the shrub layer cover wherever that layer is present. The only significant components of the shrub layer other than 'ilima are 'uhaloa and hoary abutilon. Pili is the dominant component of the herb layer. Subdominant elements in certain areas include feather fingergrass, buffelgrass, and the aggressive hairy merremia. Present in moderate numbers are Panicum torridum, an unidentified species of native Panicum, ma'o (Gossypium tomentosum), cowpea (Phaseolus lathyroides), ironweed (Vernonia cinerea), virgate mimosa (Desmanthus virgatus), partridge pea, buffelgrass and Digitaria ciliaris. Less than 40 species of flowering plants were found in this extensive vegetation type.

Kiawe-'Ilima Forest (KIF)

In ravines and gulches and wherever the soils are deeper and/or moisture is more readily available the scrub community grades into the Kiawe-'Ilima Forest. This vegetation type is similar in species composition to the scrub community and differs only in canopy cover and stature of the kiawe. Generally the trees are 3-9 m tall and the canopy cover exceeds 50%. In ravines and gulches the forest is usually closed-canopied whereas on the slopes it is open-canopied. 'Ilima is once again the dominant shrub. Other common components of this community are hoary abutilon, pili grass and feather fingergrass. Buffelgrass, bristly foxtail, 'uhaloa, ironweed, hairy merremia and Digitaria ciliaris are present in moderate numbers. Less than 30 plant species were found in this community.

Koa-Haole Scrub (KHS)

Kiawe becomes progressively shorter in stature and less abundant toward the west end of the project site. As it becomes decreasingly important, koa

haole gradually supplants it as the dominant arborescent species. The Koa-Haole Scrub is characterized by widely scattered but mostly dead or dying koa-haole shrubs 2-4 m tall and a well developed shrub layer dominated by 'ilima and hoary abutilon. This vegetation type is only found at the west boundary of the site. Feather fingergrass and buffelgrass were common and pili grass, klu and the unidentified Panicum were recorded as "occasional". Only 19 plant species were recorded from the Koa-Haole Scrub.

Strand (S)

The Strand is a poorly developed community in the project site. Generally the Kiawe-'Ilima Scrub extends down to the sea and the same species along the shore are also found in the middle and upper slopes. In addition, such characteristic strand species as beach naupaka (Scaevola taccada), 'ahinahina-ku-kahakai (Heliotropium anomalum), nehe (Lipochaeta integrifolia), pohinahina (Vitex ovata) and the prostrate form of 'ilima are conspicuous in their absence. The only species commonly associated with strand ecosystems to be found in the project site are pa'u-o-hi'iaka (Jacquemontia sandwicensis), Australian saltbush (Atriplex semibaccata) and nohu (Tribulus cistoides). Of these, only pa'u-o-hi'iaka is found in any significant numbers and thus the Strand community is here defined by the distribution of that species. Few small, isolated colonies of this species can be found 100 m inland but these were not considered part of the Strand.

The species composition of this community is similar to that of the Kiawe-'Ilima Scrub. The vegetation cover, however, is sparse due to the lack of well-developed soils. 'Ilima and buffelgrass are the most common species in this community. Pa'u-o'hi'iaka, feather fingergrass, cow pea, 'uhaloa and Boerhavia herbstii were recorded as "occasional".

ENDANGERED SPECIES

Two species are known to be restricted to the Manele-Hulupoe region - Boerhavia herbstii which is widely distributed and Canavalia lanaiensis which is considered rare and endangered. In addition, an endangered fern, Ophioglossum concinnum has been collected in the sand dunes between Manele and Hulupoe and two other species, Achyranthes lanaiensis and A. maneleensis were once endemic to the region but are now thought to be extinct. The 1985 survey failed to locate either species of Achyranthes or the Ophioglossum but several populations of Canavalia were found (M & E, 1986).

A large population of 63 individuals of Canavalia lanaiensis was found in the Strand zone on the seaward edge of an extensive boulder field approximately 450 m from the east boundary of the present project site. The plants seem to have germinated just after the winter rains and are beginning to climb into the koa-haole shrubs. The dominant species in the vicinity are 'ilima, hoary abutilon, pili and hairy merremia. 'Uhaloa, nehe (Lipochaeta heterophylla) and pa'u-o-hi'iaka are also present in small numbers. No signs of browsing by animals were observed but competition from the more aggressive hairy merremia may pose a threat to the continued survival of this colony.

Canavalia lanaiensis has long been considered a rare species. In the first official listing of rare and endangered species of American plants, the Smithsonian Institution listed it as "Endangered" (Anon., 1974). Later, Fosberg and Herbst (1975) considered it "very rare" and "endangered, in considerable danger of disappearance". Pursuant to the Endangered Species Act of 1973 and following the recommendation of the Smithsonian Report, it was proposed for official Endangered status by the U.S. Fish and Wildlifer Service in 1976 (Fed. Reg., 1976). The list of species proposed for Endangered status was

withdrawn in 1979 in accordance with the provisions of the Act but a revised list was issued in 1980 (Fed. Reg., 1980). In it, C. lanaiensis was given Category 1 status, ie. "Taxa for which the Service presently has sufficient information on hand to support the biological appropriateness of their being listed as Endangered or Threatened species". It has retained its Category 1 status in the most recent review of candidate species (Fed. Reg., 1985). It should be noted, however, that a revision of the genus presently being prepared may alter the taxonomic status of this species and thus, its endangered status may be re-evaluated.

RECOMMENDATIONS AND MITIGATING MEASURES

According to the Manele Master Plan the population of Canavalia is situated adjacent to the 16th tee and near the pin of the 15th hole of the golf course. It is strongly recommended that the 15th and 16th holes be re-aligned in such a manner that construction activity and associated rubble would not physically impact the colony or alter its microclimate. A 20-30 m buffer area between the colony and the nearest disturbence may prove adequate. Soluble as well as particulate runoff from the golf course and its construction should be channelled away from the colony.

Other than for the golf course, very little open space is planned for the present project. Unless the plan is modified for such land use, it is strongly recommended that the present 'ilima-'uhaloa-pili grass association be preserved in the golf course "rough" and in other appropriate areas. Furthermore, if any archaeological features are to be preserved, the present native species surrounding them should be retained as part of the landscaping. Such native species should also be considered wherever appropriate in the general landscaping of the project.

FAUNA

A cursory inventory of fauna was executed in conjunction with the botanical survey. For the purposes of this survey only qualitative observations are reported. No trapping or statistical methods were employed and nests were not investigated.

In the 1985 survey of the Manele-Hulupoe area, only game and "urban" animals were sighted (M & E, 1986). Common birds in that region included the common mynah (Acridotheres tristis tristis), house sparrow (Passer domesticus), Kentucky cardinal (Richmondena cardinalis), red-crested cardinal (Paroaria coronata), barred dove (Geopelia striata striata) and lace-necked dove (Streptopelia chinensis chinensis). Indian gray francolin (Francolinus pondicerianus) and the turkey (Meleagris gallopavo) were also present. Axis deer (Axis axis) was the dominant mammal in the region.

The faunal composition of the present project site was found to be similar to that of the adjacent region. The most abundant birds, found in all vegetation types, were the common mynah and the barred dove. The lace-necked dove and house sparrow, found in all areas except in the Strand zone, were almost as abundant. Less common were the red-crested cardinal and the Kentucky cardinal. Neither turkeys nor francolins were seen or heard in the project site although the presence of francolins cannot be entirely discounted.

Two seabirds, tentatively identified as red-tailed tropicbirds (Phaethon rubricauda rothschildi) and Bulwer's petrels (Bulweria bulwerii), were seen flying along the coastline on two days. Both species as well as the wedge-tailed shearwater (Puffinus pacificus chlororhynchus) and white-tailed tropicbird (P. lepturus dorotheae) are known to nest in the high sea cliffs and/or offshore islets along the southwest coast of Lanai (Walker et al., 1985).

No nests or perching seabirds were observed on the cliffs in the project site despite lengthy scanning with field glasses. Consequently the seabirds seen are considered transients and not residents within the site.

The only land animal seen in the study site was the axis deer which ranges throughout the site and in all vegetation types. It is possible, however, that mice (Mus musculus domesticus) or rats (Rattus rattus rattus, R. norvegicus norvegicus and R. exulans hawaiiensis) are also present.

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PLANT SPECIES CHECKLIST

Families are arranged alphabetically in two groups - Dicotyledonae and Monocotyledonae. Genera and species are arranged alphabetically within each family. Taxonomy, common names and status generally follow that of St. John (1973). The abundance determinations are relative and are dependent on the judgement of the investigator.

EXPLANATION OF SYMBOLS

Species Status:

- E - Endemic to the Hawaiian Islands, ie. occuring naturally nowhere else in the world.
- I - Indigenous, ie. native to the Hawaiian Islands but also occuring naturally elsewhere.
- X - Exotic, ie. plants introduced after the Western discovery of the islands.
- P - Polynesian introductions; plants introduced before the Western discovery of the islands.

Relative Abundance Ratings:

- A - ABUNDANT, generally the major or dominant species in a given area.
- C - COMMON, generally distributed throughout a given area in large numbers.
- O - OCCASIONAL, generally distributed through a major portion of a given area, but in small numbers.
- U - UNCOMMON, observed uncommonly but more than 10 times in a given area.
- R - RARE, observed 2 to 10 times in a given area.

Vegetation Types:

- KIS - Kiawe-'Ilima Scrub
- KIF - Kiawe-'Ilima Forest
- KHS - Koa-haole Scrub
- S - Strand

FR - Endangered or Threatened status as determined by U.S. Fish & Wildlife Service in the Federal Register.

FH - Endangered or Threatened status as determined by Fosberg & Herbst (1975)

ANIMAL SPECIES CHECKLIST

Families are arranged alphabetically and the genera and spcies are arranged alphabetically within each family. Taxonomy of the birds follow that of Berger (1972) and the mammals follow that of Tomich (1969). Only presence is recorded in each vegetation type.

EXPLANATION OF SYMBOLS

Species Status:

- X - Exotic, ie. animals introduced after the Western discovery of the islands.

Vegetation Types:

- KIS - Kiawe-'Ilima Scrub
- KIF - Kiawe-'Ilima Forest
- KHS - Koa-haole Scrub
- S - Strand

CHECK LIST OF PLANTS AND ANIMALS

SCIENTIFIC NAME	COMMON NAME	STATUS	FR	FR	RELATIVE ABUNDANCE									
PLANT SPECIES					KIS	KIF	KHS	S						
MONOCOTYLEDONAE														
GRAMINEAE														
Cenchrus ciliaris L.	Buffelgrass	X			O	O	C	C						
Chloris virgata Swartz	Feather fingergrass	X			C	C	C	O						
Digitaria ciliaris (Retz.) Koeler		X			O	O	U	U						
Echinochloa colona (L.) Link	Jungle-rice	X			U	–	–	R						
Heteropogon contortus (L.) Beauv. ex R. & S.	Pili grass	I			C	C	O	U						
Panicum maximum Jacq.	Guinea grass	X			–	R	–	–						
P. torridum Gaud.	Kakonakona	E			O	R	U	U						
P. sp.		E			O	O	O	U						
Rhynchelytrum repens (Willd.) C.E. Hubb.	Natal redtop	X			R	–	–	–						
Setaria verticillata (L.) Beauv.	Bristly foxtail	X			O	O	U	U						
DICOTYLEDONAE														
ASCLEPIADACEAE														
Gomphocarpus physocarpus E. Mey.	Balloon plant	X			R	–	–	–						
CHENOPODIACEAE														
Atriplex semibaccata R. Br.	Australian salt bush	X			–	–	–	U						
Chenopodium album L.	Lamb's quarters	X			R	U	–	R						
COMPOSITAE														
Bidens pilosa L.	Spanish needle	X			R	U	–	–						
Centaurea melitensis L.	Napa thistle	X			R	–	–	–						
Emilia javanica (Burm. f.) C.B. Robins.	Red pua-lele	X			–	–	–	R						
Lipochaeta heterophylla Gray	Nehe	E			U	R	–	O						
L. lavarum (Gaud.) DC.	Nehe	E			R	U	–	–						
Sonchus oleraceus L.	Sow thistle	X			–	–	R	R						
Tridax procumbens L.	Coat buttons	X			–	–	–	R						
Vernonia cinerea (L.) Less.	Ironweed	X			O	O	–	O						
Xanthium saccharatum Wallr.	Cocklebur	X			U	–	–	–						
Zinnia pauciflora L.	Wild zinnia	X			O	O	R	R						
CONVOLVULACEAE														
Ipomoea cairica (L.) Sweet	Koali	I			R	–	–	–						
Jacquemontia sandwicensis Gray	Pa'u-o-hi'iaka	E			R	–	–	O						
Merremia aegyptia (L.) Urban	Hairy merremia	X			C	O	O	U						
CUCURBITACEAE														
Momordica charantia var. pavel Crantz	Peria	X			–	R	–	U						
EUPHORBIACEAE														
Euphorbia hirta L.	Garden spurge	X			U	U	R	–						

SCIENTIFIC NAME	COMMON NAME	STATUS	FR	FH	RELATIVE ABUNDANCE			
PLANT SPECIES					KIS	KIF	KHS	S
LEGUMINOSAE								
Acacia farnesiana (L.) Willd.	Klu	X						
Canavalia lanaiensis Deg. & Deg.	Lanai jackbean	E	C-1	Vr, R	O	R	O	U
Cassia leschenaultiana DC.	Partridge pea	X			–	–	–	U
Desmanthus virgatus (L.) Willd.	Virgate mimosa	X			O	U	R	U
Leucaena leucocephala (Lam.) de Wit	Koa-haole	X			O	O	U	U
Phaseolus lathyroides L.	Cow pea	X			U	O	A	U
Prosopis pallida (Humb. & Bonpl. ex Willd.) HBK.	Kiawe	X			O	U	U	O
					A	A	U	U
MALVACEAE								
Abutilon incanum (Link) Sweet	Hoary abutilon	I			C	C	C	U
Gossypium sandvicense Parl.	Ma'o	E			O	O	–	O
Sida fallax Walp.	'Ilima	I			A	A	A	C
NYCTAGINACEAE								
Boerhavia herbstii Fosb.		E			U	O	R	O
PORTULACACEAE								
Portulaca oleracea L.	Common purslane	X			U	–	U	U
SOLANACEAE								
Lycopersicon pimpinellifolium Mill.	Currant tomato	X			R	–	–	–
STERCULIACEAE								
Waltheria americana L.	'Uhaloa	I			C	O	U	O
VERBENACEAE								
Lantana camara L.	Lantana	X			–	R	–	–
ZYGOPHYLLACEAE								
Tribulus cistoides L.	Nohu	I			–	–	–	R
ANIMAL SPECIES								
BIRDS								
COLUMBIDAE								
Geopelia striata striata	Barred dove	X			X	X	X	X
Streptopelia chinensis chinensis	Lace-necked dove	X			X	X	X	–
PLOCEIDAE								
Paroaria coronata	Red-crested cardinal	X			–	X	–	–
Passer domesticus	House sparrow	X			X	X	X	–
Richmondena cardinalis	Kentucky cardinal	X			X	X	–	–
STURNIDAE								
Acridotheres tristis tristis	Common mynah	X			X	X	X	X
MAMMALS								
CERVIDAE								
Axis axis	Axis deer	X			X	X	X	X

MANELE PD EXTENSION

BIOLOGICAL SURVEY

AND

CANAVALIA STATUS REPORT

Prepared for: M & E Pacific, Inc.

By: Kenneth M. Nagata

Date: [illegible] 1990

INTRODUCTION

The project area encumbering 173 acres is situated on the south coast of Lanai west of Manele between 330' and 620' elevation. Ripperton and Hosaka (1942) classified the vegetation of the region as one of lowland xerophytic shrubs with a coastal fringe of kiawe trees (Prosopis pallida) (Zone A). Conspicuous shrubs in this arid environment include klu (Acacia farnesiana), koa-haole (Leucaena leucocephala), and 'ilima (Sida fallax). Koa-haole is dominant in gully floors and rich alluvial flats while 'ilima is widely distributed throughout the area. Because of the arid conditions, herb cover is sparse and consists mainly of annual grasses such as bristly foxtail (Setaria verticillata), swollen fingergrass (Chloris inflata), feather fingergrass (C. virgata) and pili (Heteropogon contortus).

Recent surveys in the region indicate that the present vegetation closely resembles that described by Ripperton and Hosaka. The slopes behind Manele and Hulupoe were found to be dominated by xerophytic scrub consisting of koa-haole, 'ilima and kiawe (M & E 1986). The herb layer consisted of annual grasses, Spanish needle (Bidens pilosa), wild zinnia (Zinnia pauciflora), hairy merremia (Merremia aegyptia), 'uhaloa (Waltheria americana), partridge pea (Cassia leschenaultiana) and hoary abutilon (Abutilon incanum).

Similar vegetation has been reported from the slopes makai of the proposed project area (Nagata 1988). The vegetation here consists of scattered scrubby kiawe trees, a shrub layer of 'ilima, hoary abutilon and 'uhaloa and an herb layer of feather fingergrass, buffelgrass and pili. Four vegetation types were identified. The Kiawe-'Ilima Scrub, the predominant community, consists of widely scattered kiawe trees 2-5 m height, a well developed shrub layer of 'ilima, and an herb layer of feather fingergrass, buffelgrass and the dominant pili. In areas where moisture and soil are more readily available the vegetation grades into Kiawe-'Ilima Forest. This community is similar in composition to

the scrub community and differs only in canopy cover and height of the kiawe. Koa-haole Scrub is characterized by widely scattered koa-haole shrubs 2-4 m tall, a well developed shrub layer of 'ilima and hoary abutilon and an herb layer of feather fingergrass and buffelgrass. The smallest community, the Strand, is found along the cliffs. It is poorly developed and is defined by the distribution of pa'ū-o-hi'iaka (Jacquemontia sandwicensis).

The following common urban and field birds have been recorded in the Manele-Hulupoe area: common mynah (Acridotheres tristis), house sparrow (Passer domesticus), Kentucky cardinal (Richmondena cardinalis), red-crested cardinal (Paroaria coronata), barred dove (Geopelia striata) and lace-necked dove (Streptopelia chinensis) (M & E 1986). In addition, two game birds - Indian gray francolin (Francolinus pondicerianus) and the turkey (Meleagris gallopavo) - were also observed in the region.

Similar species were observed in the land makai of the present project site. The most abundant birds, found in all vegetation types, were the common mynah and barred dove. Turkeys and francolins, however, were not seen in this area. Two seabirds, tentatively identified as red-tailed tropicbird (Phaethon rubricauda rothschildi) and Bulwer's petrel (Bulweria bulwerii) were observed just offshore. These were believed to be transient rather than resident species. Axis deer (Axis axis) were abundant throughout the region.

METHODS

A walk-through survey was conducted during February after some heavy rains to determine the vegetational composition of the project site. Transects with 70-80% coverage were established throughout the site. Special emphasis was given to native plant communities and rare and endangered species. A cursory inventory of animals was conducted in conjunction with the vegetational survey. Observations were made along vegetation transects and listening posts were established at intervals. Nests were not investigated and no quantitative data were recorded.

RESULTS

FLORA

The vegetation in the present project area was found to be almost identical to that of the lower slopes. Generally it consists of scrubby kiawe trees, a well developed shrub layer of 'ilima and an herb layer of pili and feather fingergrass. Three vegetation types were recognized and are depicted on the accompanying vegetation map with distinct boundaries. It must be remembered, however, that in nature no sharp boundaries exist. Rather, the vegetation exists as a continuum with one type gradually grading into another.

Kiawe-'Ilima Scrub (KIS)

The Kiawe-'Ilima Scrub was considered the dominant vegetation type on the lower slopes (Nagata 1988) and continues in that role in the present project site. It is characterized by scattered kiawe 8-15' tall with less than 50% canopy cover, a dense shrub layer of 'ilima 1-3' tall and a well developed herb layer of pili and feather fingergrass. Kiawe becomes less abundant towards the west portion of the site. Here the Scrub grades into the Koa-Haole Scrub. Pili is well distributed throughout the site in large numbers and is abundant in some areas especially in the upper portion of the property. Perhaps due to recent heavy rains the total vegetational cover exceeds 90%. All pockets of soil supported significant amounts of vegetation. Present in moderate numbers were koa-haole, 'uhaloa, partridge pea, klu (Acacia farnesiana) and ironweed (Vernonia cinerea).

Kiawe-'Ilima Forest (KIF)

This vegetation type was only found in the major ravines. Species composition is somewhat similar to that of the Kiawe-'Ilima Scrub from which it differs in the abundance, canopy cover and stature of the kiawe. Generally, the

trees are more abundant, taller (15-25') and provide canopy cover exceeding 50%. 'Ilima and virgate mimosa (Desmanthus virgatus) are the dominant shrubs and pili and buffelgrass are common in the herb layer. Few other species were found in this community.

Koa-Haole Scrub (KHS)

In the west end of the project site, koa-haole replaces kiawe as the dominant arborescent species and the vegetation grades into a Koa-Haole Scrub. This community is characterized by widely scattered, mostly dead or dying koa-haole 5-10' tall. 'Ilima continues to be the dominant shrub and pili is dominant in the herb layer. Feather fingergrass is a common species and 'uhaloa was present in moderate numbers. Only five other species were recorded from this community.

FAUNA

The faunal composition of the site was found to be similar to that of the lower slopes. Kentucky cardinals, barred doves and Japanese white-eyes were observed in the Kiawe-'Ilima Scrub and the Kiawe-'Ilima Forest. Lace-necked doves were only seen in the Kiawe-'Ilima Scrub. Mynahs and ricebirds were present in all vegetation types. Although not actually observed, francolins (Francolinus sp.) were heard in the Kiawe-'Ilima Scrub. Deer trails and droppings were abundant throughout the project site and three of these animals were actually sighted. It is possible that mice (Mus musculus domesticus) and one or more species of rats (Rattus spp.) may also be present in the site.

SUMMARY

Only six native plant species are present in the site. Two are considered endemic and four are indigenous. Of these, 'ilima and pili, both common indigenous species, are found in great abundance. Consequently, a large amount

of native plants will be destroyed by the proposed project. All of the species involved are common to similar habitats on one or more islands in the archipelago. Furthermore, vegetation types identical to those in the project site can be found in other areas on Lanai. Thus it is believed that the proposed project will not detrimentally impact the integrity of the native flora.

Whenever such an extensive coastal project is undertaken, however, caution must be exercised to prevent excessive erosion and runoff into the sea. Steps may be taken to prevent soluble and particulate runoff as well as construction rubble from reaching the shoreline.

CANAVALIA UPDATE

During February 1990 following a period of heavy rains each of the confirmed populations of Canavalia lanaiensis (Nagata 1986, 1988) were visited. Census of each population is as follows:

SITE	PRIOR CENSUS	1990 CENSUS
Manele Gulch (1986)		
Colony 1	32	20
Colony 2	101	75
Colony 3	66	25
Colony 4	58	25
Colony 5	36	35
Puu Pehe (1986)	10	7
Gulch near Hulupoe (1986)	6	7
"Rural" Development Area (1988)	63	50

Generally speaking all populations are intact and thriving. The vines are robust, no signs of predation were evident and several had already gone to seed while several more were just coming into flower. A number of young seedlings were also present. The recent population counts are low compared to the previous census - 30% - 50% below the 1986 census in the Manele Gulch colonies. Three explanations are possible: 1)The recent rains have resulted in a thick herbaceous cover, especially of Guinea grass (Panicum maximum), pili and peria (Momordica charantia var. pavel). Dense growths of such rapid growing species

may have had a stifling effect on the germination of Canavalia seeds; 2)As evidenced by the presence of young seedlings, the germination process is not yet over; hard seeds such as those of Canavalia often germinate over a period of several months; 3)Natural variation: each year's population is dependent on the amount of seeds produced the previous year.

Canavalia lanaiensis has always been considered a rare species (see Nagata 1988). Recent taxonomic work on the genus, however, has shown that the species is identical to those found on Kauai, Niihau and East Maui and should be rightfully be called C. pubescens. Consequently, the U.S. Fish and Wildlife Service has re-evaluated the status of the species and in the next Federal Register, C. pubescens (including what we are presently calling C. lanaiensis) will be downgraded to Category II status (D. Herbst, pers. comm.). Category II plants are those which the U.S.F.W.S. does not have sufficient information to warrant listing as an Endangered Species. Additional information is required of plants in this category before they can be moved up into Category I status or further downgraded into Category III (plants which are no longer being considered for listing).

Despite the fact that the species is not as rare as once thought, efforts can be made to protect the integrity of the populations. Most of the plants appear to be in peripheral areas - two populations are in gulches and one is at the edge of a sea cliff (Puu Pehe) adjacent to a designated "Open Area". Only the population in the Manele "Rural" District seems to require some adjustment of the proposed development.

The following recommendations are reiterated:

1. Construction rubble and soluble and particulate runoff be prevented from spilling over into Manele Gulch and the gulch remain free of undue disturbence.

2. The appropriate holes of the proposed golf course in the "Rural" District be re-aligned in such a manner that construction activity and associated rubble and runoff would not physically impact the Canavalia population or alter its microclimate.

It is believed that if these measures are instituted the Canavalia populations presently recorded from the Manele Project District and Manele "Rural" Development Area will not be detrimentally affected by the proposed projects.

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SPECIES CHECKLIST

Plant families are arranged alphabetically in two groups - Monocotyledones and Dicotyledones. Genera and species are arranged alphabetically within each family. Taxonomy, common names and status of the plants generally follow that of St. John (1973). Taxonomy of bird species follows that of Berger (1981).

EXPLANATION OF SYMBOLS

Species Status:

- E - Endemic to the Hawaiian Islands, ie. occuring nowhere else in the world.
- I - Indigenous, ie. native to the Hawaiian Islands but also occuring naturally elsewhere.
- X - Exotic (alien), ie. plants introduced after the Western discovery of the islands.
- P - Polynesian, plants introduced before the Western discovery of the islands.

Vegetation types:

- KIS - Kiawe-'Ilima Scrub
- KIF - Kiawe-'Ilima Forest
- KHS - Koa-Haole Scrub

Relative Abundance Rating:

- A - Abundant, generally the major or dominant element in an area.
- C - Common, generally distributed throughout a given area in large numbers.
- O - Occasional, generally distributed throughout a given area in small numbers.
- U - Uncommon, observed uncommonly but more than 10 times in a given area.
- R - Rare, observed 2-10 times in a given area.
- X - Indicates presence only.

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS	N*	FH *	RELATIVE ABUNDANCE		
					KFS	KIF	KHS
MONOCOTYLEDONES							
GRAMINEAE							
Cenchrus ciliaris L.	Buffelgrass	X			U	C	U
Chloris virgata Swartz	Feather fingergrass	X			C	U	C
Digitaria ciliaris (Retz.) Koeler		X			U	-	-
Heteropogon contortus (L.) Beauv. ex R. & S.	Pili	I			C	C	A
Panicum maximum Jacq.	Guinea grass	X			-	R	-
Setaria verticillata (L.) Beauv.	Bristly foxtail	X			-	R	-
DICOTYLEDONES							
ASCLEPIADACEAE							
Gomphocarpus physocarpus E. Mey.	Balloon plant	X			R	-	-
CHENOPODIACEAE							
Chenopodium album L.	Lamb's quarters	X			-	R	-
COMPOSITAE							
Ageratum conyzoides L.	Ageratum	X			-	U	-
Bidens pilosa L.	Spanish needle	X			U	U	-
Emilia fosbergii Nicolson		X			U	-	-
Lipochaeta lavarum (Gaud.) DC.	Nehe	E			R	-	R
Vernonia cinerea (L.) Less.	Ironweed	X			O	U	U
Zinnia pauciflora L.	Wild zinnia	X			R	-	-
CONVOLVULACEAE							
Merremia aegyptia (L.) Urban	Hairy merremia	X			U	R	-
CUCURBITACEAE							
Momordica charantia var. pavel Crantz	Perla	X			-	R	-
EUPHORBIACEAE							
Euphorbia hirta L.	Garden spurge	X			U	U	-
LEGUMINOSAE							
Acacia farnesiana (L.) Willd.	Klu	X			O	-	U
Cassia leschenaultiana DC.	Partridge pea	X			O	U	R
Desmanthus virgatus (L.) Willd.	Virgate mimosa	X			U	A	-
Leucaena leucocephala (Lam.) de Wit	Koa-haole	X			O	U	C
Phaseolus lathyroides L.	Cow pea	X			U	-	U
Prosopis pallida (Humb. & Bonpl. ex Willd.) HBK.	Kiawe	X			C	A	U
MALVACEAE							
Abutilon incanum (Link) Sweet	Hoary abutilon	I			U	U	R
Sida fallax Walp.	'Ilima	I			A	A	A
NYCTAGINACEAE							
Boerhavia herbstii Fosb.		E			U	-	-

* Category not applicable

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS	N*	FH*	RELATIVE ABUNDANCE		
					KIS	KIF	KHS
STERCULIACEAE							
Waltheria americana L.	Uhaloa	I			O	U	O
VERBENACEAE							
Lantana camara L.	Lantana	X			-	R	-

CHECK LIST OF ANIMALS

BIRDS

COLUMBIDAE							
Geopelia striata	Barred dove	X			X	X	-
Streptopelia chinensis	Lace-necked dove	X			X	-	-
PHASIANIDAE							
Francolinus sp.	Francolin	X			X	-	-
PLOCEIDAE							
Lonchura punctulata	Ricebird	X			X	X	X
Richmondena cardinalis	Kentucky cardinal	X			X	X	-
STURNIDAE							
Acridotheres tristis	Common myna	X			X	X	X
ZOSTEROPIDAE							
Zosterops japonica	Japanese white-eye	X			X	X	-

MAMMALS

CERVIDAE							
Axis axis	Axis deer	X			X	X	X

* Category not applicable

B: MARINE RESOURCES ASSESSMENT

A QUANTITATIVE ASSESSMENT OF THE MARINE COMMUNITIES AND WATER QUALITY IN AN AREA AFFRONTING THE PROPOSED HULOPOE - MANELE BAY GOLF COURSE DEVELOPMENT

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EXECUTIVE SUMMARY

This study was undertaken to establish baseline conditions for the marine communities and water chemistry characteristics along a 2.7km section of coastline affronting a proposed development of approximately 185ha (458 acres) in and adjacent to Hulopoe Bay, Lanai. This development proposes to take the land from a natural state and develop a golf course and housing units. Identified environmental concerns include the potential impact of changes in (1) runoff and sedimentation during construction and (2) water quality due to the subsequent operation of the facilities on the adjacent marine communities and waters affronting the project site.

This study established baseline conditions in three areas: in Hulopoe Bay, in a control area about 4km to the east (Makole), and at two sites affronting the proposed golf course (Huawai Bay and Kaluakoi Point). The study was restricted to depths from shore to 20m (60 feet). Four major biotopes or zones were identified in these areas and all were present in Hulopoe Bay. The zones are: the biotope of low channels situated in deeper (12 to 20m) waters, the biotope of grooves in shallower more exposed locations, the biotope of sand which extends in places from shore to depths greater than 20m and the biotope of shallow high coral coverage in more wave protected locations.

In the study area 10 water quality and 10 marine community sampling stations were established to quantitatively assess pertinent water quality parameters and the marine macrobiota. The water chemistry sampling shows that a gradient exists from the shore decreasing in a seaward direction for certain dissolved nutrient species (nitrate and ammonia nitrogen, orthophosphate and silicate); oceanic waters are typically low in these nutrients. Other measures of water quality (turbidity, chlorophyll-a and salinity) suggest that the causal mechanism for these gradients is surface water runoff due to unusually heavy rainfall (1.2 inches in 24 hours) two days prior to sampling. These inputs resulted in the sampled waters not meeting State Department of Health water quality standards for nitrate and ammonia nitrogen, turbidity and chlorophyll-a irrespective of location (i.e., either along "developed - Hulopoe Bay" or undeveloped natural coastline). These data suggest that state water quality standards are often exceeded following rainfall events in completely undeveloped areas. Despite these occasional events, the waters affronting the project site are typical of well-flushed, open Hawaiian coasts.

The analysis of marine fish and benthic communities noted no unusual components present; interestingly, the most diverse fish communities were located outside of the Hulopoe MLCD in the con-

trol area (Makole). The greatest benthic and fish community development was found in the biotope of shallow high coral coverage and least in the biotope of sand. The biotope of shallow high coral coverage occurs in areas somewhat protected from occasional storm surf and primarily within 100m of the shoreline where appropriate hard substratum is present. Despite the occasional input of sediment and runoff from storms inudating the shallow areas adjacent to shore, these diverse communities persist. This suggests that sedimentation and runoff have less negative influence on these marine communities than does occasional high wave energy due to storms. Thus the potential for impact from sedimentation with the proposed development is probably small.

Longterm water quality studies (e.g. for dissolved nutrients, pesticides and herbicides) in a resort setting on the West Hawaii coast have noted statistically significant increases in nutrient concentrations since development; however, these increases fall within the range of dissolved inorganic nutrient concentrations found in completely natural (undisturbed) systems along that coast. Furthermore 100m seaward of the shoreline, these changes are not chemically detectable. Other than naturally occurring arsenic, the studies have found no indication of pesticides or herbicides present in groundwater emanating at the shoreline. Aquatic biota in either brackish or marine waters subjected to elevated nutrient levels have shown no response probably because of (1) the presence of numerous herbivores controlling algal growth, (2) high dilution and advection rates of incoming high nutrient water and (3) a probable preadaptation of these organisms to waters with highly variable nutrient concentrations.

Development on the West Hawaii coast is situated on very porous geologically young lavas no more than a few meters above sealevel with only a minimal layer of soil. In contrast, the south Lanai coast is geologically older and has greater soil depth; most of the proposed development lies more than 30m above sealevel. Thus the opportunity for leaching of materials to the watertable at Hulopoe would be less than on the West Hawaii coast.

These data suggest that if elevation of nutrient levels were to occur with the proposed development, more time would pass prior to detection of the increases due to local geology and that the impact would, in any case, not be discernible in the biota of adjacent marine communities. The species composition of marine communities along Lanai's south coast are similar to those at West Hawaii; thus, one would expect a similar lack of response by these communities to the proposed development.

INTRODUCTION

Purpose

Hulopoe Bay on the south shore of Lanai has been designated a Marine Life Conservation District (MLCD) because of the exceptional marine communities in the area. With the development of the Manele Bay Hotel affronting the MLCD, concern has surfaced that the construction of the hotel and adjacent proposed golf course as well as their subsequent operation would have a negative impact to nearby marine communities and the quality of the surrounding waters. This concern has lead to steps being taken to develop a comprehensive management plan to protect the resources of Hulopoe and environs. As a first step to this management plan we suggested that a quantitative survey of the biota and extant water quality conditions be conducted to establish baseline conditions against which man's impacts could be assessed. It was further suggested that periodic monitoring surveys be carried out to define ranges of natural variation as well as to detect any departures from baseline conditions which could be attributable to human activities. This document has been prepared (1) to provide a quantitative description of the marine macrobiota and water quality conditions in the waters affronting the Manele Bay Hotel and to the west as well as (2) to serve as the first phase of the comprehensive management plan to protect marine resources in the Hulopoe Bay area.

Strategy

Marine environmental surveys are usually performed to evaluate feasibility of and ecosystem response to specific proposed activities. Appropriate survey methodologies reflect the nature of the proposed action(s). An acute potential impact (as channel dredging) demands a survey designed to determine the route of least harm and the projected rate and degree of ecosystem recovery. Impacts that are more chronic or progressive require different strategies for measurement. Management of chronic stress to a marine ecosystem demands identification of system perturbations which exceed boundaries of natural fluctuations. Thus a thorough understanding of normal ecosystem variability is required in order to separate the impact signal from background "noise".

The potential impacts confronting the Hulopoe Bay marine ecosystem are most probably those associated with chronic or progressive stresses. Other than changes in runoff characteristics caused by the introduction of cattle to Lanai in the last century, terrigenous input to the bay and environs has probably

remained fairly constant due to the dry climate in the watershed. (These inputs are most obvious following heavy rainfall). Direct human impacts on the bay ecosystem, such as fishing pressure and physical damage from vessel anchors, have diminished since the bay was declared a Marine Life Conservation District about ten years ago. However, the modifications to land use in the watershed with resort construction and surrounding proposed golf course development may bring alterations to the quantity and quality of the runoff. Recreational activities in the bay could result in additional nutritional subsidies and other impacts to the ecosystem.

Monitoring strategies for assessing chronic stresses rely on comparative spatial and temporal evaluations of ecosystem structure and function in relation to ambient conditions. Usually in order to reliably detect system perturbations, detailed quantitative descriptions of the pre-development environment are necessary as a "benchmark" against which later studies may be comparatively analyzed. However, development has commenced at Hulopoe Bay and the preconstruction benchmark is not available. Thus a strategy employing comparative analysis of quantitative data taken from a series of temporal (times) and spatial (localities) scales should allow the delineation of change as it occurs. Hence the strategy of this study is to conduct comparative analyses of marine communities directly affronting the project site and at selected areas well removed to serve as controls. These sites are to be sampled at a number of points in time. The sampling schedule as presently proposed is to (1) establish a benchmark, (2) if the project proceeds, sample once every three months during the construction of the golf course, and (3) conduct post-construction surveys approximately once every nine months to determine system equilibrium. Such a sampling strategy will assist in establishing the baseline conditions in Hulopoe Bay as well as aid in defining changes that may later occur. This document reports on the first field effort, thus establishing the first "benchmark".

MATERIALS AND METHODS

A. BENTHIC STUDIES

The fieldwork which provided the database for this baseline study of the marine macrobiota offshore of the Manele Bay Hotel and environs was carried out on 21-23 December 1989. The area encompassed in this survey is given in Figure 1; it includes the nearshore region from the shore, seaward to approximately the 20m (60 foot) isobath up to 620m from shore affronting Hulopoe Bay and is bordered by Sharks Bay (Puupehe) on the east and Huawai Bay about 2.6km to the west

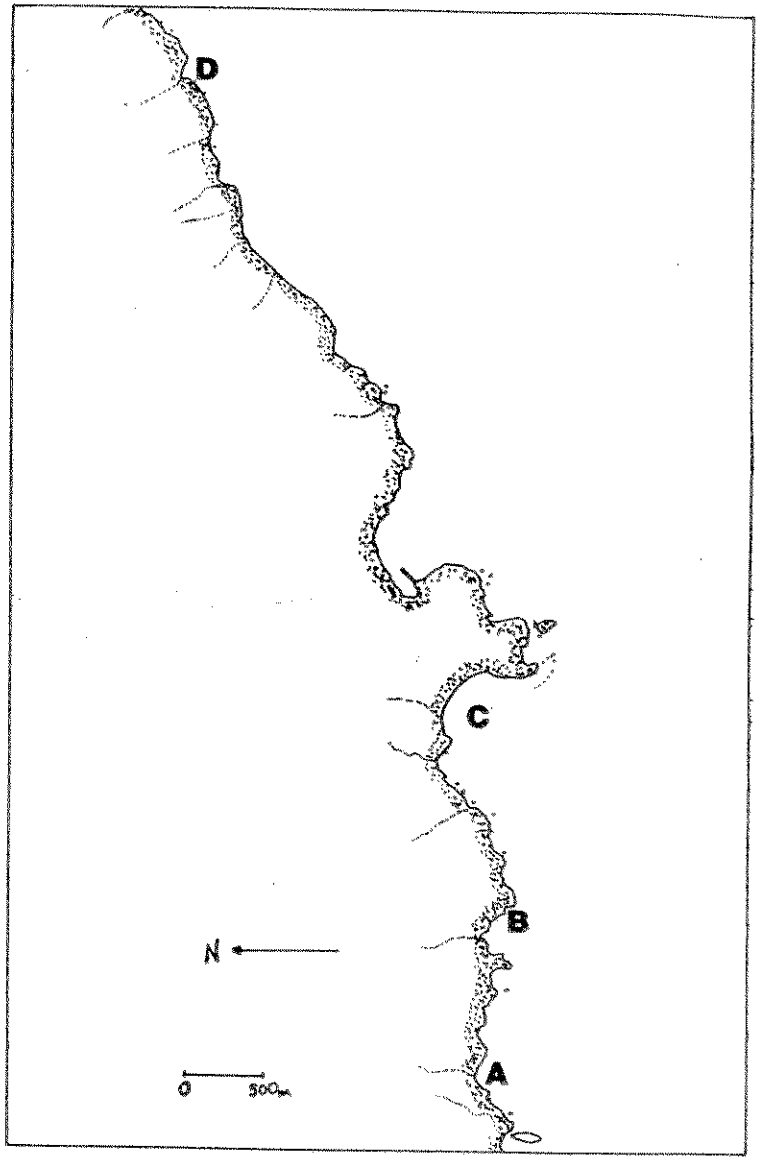

FIGURE 1. Map showing the boundaries of the project area. Sites examined in this study include those affronting the proposed golf course at Huawai Bay ("A" on the map) and Kaluakoi Point ("B"), Hulopoe Bay ("C"), and the control site ("D") at Makole. Map redrawn from USGS 7.5 x 15 minute quadrangle map No. 20156-F7-TM-025. Shoreline is stippled; intermittent streams are shown as stippled lines.

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The quantitative sampling of macrofauna of marine communities presents a number of problems; many of these are related to the scale on which one wishes to quantitatively enumerate organism abundance. Marine communities in the Hulopoe Bay region may be spatially defined in a range on the order of a few hundred square centimeters (such as the community residing in a Pocillopora meandrina coral head) to major biotopes covering many hectares. Recognizing this ecological characteristic, we designed a sampling program that attempted to delineate all major extant communities in the limits of the study area and to quantitatively describe these communities. Thus, a number of methods were used.

To obtain an overall perspective on the extent of the major communities or "zones" occurring in the study area, divers were slowly towed behind a skiff over most of the study site from shore seaward to the 20m isobath (the outer limits for this study). This exercise allowed the qualitative delineation of major biotopes based partially on the presence of large structural elements (e.g., amount of sand, hard substratum, fish abundance, coral coverage or dominant coral species). Within each of these a number of stations were established and quantitative studies were conducted, including visual enumeration of fish, counts along benthic transect lines and cover estimates in benthic quadrats. Besides these quantitative measures, a qualitative reconnaissance was made in the vicinity of each station by swimming and noting the presence of species not encountered in the transects. All assessments were carried out using SCUBA.

The location of stations were subjectively chosen as being representative of a given biotope and were also selected as to coincide with appropriate points for sampling in water quality studies. Immediately following site selection, a visual fish census was undertaken to estimate the abundance of fishes. These censuses were conducted over a 25 x 4m corridor and all fishes within this area to the water's surface were counted. Data collected included species, numbers of individuals and with larger fish, an estimate of their length; the length data were later converted to standing crop estimates using linear regression techniques. A single diver equipped with SCUBA, transect line , slate and pencil would enter the water, count and note all fishes in the prescribed area (method modified from Brock 1954). The 25m transect line was paid out as the census progressed, thereby avoiding any previous underwater activity in the area which could frighten wary fishes.

Fish abundance and diversity is often related to small-scale topographical relief over short linear distances. A long transect may bisect a number of topographical features (e.g., cross coral mounds, sand flats, and algal beds), thus sampling more than one community and obscuring distinctive features of individual communities. To alleviate this problem, a short transect

(25m in length) has proven adequate in sampling many Hawaiian benthic communities (Brock and Norris 1989).

Besides frightening wary fishes, other problems with the visual census technique include the underestimation of cryptic species such as moray eels (family Muraenidae) and nocturnal species, e.g., squirrelfishes (family Holocentridae), aweoweos or bigeyes (family Priacanthidae), etc. This problem is compounded in areas of high relief and coral coverage affording numerous shelter sites. Species lists and abundance estimates are more accurate for areas of low relief, although some fishes with cryptic habits or protective coloration (e.g., the nohus, family Scorpaenidae; the flatfishes, family Bothidae) might still be missed. Obviously, the effectiveness of the visual census technique is reduced in turbid water and species of fishes which move quickly and/or are very numerous may be difficult to count and to estimate sizes. Additionally, bias related to the experience of the diver conducting counts should be considered in making any comparisons between surveys. In spite of these drawbacks, the visual census technique probably provides the most accurate non-destructive method available for the assessment of diurnally active fishes (Brock 1982).

After the assessment of fishes, an enumeration of epibenthic invertebrates (excluding corals) was undertaken using the same transect line as established for fishes. Exposed invertebrates usually greater than 2cm in some dimension (without disturbing the substratum) were censused in a 4 x 25m area. As with the fish census technique, this sampling methodology is quantitative for only a few invertebrate groups, e.g., some of the echinoderms and holothurians. Most coral reef invertebrates (other than corals) are cryptic or nocturnal in their habits making accurate assessment of them in areas of topographical complexity very difficult. This, coupled with the fact that the majority of these cryptic invertebrates are small, necessitates the use of methodologies that are beyond the scope of this survey (e.g., see Brock and Brock 1977). Recognizing constraints on time and the scope of this survey, the invertebrate censusing technique used here attempted only to assess those few macroinvertebrate species that are diurnally exposed.

Exposed sessile benthic forms such as corals and macrothalloid algae were quantitatively surveyed by use of quadrats and the point-intersect method. The point-intersect technique only notes the species of organism or substratum type directly under a point. Along the previously set fish transect line, 50 such points were assessed (once every 50cm). These data have been converted to percentages. Quadrat sampling consisted of recording benthic organisms, algae and substratum type present as a percent cover in six one-meter square frames placed at five-meter intervals along the transect line established for fish censusing (at 0, 5, 10, 15, 20 and 25m).

If macrothalloid algae were encountered in the 1 x 1m quadrats or under one of the 50 points, they were quantitatively recorded as percent cover. Emphasis was placed on those species that are visually dominant and no attempt was made to quantitatively assess the multitude of microalgal species that constitute the "algal turf" so characteristic of many coral reef habitats.

During the course of the fieldwork, notes were taken on the number, size and location of green sea turtles and other threatened or endangered species seen within or near to the study area. Additionally, casual observations were made on recreational use patterns as observed within the study area while carrying out other field studies. Further information on threatened or endangered species was obtained by questioning users familar with the area.

B. WATER CHEMISTRY STUDIES

Water quality parameters were measured at 10 locations (Station numbers 1 through 10) at the surface (about 20cm below the air-water interface). The location of these stations is presented in Figure 2. Water quality parameters that were evaluated are specific criteria designated for "open coastal waters" in Title 11, Chapter 54, Amended Administrative Rules for Water Quality Standards. These criteria include ammonia nitrogen, nitrate + nitrite nitrogen, total nitrogen, orthophosphate phosphorus, total phosphorus, chlorophyll-a and nephelometric turbidity. Also collected were samples for the non-specific criteria including oxygen, temperature, pH and salinity as well as the nutrient, silica at each station.

Water samples for nutrient analyses were taken in 125ml acid-washed polyethylene bottles. These samples were filtered through glass fiber filters in the field, immediately placed on ice and subsequently frozen until analysis. Analyses for ammonium, nitrate + nitrite and orthophophate were carried out using standard techniques; inorganic and total (after oxidation) nutrient analyses were determined using manual spectrophotometric techniques on a fiber optic colorimeter. All samples were collected and measured in triplicate; data are presented as means. The analytical procedures followed those given in Standard Methods (1985) with modifications according to Strickland and Parsons (1972).

Turbidity samples were collected as unfiltered water and stored on ice in 250ml polyethylene bottles until measurements were made. Turbidity was measured on a Monitek Laboratory Nephelometer following the procedures as described in Standard Methods (1985). The instrument was calibrated as specified by the Environmental Protection Agency with standard formazin

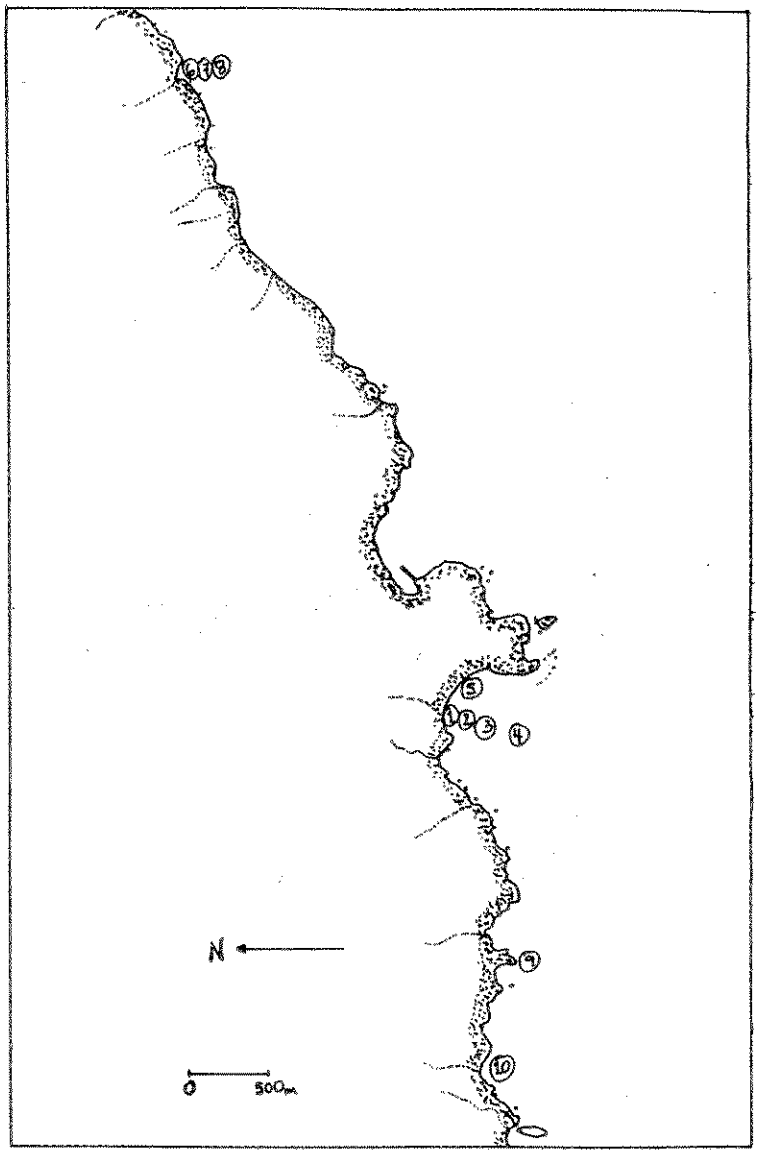

FIGURE 2. Map showing the locations of the ten water quality sampling stations assessed in this study. Map redrawn from USGS 7.5 x 15 minute quadrangle map No. 20156-F7-TM-025. Shoreline is stippled; intermittent streams are stippled lines.

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solutions prior to and after sample measurements. Prior to measurement, samples were throughly mixed to disperse particulate materials and measured in duplicate when all air bubbles disappeared.

Chlorophyll-a samples were collected by filtering known volumes of seawater through glass microfiber filters; filters were stored in acetone and the samples frozen until laboratory analyses were carried out. Laboratory procedures followed Standard Methods (1985) and pigments were extracted and determined fluorometrically. Salinity samples were collected in 250ml polyethylene bottles in the field, filled completely and capped tightly until measurement by tritration (EPA method 325.3) in the laboratory. In the field oxygen and temperature were measured using a YSI Model 58 meter and pH was determined using a Cole-Parmer digisense millivolt meter.

RESULTS

WATER CHEMISTRY

Water quality parameters as specified by the State Department of Health (DOH) Water Quality Standards were collected and measured about 20cm below the water surface at ten locations affronting the project site and in a control area. The station locations are given in Figure 2. The waters affronting the project site are classified as open coastal waters by the state (Chapter 11-54) and the standards are given in Table 1 for comparative purposes.

Table 2 presents a synopsis of the water chemistry parameters measured in this study. There are several trends apparent in these data: (1) the concentrations of dissolved nutrients (orthophosphate, nitrite+nitrate, ammonium and silicate) decrease with distance from shore, (2) salinity shows a weak increase with distance from shore and (3) the geometric means for nitrate+nitrite nitrogen, ammonia nitrogen, turbidity and chlorophyll-a all exceed state water quality standards for "dry" coastlines. Dry coastlines are those receiving less than three million gallons of freshwater discharge per shoreline mile. The gradients are probably related to unusually heavy rainfall during the week preceding the water quality sampling and/or the possible diffuse input of groundwater along the shoreline. Both silica and nitrate+nitrite nitrogen usually exist in high concentration in groundwater owing to metabolism of organic material and mineral dissolution; these ions are in low concentration in open ocean waters and hence they (along with salinity) may serve as tracers for freshwater (groundwater or stream) input into oceanic settings.

TABLE 1. Specific criteria specified by the Department of Health water quality standards for open coastal waters as amended in 1988.

Parameter	Geometric mean not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value
Total Nitrogen (ug N/L)	150.00* 110.00**	250.00* 180.00**	350.00* 250.00**
Ammonia Nitrogen (ug NH_4-N/L)	3.50* 2.00**	8.50* 5.00**	15.00* 9.00**
Nitrate+Nitrite Nitrogen (ug[NO_3+NO_2]-N/L)	5.00* 3.50**	14.00* 10.00**	25.00* 20.00**
Total Phosphorus (ug P/L)	20.00* 16.00**	40.00* 30.00**	60.00* 45.00**
Chlorophyll-a (ug/L)	0.30* 0.15**	0.90* 0.50**	1.75* 1.00**
Turbidity (NTU)	0.50* 0.20**	1.25* 0.50**	2.00* 1.00**

* "Wet" criteria apply when the open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile.

** "Dry" criteria apply when the open coastal waters receive less than three million gallons per day of fresh water discharge per shoreline mile.

Applicable to both "wet" and "dry" conditions:

Salinity - Shall not vary more than 10 percent from natural or seasonal changes considering hydrologic input and oceanographic factors.

Orthophosphate was eliminated from the list of requirements in the revised 1988 document but becasue of its biological importance, it was measured in this study. The old "wet" criteria was 7.00ug/L and "dry" standard was 5.00ug/L.

TABLE 2. Summary of the water quality parameters as measured at 10 sites in the study. In the body of the table concentrations of dissolved nutrients given in U/L. Geometric means given at the foot of the table for each species measured; single underlined values exceed "dry" Department of Health water quality standards and double underlined values are in excess of the "wet" standards.

Station	Nitrate N	Ammonia N	Total N	Ortho-P	Total P	Silicate
1	11.43	3.03	73.50	6.61	8.99	196.56
2	8.96	2.75	74.20	5.99	9.92	84.28
3	8.45	3.64	76.86	5.79	9.92	95.48
4	0.70	0.89	57.68	3.19	8.68	22.40
5	6.16	3.03	71.82	5.27	9.92	28.00
6	10.41	2.80	67.62	4.34	8.99	185.36
7	3.59	2.01	58.10	4.03	8.68	28.00
8	1.59	1.35	59.78	3.41	8.68	33.60
9	3.78	2.42	59.78	4.24	9.61	28.00
10	3.08	3.03	59.50	4.44	8.68	39.20
GEOMETRIC MEAN	4.27	2.32	65.49	4.61	9.19	53.44

Station	Turbidity (NTU)	Chlorophyll a (ug/l)	Salinity (°/oo)	Temp (°C)	Oxygen (% Sat)	pH
1	0.81	1.20	33.0	25.5	100	8.0
2	0.35	0.58	33.4	25.7	102	8.0
3	0.47	0.41	33.5	25.7	99	8.1
4	0.11	0.27	33.5	25.6	100	8.1
5	0.22	0.27	33.2	25.6	101	8.1
6	4.10	0.56	33.0	25.4	97	8.0
7	0.12	0.51	33.2	25.5	100	8.1
8	0.21	0.55	33.4	25.6	101	8.1
9	0.13	0.47	32.5	25.7	100	8.1
10	0.18	0.25	33.0	25.7	101	8.1
GEOMETRIC MEAN	0.31	0.46	33.2	25.6	100	8.1

Two groups of samples were collected fronting natural intermittent streambeds; sample numbers 1 through 4 were taken in Hulopoe Bay affronting and offshore of the gulch just west of the hotel and sample numbers 6 through 8 were offshore of unnamed intermittent streambed at Makole about 500m west of Kawaiu Gulch, an area which served as a control site for this study. Samples 1 and 6 were taken at the shoreline, sample 2 about 60m offshore, sample 7 at 100m offshore, sample 3 at 130m offshore and samples 4 and 8 at about 500m offshore. Thus the presence of gradients in the concentrations of these parameters are not surprising considering the rainfall that preceded sampling. Sample numbers 9 and 10 were collected affronting the proposed golf course at a distance of 60 to 70m from the shoreline.

BIOLOGICAL

The qualitative reconnaissance to define major biotopes affronting Hulopoe Bay and environs extended from the shoreline to approximately the 20m isobath up to 650m from shore and from Sharks Bay at Puupehe Point on the east to Kaluakoi Point about 1.5km to the west (Figure 3). In total more than 38ha (95 acres) were surveyed in the bay and four biotopes were recognized. The physical extent of each is shown in Figure 3. It should be noted that the boundaries of each zone are not sharp but rather grade from one to another; these are ecotones or zones of transition. Biotopes were delimited by physical characteristics including water depth, relative exposure to wave and current action, and the major structural components present in the benthic communities. The latter include the amount of sand, hard substratum, and vertical relief present as well as the biological attributes of relative coral coverage, fish abundance, and dominant species of the coral community. Biotopes were named for distinctive features of each as shown in Figure 3.

The biotope of sand dominates the eastern and central parts of Hulopoe Bay and it extends from the shore where it forms the white sand beach at Hulopoe up to 375m offshore. This biotope is roughly pie-shaped with the apex pointing seaward. Offshore of this (and at depths outside of this study) the biotope of sand is a dominant feature affronting Hulopoe Bay. Because of the lack of appropriate shelter and solid substratum, benthic and fish communities are poorly developed; Station 3 sampled the communities in this biotope. Sandwiched on either side of the biotope of sand are the biotope of grooves and low coral cover (on the eastern flank) and the biotope of shallow high coral cover to the west. Station 2 sampled the biotope of grooves and low coral cover and Station 4 was situated in the biotope of shallow high coral cover. Across much of the mouth of Hulopoe Bay is the biotope of low channels. The biotope of low channels commences in water about 12m in depth and continues to depths in excess of 20m (the lower depth limit of this study). Stations 1 and 5

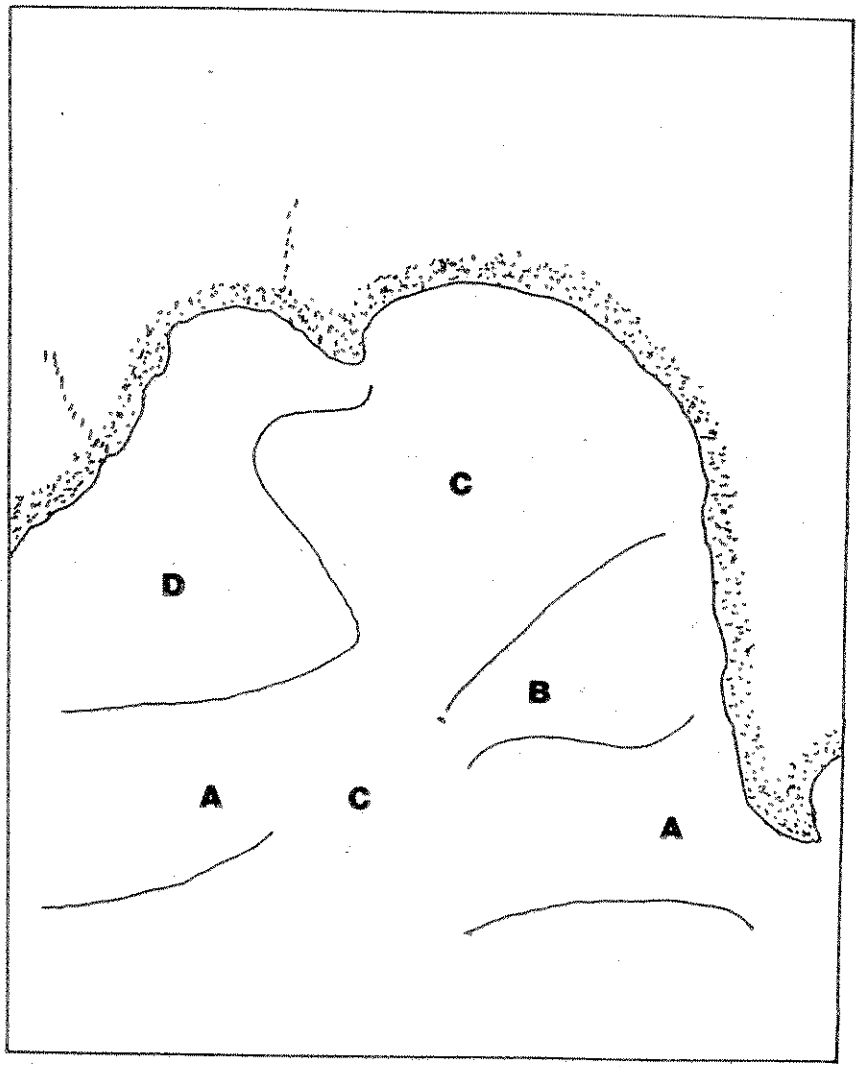

FIGURE 3. Map of Hulopoe Bay and environs showing the approximate boundaries of the four biotopes recognized in this study. These biotopes are (A) the biotope of low channels, (B) the biotope of grooves and low coral cover, (C) the biotope of sand and (D) the biotope of shallow high coral cover. Shoreline is stippled and intermittent streams are shown as stippled lines. Scale 1cm = 60m.

sampled the biotope of low channels.

In the area selected as a control site (east of Kawaiu Gulch at Makole) three of the above biotopes were recognized and sampled. These biotopes are the biotope of sand (Station 7), the biotope of low channels (Station 6) and the biotope of shallow high coral cover (Station 8). Offshore of the proposed golf course west of Hulopoe Bay a major biotope encountered is the biotope of grooves; both Stations 9 and 10 sampled this biotope.

The stations for quantitative biological sampling were selected to be representative of a given biotope. The locations of stations are given in Figures 3 and 4 and the results of the biological inventory of the biotopes in the three areas (Hulopoe Bay, the control site at Makole, and the golf course area) are presented below.

Hulopoe Bay

The Biotope of Low Channels

The substratum in the biotope of low channels is comprised of a mix of sand, rubble and live coral. In general the biotope is dominated by low mounds of rubble and the corals, Porites lobata and P. compressa. These mounds are elongate, ranging in length from 15 to 80m, are from 5 to 35m in width and are spaced from 1 to 8m apart. The mounds attain heights of up to 1m and are oriented perpendicular to shore; between them are channels with a sand and rubble substratum. Near the seaward margin of the study area are areas of emergent hard substratum (basalt) which form small steps (up to 1m in height) oriented parallel to shore. The low mounds of corals and rubble spill over these basalt "steps". The biotope of low channels affords a reasonable amount of local cover for fishes and macroinvertebrates. Two stations (numbers 1 and 5) sampled this biotope in Hulopoe Bay.

Station 1 sampled the biotope of low channels on the eastern side of Hulopoe Bay; this station was situated about 80m from shore at depths from 18 to 22m. The substratum at this station is comprised of low ridges of rubble and corals oriented perpendicular to shore. These ridges or mounds are from 25 to 75m in length, 5 to 20m in width, up to 1m in height and are spaced from 1 to 5m apart with sand in the intervening space. The dominant coral species is Porites compressa and considerable P. compressa rubble is present forming much of the ridges. Towards the center of the bay and seaward, this biotope grades to a substratum dominated by sand. Table 3 presents the results of the quantitative survey carried out at Station 1. Four coral species were noted in the quadrat survey having a mean coverage of 41 percent. The macroinvertebrate census enumerated three species; most com-

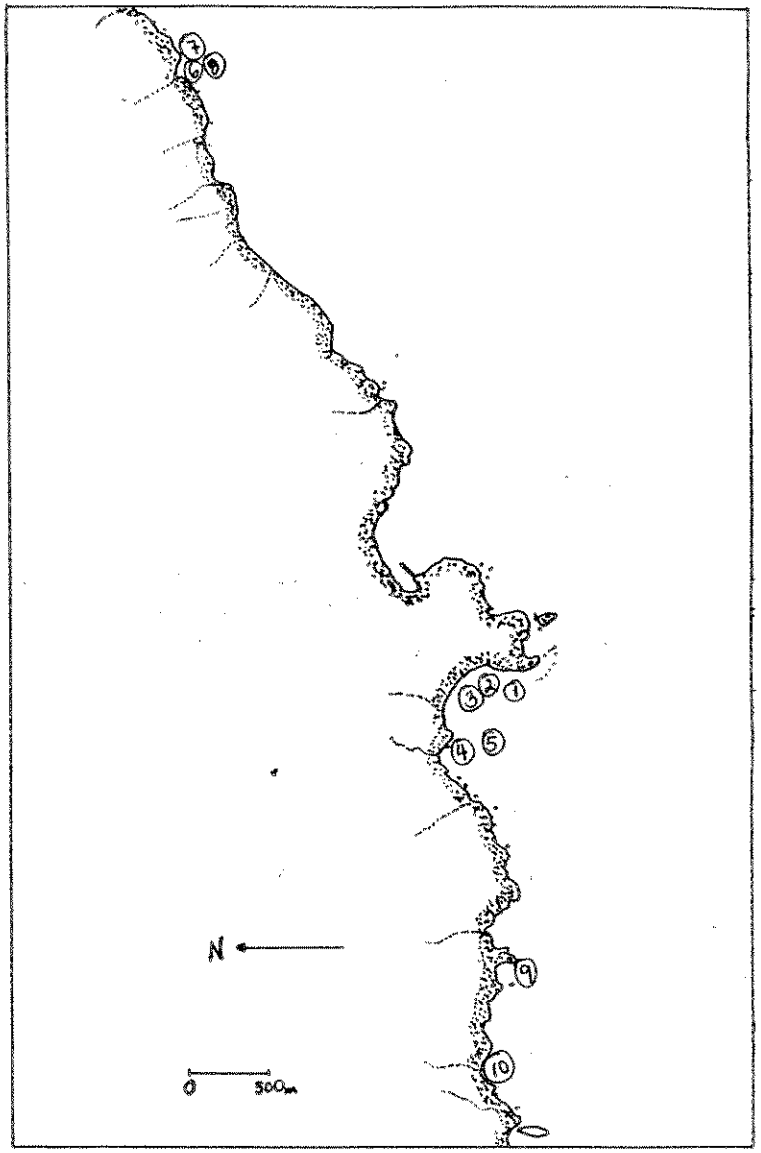

FIGURE 4. Map of the study area showing the location of stations for quantitative biological surveys. Stations 1 through 5 were established to sample Hulopoe Bay. Numbers 6 - 8 sampled the control site at Makole and Stations 9 and 10 were placed offshore of the proposed golf course at Huawai Bay and Kaluakoi Point. Map redrawn from USGS 7.5 x 15 minute topographic map number 20156-F7-TM-025. Shoreline is stippled and the intermittent streams are shown as stippled lines.

TABLE 3. Summary of the benthic survey conducted at Station 1 approximately 80m offshore of the west point of Pu'upehe at Hulopoe Bay, Lanai in the biotope of low channels on 21 December 1989. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 18-22m; mean coral coverage is 41.1 percent (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Corals						
Porites lobata	9	2		34	29	11
P. compressa	61	62			35	
P. evermanni			1			
Pocillopora meandrina	2.5					
Sand			65	4		13
Rubble			34	26	3	36
Hard Substratum	27.5	36		36	33	40

B. 50-Point Analysis

Species	Percent of the Total
Corals	
Porites lobata	20
P. compressa	16
Sand	18
Rubble	26
Hard Substratum	20

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Spondylus tenebrosus	1
Phylum Echinodermata	
Linckia multiflora	3
Tripneustes gratilla	3

D. Fish Census (4 x 25m)
33 Species
300 Individuals
Estimate Biomass = 84g/m^2

mon were the starfish Linckia multiflora and the black sea urchin, Tripneustes gratilla. The results of the fish census are presented in Appendix A. In total 33 species of fish were censused (300 individuals); most abundant species include the kole (Ctenochaetus strigosus), maiko (Acanthurus nigroris), lau'ipala (Zebrasoma flavescens), hinalea lauwili (Thalassoma duperrey), and damselfishes (Chromis hanui and C. agilis). The estimated standing crop of fishes at this station is 84g/m^2; important contributors to this biomass include mempachi (Myripristes amaena), a'awa (Bodianus bilunulatus), hinalea lauwili (Thalassoma duperrey) and na'ena'e (Acanthurus olivaceus). In the vicinity of Station 1 were seen the uhus (Scarus sordidus and S. psittacus), nunu (Aulostomus chinensis), hilu piliko'a (Paracirrhitus forsteri), black sea cucumber (Holothuria atra), starfish (Linckia diplax), soft coral (Palythoa tuberculosa), palani (Acanthurus dussumieri) and a large (about 4kg) uku (Aprion virescens).

Station 5 sampled the biotope of low channels in the western part of Hulopoe Bay. The depth at this station was 15m and the station was located about 150m from shore. The substratum at this station is dominated by low ridges of rubble and Porites compressa oriented perpendicular to shore. These ridges or elongate mounds are from 15 to 40m in length, 2 to 10m in width and are spaced from 1 to 8m apart. The intervening substratum is sand and rubble. A summary of the biological survey conducted at Station 5 is presented in Table 4. Two algal species (Halimeda opuntia and Desmia hornemannii) were noted in the quadrat survey along with four coral species. Mean coral coverage was estimated to be about 22 percent. Again, Porites compressa made the greatest contribution to the cover. The invertebrate census noted two species; most common was the starfish, Linckia multiflora. One individual of the pearl oyster (Pinctado marginifera) was present in the census area. Eighteen species of fishes (95 individuals) were counted (Appendix A) and the most common were the kole (Ctenochaetus strigosus), ma'i'i'i (Acanthurus nigrofuscus), hinalea lauwili (Thalassoma duperrey), wrasse (Pseudocheilinus octotaenia) and damselfish (Chromis agilis). The fish standing crop was estimated to be 17g/m^2 and the hinalea lauwili (Thalassoma duperrey), kole (Ctenochaetus striogsus) and humuhumu 'ele'ele (Melichthys niger) contributed most to this biomass. In the vicinity of Station 5 were seen the cushion starfish (Culcita novaeguineae), wrasses (Pseudojuloides cerasinus and Anampses chrysocephalus) and kikakapu (Chaetodon ornatissimus and C. kleinii).

The Biotope of Sand

As the name implies, the biotope of sand is dominated by sand. In Hulopoe Bay this biotope extends from shore (the sand beach) to well out in the bay and beyond the seaward boundary of

TABLE 4. Summary of the benthic survey conducted at Station 5 approximately 150m offshore of the eastern shore at Hulopoe Bay, Lanai in the biotope of low channels on 21 December 1989. Results of the $6m^2$ quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 15m; mean coral coverage is 21.6 percent (quadrat method).

A. Quadrat Survey

Species	Quadrat Number 0m	5m	10m	15m	20m	25m
Algae						
Halimeda opuntia	5	3.2				
Desmia hornemannii	1	6	4			
Corals						
Porites lobata	4	13	7	2	1.1	7
P. compressa	15	31	43		0.1	2.5
Pocillopora meandrina	4					
Montipora flabellata		0.1				
Sand	4			35	10	23
Rubble	67			63	88.8	67.5
Hard Substratum		46.7	46			

B. 50-Point Analysis (4 x 25m)

Species	Percent of the Total
Corals	
Porites lobata	6
P. compressa	16
Sand	20
Rubble	34
Hard Substratum	24

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Pinctado marginifera	1
Phylum Echinodermata	
Linckia multiflora	8

TABLE 4. Continued.

D. Fish Census (4 x 25m)

18 Species
95 Individuals
Estimated Biomass = $17g/m^2$

this study. Because of the lack of cover and solid substratum, few fishes and macroinvertebrates are encountered in this biotope. Station 3 sampled the biotope of sand in Hulopoe Bay. This station was established in 8m of water about 200m offshore and affronting the white sand beach at Hulopoe Bay. The substratum at this station is sand. The results of the survey carried out at Station 3 are presented in Table 5. No corals were censused at this station. Three invertebrate species were noted in the 4 x 25m census area; present was a mound of tubeworms (Chaetopterus sp.), a single auger (Terebra maculata and three starfish (Linckia multiflora) which probably were carried out on to the sand by wave action. The fish census resulted in single fish encountered (a garden eel); the estimated biomass of fishes is $2g/m^2$. In the vicinity of this station were seen several small kona crabs (Rania rania) and a single yellow papio (Gnathanodon speciosus). Other invertebrate and fish species often encountered on extensive sand flats such as that at Hulopoe Bay include the nabeta (Hemipteronotus spp.), weke pueo (Upeneus arge), flea cone (Conus pulicarius), augers (Terebra crenulata, T. guttata and others) and occasionally as well the helmut shell (Cassius cornuta).

The Biotope of Grooves and Low Coral Cover

The biotope of grooves and low coral cover is a shoreward extension of the biotope of low channels. The biotope can be best described as being dominated by hard substratum through which channels oriented perpendicular to shore are cut. These channels and ridges create a spur and groove formation which is characteristic of coral reef communities in areas exposed to occasional wave energy. The biotope of grooves and low coral cover is located in eastern Hulopoe Bay from the shore to a depth of 12m. Because of exposure to occasional high energy conditions, coral cover in this biotope is not high; the dominant species are Porites lobata and Pocillopora meandrina.

Station 2 was established to sample the biotope of grooves and low coral cover in 7.5 to 9m of water approximately 60 from the eastern shore in Hulopoe Bay. The substratum at this station is limestone and basalt with channels 1 to 5m wide, 3 to 30m long and spaced 1 to 6m apart. Channel depths are from 0.5 to 2m below the intervening ridges and channel floors are primarily solid substratum with pockets and/or a veneer of sand and rubble. Table 6 presents the results of the survey carried out at Station 2; five coral species were present in the quadrat survey and the mean coral coverage was estimated at 9 percent. The dominant coral species was Porites lobata. Four macroinvertebrate species were censused in the 4 x 25m survey area. The most abundant species was the green urchin (Echinometra mathaei). The fish census carried out over the same area yielded 37 species (190 individuals - see Appendix A). The most common fishes present

TABLE 5. Summary of the benthic survey conducted at Station 3 approximately 200m offshore of the sand beach at Hulopoe Bay, Lanai in the biotope of sand on 21 December 1989. Results of the $6m^2$ quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 8.2m; mean coral coverage is 0 percent (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Sand	100	100	100	100	100	100

B. 50-Point Analysis

Species	Percent of the Total
Sand	100

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Annelida	
Chaetopterus sp.	about 200 in a small mound
Phylum Mollusca	
Terebra maculata	1
Phylum Echinodermata	
Linckia multiflora	3

D. Fish Census (4 x 25m)

1 Species
1 Individual
Estimated Biomass = $2g/m^2$

TABLE 6. Summary of the benthic survey conducted at Station 2 approximately 60m offshore of east shore in Hulopoe Bay, Lanai in the biotope of grooves and low coral cover on 21 December 1989. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 7.5-9m; mean coral coverage is 9.2 percent (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Corals						
Porites lobata	5.5	7	17	7	12	3
Montipora verrucosa	0.1	0.1		0.1	0.1	
M. patula					0.1	0.2
M. flabellata			0.1			
Pocillopora meandrina	0.1				0.5	2.4
Rubble	76			6		
Hard Substratum	18.3	92.9	82.9	86.9	87.3	94.4

B. 50-Point Analysis

Species	Percent of the Total
Corals	
Porites lobata	8
Rubble	18
Hard Substratum	74

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Conus lividus	1
Phylum Echinodermata	
Linckia multiflora	3
Echinostrephus aciculatum	4
Echinometra mathaei	18

D. Fish Census

37 Species
190 Individuals
Estimated Biomass = 159g/m^2

were the ma'i'i'i (Acanthurus nigrofuscus), kole (Ctenochaetus strigosus), hinalea lauwili (Thalassoma duperrey), moano (Parupeneus multifasciatus), uhu (Scarus psittacus) and damselfish (Chromis vanderbilti). The biomass of fishes was estimated at 159g/m^2; the important contributors to this standing crop were uhus (Scarus perspicillatus and S. rubroviolaceus), roi (Cephalopholis argus) and the umaumalei (Naso lituratus). In the vicinity of Station 2 were seen the rock oyster (Spondylus tenebrosus), soft coral (Palythoa tuberculosa), sea cucumbers (Holothuria atra and Actionpyga mauritana), wana (Echinothrix diadema), cowry (Cypraea reticulata), kikakapu (Chaetodon ornatissimus),mu (Monotaxis grandoculis), moano kea (Parupeneus cyclostomus) and nenue (Kyphosus bigibbus).

Biotope of Shallow High Coral Cover

The biotope of shallow high coral cover occurs from adjacent to the emergent shoreline basalt bench to a depth of about 12m in an area west of the sand beach at Hulopoe Bay. This biotope is dominated by a variety of coral species growing over a solid substrate much like that at Station 2 in the biotope of grooves and low coral cover. The substratum is bisected by channels cut through it with a general orientation perpendicular to shore. Station 4 was established about 55m from shore in the biotope of shallow high coral cover at a depth from 5.5 to 7.6m. In the area of the station the substratum is a mix of limestone and basalt with ridges 2 to 10m in width, up to 40m in length and to 3m in height. Spacing between the ridges is from 1 to 5m. Corals are found on the ridges as well as in the channels.

Table 7 presents a summary of the survey carried out at Station 4. The quadrat survey noted two macroalgal species, two soft coral species and 10 coral species having a mean coverage of 49 percent. The dominant coral species in the biotope is Porites lobata. Three exposed macroinvertebrate species were encountered in the census area. The most common species was the starfish, Linckia multiflora; one coral feeding starfish (the crown of thorns or Acanthaster plancii) was also seen. Thirty species of fishes (200 individuals) were censused in 4 x 25m study area. The most abundant fishes were the ma'i'i'i (Acanthurus nigrofuscus), manini (A. triostegus), paku'iku'i (A. achilles), kole (Ctenochaetus strigosus) and lau'ipala (Zebrasoma flavescens). The standing crop of fish was estimated to be 139g/m^2; the important contributors to this biomass include the ma'i'i'i (Acanthurus nigrofuscus), manini (A. triostegus), uhus (Scarus perspicillatus and S. sordidus), nenue (Kyphosus bigibbus) and moano (Parupeneus multifasciatus). In the vicinity of Station 4 were seen a small amount of the alga, Amansia glomerata, wana (Echinothrix diadema), munu (Parupeneus bifasciatus), lauhau (Chaetodon unimaculatus), malamalama (Coris

TABLE 7. Summary of the benthic survey conducted at Station 4 approximately 55m offshore in Hulopoe Bay, Lanai in the biotope of shallow high coral cover on 21 December 1989. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 5.5 to 7.6m; mean coral coverage is 49.1 percent (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Algae						
Desmia hornemannii		0.1				
Halimeda opuntia	0.1		1			
Soft Corals						
Anthelia edmondsoni	4	1.2	0.1			
Palythoa tuberculosa		0.5				0.1
Corals						
Porites lobata	37	25	57	4	42	8
P. evermanni			28			
P. compressa	3		2	41	4	
Pocillopora meandrina	4	0.5		2.1	0.2	6
Montipora verrucosa		0.1	0.1			
M. flabellata	4.5	2			4	
M. patula					12	1
M. verrilli						0.3
Pavona varians				6		0.1
Leptastrea purpurea						0.5
Rubble		7				
Hard Substratum	47.4	63.6	11.8	46.9	37.8	84

B. 50-Point Analysis

Species	Percent of the Total
Soft Corals	
Anthelia edmondsoni	4
Corals	
Porites lobata	24
P. compressa	6
Pocillopora meandrina	4
Pavona varians	2
Rubble	4
Hard Substratum	56

TABLE 7. Continued.

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Arthopoda	
Dardanus sp. (juvenile)	1
Phylum Echinodermata	
Acanthaster plancii	1
Linckia multiflora	9

D. Fish Census (4 x 25m)

30 Species
200 Individuals
Estimated Biomass = 139g/m^2

ballieui), damselfish (Plectroglyphidodon imparipennis), po'ou (Cheilinus unifasciatus) and palukaluka (Scarus rubroviolaceus).

Control Area at Makole

A site well removed from any development was selected to serve as a control; criteria for selection included (1) the presence of biotopes and marine communities similar to those found in Hulopoe Bay, (2) a similar southern exposure to storm surf, (3) presence of a nearby similar natural drainage basin (i.e., presence of intermittent streambeds), (4) no surrounding development, thus a terrain having only natural disturbance and (5) reasonable accessibility by boat. The site selected was just offshore of Makole about 500m west of Kawaiu Gulch and 75m from a small intermittent streambed. This site is about 4km east of Puupehe Rock affronting the Manele-Hulopoe Marine Life Conservation District. The steep terrain mauka of the site appeared to be completely undisturbed kiawe scrub. At Makole three of four biotpes were recognizable; these were the biotope of sand, the biotope of low channels and the biotope of shallow high coral cover.

Station 6 sampled the biotope of low channels. This station was established about 75m from the emergent basalt shoreline in water from 9 to 12m in depth. The substratum at this station is comprised of ridges of coral rubble and live coral (primarily Porites compressa and P. lobata); these ridges have a general orientation perpendicular to shore and are from 5 to 25m wide, 30 to 80m long and rise up to 1.5m above the substratum. Between the ridges are areas of sand and rubble spaced from 2 to 15m apart. Approximately 40m seaward of Station 6 the sand/rubble channels coalesce forming a major area of sand.

The results of the quantitative survey carried out at Station 6 are summarized in Table 8. In the quadrat survey three algal species were noted; in terms of coverage, the most common was Halimeda opuntia. Two soft coral and nine coral species were also seen. Mean coral coverage was estimated to be about 38 percent. Two macroinvertebrate species were in the survey area and the most common was the ubiquituous starfish, Linckia multiflora. Thirty-nine species of fishes (208 individuals) were censused; the most abundant fish species were the ma'i'i'i (Acanthurus nigrofuscus), kole (Ctenochaetus strigosus), hinalea lauwili (Thalassoma duperrey) and the damselfish (Stegastes fasciolatus). The biomass of fishes at Station 6 was estimated to be 101g/m^2 and species comprising the most weight were the yellow papio (Gnathanodon speciosus), opelu (Decapterus macrellus), mempachi (Myripristes kuntee), weke'ula (Mulloides vanicolensis) and kole (Ctenochaetus strigosus). In the vicinity of Station 6 were seen the soft coral (Palythoa

TABLE 8. Summary of the benthic survey conducted at Station 6 approximately 75m offshore of the control site east of Kawaiu Gulch, Lanai in the biotope of low channels on 22 December 1989. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 9 to 12m; mean coral coverage is 37.8 percent (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Algae						
Desmia hornemannii			1			
Halimeda opuntia	3	3	2.2		0.9	2
Dotyella hawaiiensis				0.1		
Sponges						
Planorkis sp.						1.2
Soft Corals						
Anthelia edmondsoni				0.5	0.1	1
Zoanthus pacificus		2.5		0.5		
Corals						
Porites lobata	19	14	6	9	32	4.5
P. compressa	12	5	39	27	26	0.5
P. (Synarea) convexa					0.5	
Pocillopora meandrina	3.5	1.5	2	4	3.5	4.5
Pavona varians	3					
Montipora verrucosa	2					0.3
M. patula		3				0.8
M. flabellata				2.7		0.7
Leptastrea purpurea		0.5				
Sand						6
Rubble					4	12
Hard Substratum	57.5	70.5	49.8	56.2	33	66.5

Table Continued on Next Page

TABLE 8. Continued.

B. 50-Point Analysis

Species	Percent of the Total
Algae	
Halimeda opuntia	10
Soft Corals	
Zoanthus pacificus	2
Corals	
Porites lobata	10
P. compressa	10
Pocillopora meandrina	4
Montipora patula	2
M. flabellata	2
Hard Substratum	60

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Echinodermata	
Linckia multiflora	13
Tripneustes gratilla	2

D. Fish Census (4 x 25m)

39 Species
208 Individuals
Estimated Biomass = 101g/m^2

tuberculosa), algae (Amansia glomerata and Cladymenia pacifica), polychaete (Loimia medusa), cushion starfish (Culcita novaeguineae), coral (Cyphastrea ocellina), wire coral (Cirrhipathes anguina), puhi'oni'o (Gymnothorax meleagris) and the uhu (Scarus sordidus).

Station 7 sampled the biotope of sand at the Makole control site. The sand substratum offshore of Makole has a considerable amount of basalt material mixed with it which is suggestive of storm derived terrigenous inputs. The sand substratum is a near continuous feature from the shore affronting the intermittent streambed at Makole where a basalt boulder/cobble beach occurs to depths of at least 20m at distances more than 250m offshore. Station 7 was established about 85m offshore of the intermittent streambed in 13m of water. The results of the survey carried out at this station are given in Table 9. No corals were encountered in the quadrat survey and the fish census noted no fishes (Appendix A). The invertebrate census over the 4 x 25m area found one oak cone (Conus quercinus). In the vicinity of Station 7 were seen several small kona crabs (Rania rania), an auger (Terebra crenulata) and one juvenile nabeta (Hemipteronotus sp.).

The biotope of shallow high coral coverage is present in the control area at Makole. Station 8 sampled this biotope about 40m offshore of the emergent basalt bench. The substratum at this station is a mix of basalt and limestone forming a hard bottom which steeply slopes seaward until the biotope of low channels is encountered. Thus the station encompassed depths from 2.4 to more than 10m. This hard substratum continues to the west paralleling the shoreline; to the east is the biotope of sand. Table 10 presents the results of the quantitative survey carried out at Station 8. Three soft coral species (mean cover = 9.6%) and 8 coral species were present in the quadrat survey; the stony corals had an estimated mean coverage of about 32 percent. Pocillopora meandrina provided the greatest coverage particularly in the shallow end of the transect. The macroinvertebrate census found three echinoderm and one mollusc species; the most conspicuous motile invertebrate present was the starfish, Linckia multiflora. Forty-two species of fishes (506 individuals) were censused (Appendix A); the most common species were the kole (Ctenochaetus strigosus), ma'i'i'i (Acanthurus nigrofuscus), hinalea lauwili (Thalassoma duperrey), damselfishes (Chromis vanderbilti, C. ovalis and C. verator) and the mamo (Abudefduf abdominalis). The standing crop of fishes was estimated to be 243g/m^2; the most important contributors to this standing crop include weke'ula (Mulloides vanicolensis), munu (Parupeneus bifasciatus), hinalea lauwili (Thalassoma duperrey), uhus (Scarus perspicillatus and S. sordidus), ma'i'i'i (Acanthurus nigrofuscus), kole (Ctenochaetus strigosus), umaumalei (Naso literatus) and humuhumu 'ele'ele (Melichthys niger). In the vicinity of Station 8 were seen aweoweo (Priacanthus cruentatus),

TABLE 9. Summary of the benthic survey conducted at Station 7 approximately 85m offshore of the control site east of Kawaiu Gulch, Lanai in the biotope of sand on 22 December 1989. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 12.8m; mean coral coverage is 0 percent (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Sand	100	100	100	100	100	100

B. 50-Point Analysis

Species	Percent of the Total
Sand	100

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Conus quercinus	1

D. Fish Census (4 x 25m)

No fishes encountered

TABLE 10. Summary of the benthic survey conducted at Station 8 approximately 40m offshore of the control site east of Kawaiu Gulch, Lanai in the biotope of shallow high coral cover on 22 December 1989. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 2.4 to 10.6m; mean coral coverage is 31.8 percent (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Algae						
Halimeda opuntia					1	1.5
Sponges						
Porifera (unidentified)					1	
Soft Corals						
Anthelia edmondsoni			0.5	0.5	0.5	
Zoanthus pacificus						1
Palythoa tuberculosa	36	13	6			
Corals						
Porites lobata		2.3	1	7	15	28
P. compressa					1	
Pocillopora meandrina	38	27		4	12	5
Montipora verrilli			1.5		0.5	
M. patula			0.5	4	9	
M. verrucosa				5	3	2
M. flabellata				3		14
Leptastrea purpurea					1	1
Hard Substratum	26	57.7	90.5	76.5	57	47.5

Table Continued on Next page

TABLE 10. Continued.

B. 50-Point Analysis

Species	Percent of the Total
Soft Corals	
Anthelia edmondsoni	2
Palythoa tuberculosa	6
Corals	
Porites lobata	10
Pocillopora meandrina	16
Montipora flabellata	2
M. patula	2
Cyphastrea ocellina	2
Hard Substratum	60

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Conus miles	1
Phylum Echinodermata	
Echinothrix diadema	7
E. calamaris	1
Linckia multiflora	42

D. Fish Census (4 x 25m)

42 Species
506 Individuals
Estimated Biomass = 243g/m^2

mempachi (Myripristes berndti and M. amaena), ala'ihi (Flammeo sammara), damselfish (Plectroglyphidodon imparipennis), sea cucumber (Actinopyga mauritana), button coral (Fungia scutaria), wire coral (Cirrhipathes anguina), lobsters (Panulirus marginatus and Enoplometopus occidentalis) and slipper lobsters (Paribaccus antarcticus and Paribaccus sp.).

Offshore of Proposed Golf Course (Kaluakoi Point - Huawai Bay)

Two stations (numbers 9 and 10) were established in waters affronting the proposed golf course in the biotope of grooves. Station 9 was setup approximately 30m offshore of the point 375m west of Kaluakoi Point in water depths from 10 to 13.7m. The substratum at Station 9 is comprised of basalt/limestone ridges oriented perpendicular to shore with intervening sand channels. Ridges are from 10 to 30km wide, up to 80m in length and spaced from 20 to 75m apart. The height of ridges does not exceed 2.5m. The station sampled along a ridge and out on to a sand channel floor. The results of the survey at Station 9 are presented in Table 11. Two soft coral species were recorded and six coral species in the quadrat survey. Corals had an estimated mean coverage of 15 percent. Five macroinvertebrate species were noted at the station and the most common was the starfish, Linckia multiflora. Thirty-eight fish species (159 individuals) were censused in the 4 x 25m census area (Appendix A). The most abundant fishes were the ma'i'i'i (Acanthurus nigrofuscus), kole (Ctenochaetus strigosus), laui'pala (Zebrasoma flavescens), hinalea lauwili (Thalassoma duperrey), moano (Parupeneus multifasciatus) and damselfish (Chromis vanderbilti). The standing crop of fishes at this station was estimated to be 147g/m^2; the largest contributors to this biomass include uku (Aprion virescens), hinalea lauwili (Thalassoma duperrey), uhu (Scarus sordidus), ma'i'i'i (Acanthurus nigrofuscus) and kala (Naso unicornis). In the vicinity of Station 9 were seen maiko (Acanthurus nigroris), lauhau (Chaetodon quadrimaculatus), munu (Parupeneus bifasciatus), lauwiliwili nukunuku'oi'oi (Forcipiger flavissimus), kala holo (Naso hexacanthus), kihikihi (Zanclus cornutus), hilu piliko'a (Paracirrhites forsteri), moa (Ostracion meleagris), mempachi (Myripristes berndti), ala'ihi (Adioryx spinifer), a'awa (Bodianus bilunulatus), roi (Cephalopholis argus), 'ula or spiny lobster (Panulirus marginatus), banded shrimp (Stenopus hispidus), polychaete (Loimia medusa) and alga (Galaxaura acuminata).

Station 10 was located in the biotope of grooves in Huawai Bay about 100m offshore in 7.6m of water. The substratum at this station is primarily basalt with basalt boulders and cobble scattered throughout the area. Channels oriented perpendicular to shore are cut into the substratum; boulders are concentrated on the "ridges". Channels between ridges are from 1 to 8m wide, up to 1m in depth and spaced from 3 to 20m apart. The results of

TABLE 11. Summary of the benthic survey conducted at Station 9 approximately 30m offshore of the point 375m west of Kaluakoi Point, Lanai affronting the proposed golf course in the biotope of grooves on 22 December 1989. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 10 to 13.7m; mean coral coverage is 15.3 percent (quadrat method).

A. Quadrat Survey

Species	Quadrat Number 0m	5m	10m	15m	20m	25m
Algae						
Halimeda opuntia				1		
Soft Corals						
Palythoa tuberculosa				0.1		
Anthelia edmondsoni				0.1		
Corals						
Porites lobata	2.2	7	2.5	19	23	36
P. compressa			1.5		0.1	
Montipora verrucosa	0.1					
M. flabellata						0.1
M. patula					0.3	
M. verrilli					0.1	
Sand	8	32	18	6		
Rubble	89.7	31	53	31		
Hard Substratum		30	25	42.8	76.5	63.9

B. 50-Point Analysis

Species	Percent of the Total
Corals	
Porites lobata	6
P. compressa	2
Pocillopora meandrina	2
Sand	12
Rubble	58
Hard Substratum	20

Table Continued on Next Page

TABLE 11. Continued.

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Murex pele	1
Conus lividus	1
Phylum Echinodermata	
Echinothrix diadema	1
Echinostrephus aciculatum	3
Linckia multiflora	5

D. Fish Census (4 x 25m)

38 Species
159 Individuals
Estimated Biomass = 147g/m^2

the quantitative survey carried out at Station 10 are presented in Table 12. A small amount of the alga, Amansia glomerata was noted in the quadrat survey along with two soft coral species. One of the soft coral species, Sinularia abrupta, is only infrequently encountered in Hawaiian waters; the colony found in this survey was 2.1 x 1.5m in outside dimensions. Four coral species were in the survey and these had a mean coverage of 4 percent; the dominant species was Porites lobata. Six motile macroinvertebrate species (2 molluscs and 4 echinoderms) were censused. The most abundant motile invertebrate was the starfish (Linckia multiflora). Thirty-two species of fishes were censused (366 individuals) at Station 10. The most common fish species were the ma'i'i'i (Acanthurus nigrofuscus), umamalei (Naso lituratus), hinalea lauwili (Thalassoma duperrey), moano (Parupeneus multifasciatus) and damselfish (Chromis vanderbilti). The standing crop of fish was estimated to be 149g/m^2 and the largest contributors to this biomass were the palukaluka (Scarus psittacus), moano kea (Parupeneus cyclostomus), hinalea lauwili (Thalassoma duperrey), humuhumu'ele'ele (Melichthys niger), umaumalei (Naso lituratus) and ma'i'i'i (Acanthurus nigrofuscus). In the vicinity of Station 10 were seen the uhu (Scarus psittacus), manini (Acanthurus triostegus), kikakapu (Chaetodon multicinctus), awela (Thalassoma fuscum), angelfish (Centropyge potteri) and the rock oyster (Spondylus tenebrosus).

Three green turtles (Chelonia mydas) were sighted during the course of this study. The first turtle was seen about 60m offshore of Puupehe Rock affronting Sharks Bay. This turtle was estimated to have a straight-line carapace length of 50cm. The second turtle (about 60cm carapace length) was encountered about 75m offshore of Kaluakoi Point in approximately 11m of water. The third turtle (estimated 50cm carapace length) was found about 1[illegible]m offshore along the eastern side of Kawaiu Gulch in 12m of water. These turtles were all seen in areas with considerable cover which could serve as resting sites. As noted in the quantitative surveys conducted at the 10 stations, little appropriate algal forage was encountered; among the species seen that are known forage species for green turtles is Amansia glomerata which was seen at Stations 4, 6 and 10. Inspection of the emergent bench at a number of locations along coastline of the study area found little intertidal macrothalloid algae present; the presence of numerous sea urchins (Colobocentrotus atrata, Echinometra oblongata and E. mathaei) probably serve to effectively graze most of the algae down. Algal species seen on the emergent bench/basalt boulders include aki'aki (Ahnfeltia concinna), kala (Sargassum echinocarpum) and limus (Acanthophora spicifera and Pterocladia capillacea). Very little Pterocladia was seen.

The well-known resident pod of spinner porpoises (Stenella longirostris) was present in Hulopoe Bay in the late morning/early afternoon hours on 22 December 1989. At 1205 hours we attempted a count of individuals in Hulopoe Bay and estimated that

TABLE 12. Summary of the benthic survey conducted at Station 10 approximately 100m offshore of the caves at Huawai Bay, Lanai affronting the proposed golf course in the biotope of grooves on 22 December 1989. Results of the 6m^2 quadrat sampling of the benthic community (expressed in percent cover) are given in Part A; a 50-point analysis is presented in Part B and counts of invertebrates in Part C. A short summary of the fish census is given in Part D. Water depth 7.6m; mean coral coverage is 4 percent (quadrat method).

A. Quadrat Survey

	Quadrat Number					
Species	0m	5m	10m	15m	20m	25m
Algae						
Amansia glomerata						0.5
Soft Corals						
Palythoa tuberculosa		0.1			0.1	
Sinularia abrupta			48			
Corals						
Porites lobata	1	4		3	2.2	2.5
Pocillopora meandrina	7			0.1	3.8	
Pavona varians						0.3
Montipora verrilli					0.1	
Sand			18			
Rubble	62				38	
Hard Substratum	30	95.9	34	96.9	55.8	96.7

B. 50-Point Analysis

Species	Percent of the Total
Soft Coral	
Sinularia abrupta	6
Corals	
Porites lobata	6
Rubble	20
Hard Substratum	66

Table Continued on Next Page

TABLE 12. Continued.

C. Invertebrate Census (4 x 25m)

Species	Number
Phylum Mollusca	
Conus lividus	1
Drupa morum	1
Phylum Echinodermata	
Linckia multiflora	14
Acanthaster plancii	1
Echinometra mathaei	5
Echinostrephus aciculatum	4

D. Fish Census (4 x 25m)

32 Species
366 Individuals
Estimated Biomass = 149g/m^2

there were more than 60 dolphins present. Some individuals were within 100m of the sand beach shoreline and a number of tourists were in the water swimming at that time. By 1500 hours the dolphins had left the bay moving out and to the west. No humpback whales (Megaptera novaeangliae) were seen in the study site or seaward of it during the course of fieldwork.

During the time of our field study recreational use of Hulopoe Bay appeared to occur primarily through the tours for snorkelers brought over from Lahaina, Maui on day trips. No attempt was made in this study to count the number of tourists using the bay but the impression that we are left with is that groups of 10 or more may be present at any time from the midmorning to the midafternoon. In the waters affronting the proposed golf course several fishing vessels were seen passing through on their way to offshore trolling grounds and dive charter vessels were seen to the west of the project area at a site locally known as "cathedrals".

DISCUSSION

WATER QUALITY STUDIES

The water quality sampling commenced two days following heavy rainfall. The rain guage at Lanai Airport is read daily; rainfall was recorded on 9 December (505mm or 1.99 inches), 20 December (304mm or 1.20 inches) and on 27 December (279mm or 1.10 inches). No rainfall was recorded on other days during the month of December 1989 at Lanai Airport. The rain guage at Kaumalapali Harbor on the west coast of the island (about 13.5km west of Hulopoe Bay) recorded a monthly total of 676mm or 2.66 inches (note that data are available for this station only as monthly totals; all rainfall data courtesy of Mr. Paul Haraguchi, Department of Land and Natural Resources).

Terrigenous inputs to the nearshore waters at the Makole control site as well as in Hulopoe Bay are evident in the water quality data. Gradients in turbidity, orthophosphate, nitrate + nitrite nitrogen, ammonia nitrogen and silicate are probably due to the 20 December rainfall event albiet no surface stream flow was evident. Because oceanic waters are low in these and other dissolved nutrient species, a concentration gradient is established. The salinity data weakly suggest the existence of these gradients but the concentrations of the measured dissolved nutrient species are a more sensitive indicator of these gradients than are measurements of salinity made by titration methods.

The "composite" nutrient parameters of total nitrogen and total phosphorus yield the least information about water quality of the nutrient species measured in this study. The lack of

definitive information from these parameters is the result of the makeup of these two composite species. Total phosphorus and nitrogen include a myriad of unspecified groups of dissolved organic materials, some of which are not found in groundwater and are of unknown biological function.

The geometric means for several parameters (i.e., nitrate + nitrite N, ammonia N, turbidity and chlorophyll-a) exceeded State DOH standards for "dry" coastlines at the time of sampling; this is probably a result of the heavy rain and runoff two days prior to commencement of sampling. Chlorophyll-a is a measure of phytoplankton biomass. The input of inorganic nutrients via rain and runoff to nutrient-poor nearshore waters will usually result in a phytoplankton bloom; two days is sufficient time to manifest such a response in the phytoplankton.

Despite the geometric means of the above parameters exceeding "dry" criteria, none of them exceeded values specified by DOH as "not to exceed the given value more than 10% of the time" and only the geometric mean for chlorophyll-a exceeded the "wet" criteria. It is interesting to note that State standards for open coastal waters are frequently exceeded irrespective of the presence of nearby coastal development. Brock and Kam (1989) found that under dry conditions nitrate + nitrite nitrogen concentrations are equal to "dry" criteria for waters affronting Lahaina, Maui (a developed area) and that chlorophyll-a exceeded the "wet" criteria; following a heavy rain (858mm or 3.38 inches over a 24-hour period) nitrate + nitrite nitrogen, turbidity and chlorophyll-a all exceeded state standards (Brock 1990a). At Mahukona, Hawaii an area with little surrounding development both chlorophyll-a and ammonia nitrogen exceeded DOH "dry" standards (Marine Research Consultants 1989, Brock 1990b). A weekly ocean water quality monitoring program has been in place at the Natural Energy Laboratory of Hawaii (NELH) at Keahole Point, Hawaii since 1982. The waters offshore of Keahole Point are considered to be pristine; the presence of high quality deep ocean water adjacent to shore was an important factor in locating the NELH facility there. The longterm mean for ammonia nitorgen at Keahole Point is 5.04ug/L which exceeds state "dry" standards. The fact that pristine Kona waters exceed state standards for ammonia nitrogen suggests that the standard may be too stringent. Other longterm means from NELH are similar to the concentrations of nutrient species from the south coast of Lanai; nitrate NELH = 2.80ug/L, Lanai = 4.27ug/L; orthophosphate: NELH = 4.96ug/L, Lanai = 4.61ug/L; ammonia nitrogen: NELH = 5.04ug/L, Lanai = 2.32ug/L. The NELH data are courtesy of the University of Hawaii Analytical Services Laboratory.

BIOLOGICAL STUDIES

Studies conducted on coral reefs in Hawaii and elsewhere

have estimated fish standing crops to range from 20 to 200g per square meter (Brock 1954, Brock et al. 1979). Eliminating the direct impact of man due to fishing pressure and/or pollution, the variation in standing crop appears to be related to the variation in the local topographical complexity of the substratum. Thus habitats with high structural complexity affording considerable shelter space usually harbor a greater estimated standing crop of coral reef fish; conversely, transects conducted in structurally simple habitats (e.g., sand flats) usually result in a lower estimated standing crop of fish (5 to 20g/m^2). Goldman and Talbot (1975) noted that the upper limit to fish biomass on coral reefs is about 200g/m^2. Ongoing studies (Brock and Norris 1989) suggest that with the manipulation (increasing) of habitat space or food resources (Brock 1987), local fish standing crops may approach 2000g/m^2. Thus under certain circumstances, coral reefs may be able to support much larger standing crops of fishes than previously realized.

A summary of the standing crop of fishes by family for all stations is presented in Table 13. The high biomass estimate of fishes at Station 8 (240g/m^2) exceeds the usual maximum encountered on natural substratum; 35 percent of this biomass was comprised of surgeonfishes (family Acanthuridae) and 23 percent was made up of parrotfishes (family Scaridae). Together these two herbivorous families made the greatest contribution to the standing crop at all stations; surgeonfishes made up 36 percent and parrotfishes comprised 17 percent of the biomass at all stations (Table 13). The standing crop of fishes met with at the other stations are typical for many Hawaiian localities. Interestingly, the biomass estimates for stations within the conservation zone at Hulopoe Bay (Stations 1 through 5) are not exceptionally high suggesting that (a) the habitat is not capable of supporting a greater biomass, (b) the protected area is insufficient in size or (c) that ongoing fishing is retarding population growth. The only fishing allowed in the conservation area is by hook and line. The lack of fishes over sand (Station numbers 3 and 7) is not unusual. Standing crop estimates in Hawaiian sand habitats range from 0 to about 20g/m^2 (Brock 1954, Brock et al. 1979).

Excluding the corals, the invertebrate censuses did not yield any unusual results; species common to the habitats examined in this study are the same as one would commonly encounter elsewhere in the Hawaiian Islands in similar habitats. As noted above, the census techniques used here for macroinvertebrates assesses only those species that are large (greater than 2cm in some dimension), diurnally exposed, and are motile. The method is probably accurate for some of the echinoderm species but little else. Thus the macroinvertebrate census data are of limited value for describing the benthic community. Sessile and/or colonial forms are assessed by use of the quadrat technique.

TABLE 13. Summary of the biomass estimates (in g/m^2) calculated from estimated individual fish lengths in the field for families of fishes that collectively contributed 96 percent or more to the standing crop of fishes at the ten stations sampled in this study.

Family	Station Number 1	2	3	4	5	6	7	8	9	10	Family Mean %
Acanthuridae	35	54		87	6	17		84	25	63	36
Balistidae	2	5		2	2	4		8	3	7	3
Canthigasteridae		0.1		0.1	0.1			0.2	0.1	0.2	0.1
Carangidae						47		5			5
Chaetodontidae	0.8	0.4		1	0.1	2		2	0.3	0.1	0.7
Cirrhitidae	0.1	1			0.3	1		1	0.3	0.2	0.4
Holocentridae	6					6		0.3			1
Kyphosidae				4							0.4
Labridae	26	18		7	6	7		31	20	17	13
Lutjanidae		2							71		7
Monacanthidae	6				0.7	0.3			3	0.1	1
Mullidae	5	6		8	2	10		25	6	35	9
Muraenidae			2					0.5		2	1
Pomacentridae	0.8			4	0.2	3		24	1	1	3
Scaridae		63		26		0.8		55	11	23	17
Serranidae		9									1
Tetraodontidae								4			0.4
Zanclidae	0.5	0.5		1		0.5					0.3
Total Station Percent	99	99	100	100	99	97		99	96	99	

The results of the biological survey show that benthic and fish community development is greatest in the biotope of shallow high coral coverage and least in the biotope of sand. The important quantitative measures (i.e., number of coral species and cover, number of fish species and biomass) made in these communities are summarized in Table 14; in all, the biotope of shallow high coral coverage has the greatest biological development. The biotope of shallow high coral coverage occurs in areas somewhat protected from occasional storm surf and that have an appreciable amount of hard and stable substratum. Both of these factors are requisites for the success of corals. The stable hard substratum and coral development creates shelter which is necessary for most fish species. The biotope of shallow high coral coverage is a feature found adjacent to the shoreline (i.e., within 100m) both in and adjacent to Hulopoe Bay. If the assumptions about the requisites for successful coral and fish population growth are correct, this suggests that the diversity in the benthic and fish communities resident to the study area is related first to the presence of appropriate hard substratum generally protected from storm surge and surf and to a lesser degree, to land derived inputs (i.e., runoff and silt). This conclusion is based on the fact that the greatest coral and fish community development occurs directly adjacent to the shoreline where the sources for freshwater and terrigenous inputs are located.

POTENTIAL IMPACTS TO MARINE COMMUNITIES WITH THE PROPOSED DEVELOPMENT

The diversity of the nearshore communities at Hulopoe and environs have persisted under the present conditions of occasional storm water runoff. The impact of groundwater input to the nearshore marine communities in the study area is probably negligible, as MacDonald (1940) notes that the only prominant basal-water spring on Lanai is on the shore at Lae Hi Point on the northeast side of the island. Observations on the composition of the sand substratum throughout the study area shows a high percentage of basalt and terrigenous material mixed with the carbonate fraction suggesting input from storm water runoff. Indeed the turbidity data show that considerable sediment and debris may be washed into the sea following heavy rains (see Station 6 Table 2). Despite these events the nearshore communities have persisted. Sedimentation has been implicated as a major environmental problem for coral reefs. Increases in turbidity may decrease light levels resulting in a lowering of primary productivity. Perhaps a greater threat would be the simple burial of benthic communities that may occur with high sediment loading. Many benthic species including corals are capable of removing sediment settling on them but there are threshold levels of deposition where cleaning mechanisms may be overwhelmed and

TABLE 14. Summary of the quantitative biological observations made at 10 stations sampling four biotopes recognized in this study.

Biotope	Station No.	Depth (m)	No. Coral Spp.	Mean Cover (%)	No. Fish Spp.	Biomass (g/m^2)
Biotope of Low Channels	1	20	4	41	33	84
	5	15	4	22	18	17
	6	11	9	38	39	101
Means		15	6	34	30	67
Biotope of Grooves	2	8	5	9	37	159
	9	12	6	15	38	147
	10	8	4	4	32	149
Means		9	5	9	36	152
Biotope of Sand	3	8	-	-	1	2
	7	13	-	-	-	-
Means		11	-	-	1	1
Biotope of Shallow High Coral Cover	4	6	10	49	30	139
	8	7	8	32	42	243
Means		7	9	41	36	191

the individual becomes buried. However the impact of sedimentation on Hawaiian reefs may be overstated. Dollar and Grigg (1981) studied the fate of benthic communities at French Frigate Shoals in the Northwest Hawaiian Islands following the accidental spill of 2000 tons of kaolin clay. These authors found that after two weeks there was no damage to the reef corals and associated communities except where the organisms were actually buried by the clay deposits for a period of more than two weeks.

If allowed to proceed, the proposed development will increase the potential for runoff during the construction phase. Runoff will only occur with high rainfall in Hulopoe; such events are not common in an area that has a mean rainfall of only 30cm (12 inches) per year (MacDonald 1940). In this low rainfall setting, natural vegetative cover is incomplete and feral animals probably assist in the ongoing erosion. If prudent construction practices are followed (i.e., not uncovering too much soil at any one time, building temporary catchment and settling basins, etc.) and construction is not hampered by high rainfall events, little or no sediment should reach the sea. Following project completion, the soil should be covered and/or planted such that the generation of sediment from the project site reaching the sea will be less than occurs today.

The chemical environment may, to a large degree, dictate the structural and functional characteristics of aquatic communities thus alteration in this environment may serve to change marine communities. If changes in physio-chemical inputs are not too great, a potential for chronic, low-level disturbance can result in adjacent aquatic communities. In the development and operation of a coastal resort in a low rainfall setting such as at Hulopoe Bay, chronic disturbance may possibly come from the irrigation and upkeep of golf courses. In many dry coastal Hawaiian resorts, golf courses are irrigated by a combination of brackish groundwater and treated resort sewage effluent. In addition, dry fertilizers, pesticides and herbicides are applied to these courses. The nutrient subsidy from fertilizers and sewage as well as the pesticides and herbicides placed on these golf courses could migrate downward to the groundwater table and move laterally in the low salinity watertable towards the shoreline.

The potential for such impact may be addressed through an examination of water quality data collected on the West Hawaii coast at Waikoloa. A relatively longterm and routine water quality and aquatic community monitoring program has been in place at Waikoloa and is carried out by the University of Hawaii. A characterisitic feature of West Hawaii is its diffuse groundwater discharge at the shoreline due to the island's geologically young lavas (Cox et al. 1969). The high porosity of these young lavas will not support water contained above sealevel near the shoreline, resulting in a system where groundwater moves rapidly

through the lava towards the sea and seawater readily intrudes (Cox et al. 1969). In this porous setting are depressions or pools that extend down into the watertable; these ponds are termed anchialine pools.

The characteristics of the groundwater entering the ocean at Waikoloa have been described by Maciolek and Brock (1974), Bienfang (1977), Ziemann (1984, 1985), U.S. Army Corps of Engineers (1985), Brock and Norris (1987, 1988a) and Brock et al. (1988). Since April 1986 a regular program of water quality sampling and monitoring of benthic communities has been undertaken; the program monitors tide state, salinity, nutrient, pesticide and herbicide levels in anchialine pools, the nearshore marine environment and at other West Hawaii locations with no surrounding development.

Summarizing the data presented by Brock and Norris (1987, 1988a) and Brock et al. (1988), the concentration of inorganic nutrients is high in inland (mauka) pools and decreases in a seaward direction. Inland of the pools is golf course development; mauka of the golf course and planted grounds are a series of wells dug for irrigation purposes. Nutrient concentrations are low in the wells. Brock and Norris (1988a) concluded that the source of high nutrient levels observed in the pools was from the Waikoloa golf course which is heavily fertilized with sewage enriched irrigation water and commercial fertilizers. It was suggested that leaching of these materials through the thin topsoil to the groundwater beneath was occurring. Brock and Norris (1988a) found no statistically significant changes in water quality from the 1986-1988 period during the operation of the resort but significant changes had occurred in comparing the period prior to resort development (1977) to the 1986-88 period. The observed increases were for nitrate + nitrite nitrogen and orthophosphate. Despite these changes, these authors note that the 1986-88 mean concentrations of nitrate + nitrite nitrogen, ammonia nitrogen, orthophosphate, silicate, total organic carbon in the waters from the developed Waikoloa setting fall well within the range of values measured in anchialine and shoreline areas along the West Hawaii coast with no surrounding development. Furthermore the concentration gradient in nutrients at Waikoloa shows minimal elevation at the shoreline and 100m seaward of the shore is not detectable (Brock and Norris 1988a). Other than arsenic, pesticides and herbicides applied at Waikoloa are not detectable; arsenic concentrations were the same in groundwater from either developed or control areas (with no surrounding development) suggesting that low levels of arsenic contamination are natural in Kona coast groundwater (Brock and Norris 1988a).

Mean nitrate + nitrite nitrogen concentrations reported by Brock and Norris (1988a) range from a high in mauka pools of 90uM to 2.7uM at the shoreline. In other locations naturally occurring nitrate nitrogen levels are greater; Johannes (1980) reported

groundwater nitrate levels between 115 to 380uM from Perth, Australia and Marsh (1977) noted nitrate nitrogen concentrations in Agana, Guam groundwater of 177uM. The highest known concentration of nitrate + nitrite nitrogen consistently found along the West Hawaii coast was 180uM in the Kukio land division, an area with no surrounding or upland development (Brock unpublished data). Thus, high nitrate values are a naturally occurring phenomena in groundwater entering the sea on Hawaiian coastlines.

Periodic sampling of the aquatic biota of the anchialine pools at Waikoloa since 1972 (Maciolek and Brock 1974) to present have yielded no obvious change in ponds where exotic fish (i.e., non-native species such as topminnows and tilapia) have not been introduced. Brock and Norris (1988a) point out that the aquatic biota is unaffected by the nutrient loading. Possible mechanisms to the apparent insensitivity of the aquatic biota to the excess nutrients may be the characteristic short water residence time of ponds and the usual presence of large numbers of the herbivorous shrimp (opae'ula). Through their grazing, these crustaceans appear to keep many macrothalloid algal species and possibly phytoplankton from otherwise dominating the system. Also, the insensitivity of the biota to high nutrient levels may be a reflection of their living in a habitat that naturally has a highly variable nutrient chemistry thus they are preadapted to such a system.

With the extremely low inorganic nutrient concentrations that typify marine waters, benthic algae rapidly strip out the nutrients found in any incoming groundwater at Waikoloa (Brock and Norris 1988a). Macrothalloid algal species are rare at Waikoloa probably due to the high grazing pressure exerted by herbivorous fishes and sea urchins in the shallow subtidal areas (Brock and Norris 1988b). The marine baseline survey of the waters affronting Waikoloa carried out in August 1988 found no unique or unusual marine communities but rather the marine fish and benthos of Waikoloa are very similar to those encountered elsewhere in other West Hawaii reef sites; there was no evidence of man-induced disturbance in these communities (Brock and Norris 1988b) suggesting that what little nutrient input has occurred has had no discernible impact.

The longterm studies at Waikoloa suggest that coastal resort development (in particular, golf courses) may increase the concentration of inorganic nutrients in the underlying groundwater but that these changes are (1) not chemically detectable outside of 100m of the shore, and (2) do not manifest any discernible change in the aquatic communities whether these communities are in brackish or marine waters. The Waikoloa development is situated on a very porous substrate of pahoehoe and a'a lava located just a few meters above mean sealevel and having only a thin (about 30cm) layer of soil for planting. Due to its greater age, there is more soil (greater thickness) in the proposed Hulopoe

course area and much of the proposed golf course lies at elevations greater than 30m. Thus the opportunity for leaching of materials to the watertable at Hulopoe is probably less than that at Waikoloa. Furthermore, if leaching of materials does occur, a greater period of time would pass prior to detection.

The data suggest that the proposed development at Hulopoe may, over a long period of time, increase the concentration of inorganic nutrients in the underlying watertable but that the increases will be less than seen in some natural systems in Hawaii. Furthermore, the Waikoloa data suggests that there should be no discernible impact due to changes on the nearshore marine communities affronting the project site due to changes in nutrient chemistry.

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APPENDIX A. Results of the quantitative visual censuses conducted at ten locations offshore of Hulopoe Bay, Lanai and environs on 21-23 December 1989. Each entry in the body of the table represents the total number of individuals of each species seen; totals are presented at the foot of the table along with an estimate of the standing crop (g/m^2) of fishes present at each location. Note that no fishes were censused at Station 7.

Family and Species	Station Number 1	2	3	4	5	6	7	8	9	10
ACANTHURIDAE										
Acanthurus olivaceus	3	1		1					1	3
A. nigroris	29					8				
A. nigrofuscus		31		47	8	31		25	30	62
A. thompsoni	3									
A. triostegus				18						
A. achilles				10		3		8		
A. dussumieri				1						
A. mata									1	
A leucoparieus				1				9		
A. xanthopterus									3	
Ctenochaetus strigosus	76	38		32	21	38		44	10	
Naso lituratus	1	6		3		1		6	1	10
N. hexacanthus		2								
N. unicornis		1		3				2	1	
Zebrasoma flavescens	21	2		19	4	5			11	9
APOGONIDAE										
Apogon kallopterus	4					2			2	
AULOSTOMIDAE										
Aulostomus chinensis						2				
BALISTIDAE										
Melichthys niger								7		3
M. vidua	1	2			1	2			1	1
Sufflamen bursa		2		2	1			1	1	1
Rhinecanthus rectangulus								1		
Xanthichthys auromarginatus	2									
BLENNIIDAE										
Exallis brevis						1			2	1
Cirripectus vanderbilti										1
Plagiotremus ewaensis										1

APPENDIX A. Continued.

Family and Species	Station Number 1	2	3	4	5	6	7	8	9	10
CANTHIGASTERIDAE										
Canthigaster jactator	1	5		5	3	3		2	3	6
C. rivulata								1		
CARANGIDAE										
Caranx melampygus						1		1		
Gnathanodon speciosus						7				
Decapterus macarellus						7				
CHAETODONTIDAE										
Chaetodon fremblii						1		1		
C. lunula								1		
C. kleini	4									
C. quadrimaculatus		1		1				3		
C. multicinctus	9	2		3	3	4		4	2	
C. miliaris								1	1	
C. ornatissimus				1		2		1		
C. unimaculatus								2		2
Forcipiger flavissimus	3	2		1		1		4		
CIRRIHITIDAE										
Paracirrihitus forsteri		1				1		1		
P. arcatus	1	4		1	1	3		4	2	1
Cirrhitops fasciatus									1	1
Cirrhitus pinnulatus		1								
HOLOCENTRIDAE										
Myripristis amaena	7									
M. kuntee						8				
Adioryx diadema								1		
KYPHOSIDAE										
Kyphosus bigibbus				1						
LABRIDAE										
Anampses chrysocephalus	1									
Bodianus bilunulatus	1	1								
Cheilinus unifasciatus	1									1
Thalassoma duperrey	21	21		8	8	11		80	24	24
T. ballieui	2	2		2	1	4			1	2
Stethojulis balteata		1				1				1
Macropharyngodon geoffroy						7				1
Coris gaimard		1				1		1		2
C. flavovittata										1

APPENDIX A. Continued.

Family and Species	Station Number 1	2	3	4	5	6	7	8	9	10
LABRIDAE										
C. venusta										1
Gomphosus varius	1	2		1		1		7		2
Pseudojuloides cerasinus	3				5				1	
Labroides phthirophagus	1			2		1		1		
Pseudocheilinus octotaenia	4	1			10	5		2	2	
LUTJANIDAE										
Alpharens furcatus		1							1	
Lutjanus fulvus									1	
Aprion virescens									4	
MONACANTHIDAE										
Pervagor spilosoma						1				
P. aspricaudus	1					1				
Cantherhines sandwichiensis	1									
C. dumerili					1				1	1
MULLIDAE										
Mulloides vanicolensis						5		6		
Parupeneus pleurostigma	1	1								
P. multifasciatus	11	10		8	7	9		6	13	17
P. cyclostomus									1	3
P. bifasciatus								1		
MURAENIDAE										
Gymnothorax meleagris								1		1
OPHICHTHIDAE										
Callechelys luteus			1							
OSTRACIONTIDAE										
Ostracion meleagris								1		
POMACANTHIDAE										
Centropyge potteri	3	1			2				3	

APPENDIX A. Continued.

Family and Species	Station Number 1	2	3	4	5	6	7	8	9	10
POMACENTRIDAE										
Chromis vanderbilti		18						150	13	193
C. hanui	31	1		3	5	7			3	
C. agilis	48				13	3			8	
C. ovalis								36	1	
C. verator				3				24	1	
Dascyllus albisella		4								
Plectroglyphidodon imparipennis		1							1	4
P. johnstonianus	3			1	1	4		8	1	1
Stegastes fasciolatus				7		14		12	3	8
Abudefduf abdominalis				6				36		
SCARIDAE										
Scarus sordidus		4		6				1	2	
S. rubroviolaceus		1								1
S. psittacus		15				1				
S. perspicillatus		1		1				2		
SERRANIDAE										
Cephalopholis argus		1								
SYNODONTIDAE										
Synodus binotatus									1	
TETRAODONTIDAE										
Arothron meleagris								1		
ZANCLIDAE										
Zanclus cornutus	1	1		2		1				
Total Number of Species	33	37	1	30	18	39	0	42	38	32
Total Number of Individuals	300	190	1	200	95	208	0	506	159	366
Estimated Biomass (g/m^2)	84	159	2	139	17	101	0	243	147	149

Data recovery and preservation plan for the 300-acre rural district Palawai and Kealiaaupuni, Lana'i

by

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prepared for

LANAI COMPANY, INC.

by

Cultural Surveys Hawaii

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C-1

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Introduction

This plan has been prepared as part of mitigation measures for significant archaeological sites within the approximately 300 acre rural district on the south coast of Lana'i west of Manele Bay. This rural district is part of the Manele Master Planned Area and is proposed for golf course and residential development.

The Project Area

The project area consist of rocky, thinly vegetated dry land stretching approximately 1 mile along the coast from the Manele District Boundary (the present Hotel site) westward to Huawai Gulch. The *mauka* boundary of the project extends to a maximum of 2,800 feet from the ocean. Elevation is from sea level to as much as 370 feet. The land is mostly gently sloping except where dissected by dry gulches. Two short gulches on the eastern side drain into Kapiha'a Bay, a central gulch drains over the sea cliffs into Kaluako'i Bay. The largest gulch—Huawai—forms the western boundary.

Previous Archaeological Research

Except for limited recording by Kenneth Emory (Emory 1922, 1924) and the Bishop Museum (Hammon 1974), the first systematic archaeological survey of the project area was conducted by Cultural Surveys Hawaii in 1988 (Hammatt et al. 1988). The reader is referred to this 1988 report for detailed background information and descriptive data on archaeological sites. Most useful is the 1 inch = 200' map of the project area showing all site locations.

Number of Sites and Significance Evaluations

There were 22 archaeological sites including 75 individual features located in the 1988 survey. The majority of these sites are located in the southeastern portion of the project area around the mouth of a small gully by Kapiha'a Bay. Much of the western portion of the study area is devoid of sites.

The archaeological sites were evaluated for significance within 7 categories applying the broad criteria established for the National and State Registers of Historic Places (See Table 1, Appendix). The seven categories (A - E and NLS and NS) are listed and generally applied to the archaeological sites in the project area as follows:

A. Site reflects major trends or events in the history of the state or nation.

- This criterion seems to have little or no application to the sites in the project area. Trends or events are not particularly discernable in the archaeological record at this inventory survey level.

B. Site is associated with the lives of persons significant in our past.

- None of the sites in the project area are likely to be associated with specific individuals since they were abandoned in prehistoric times.

C. Site is an excellent example of a site type.

- This criterion addresses quality of construction and integrity of design as well as state of preservation and the degree to which a site illustrates a particular aspect of prehistory or history. Most of the sites within the 18-20 complex fit this criterion as well as the *heiau*, and fishing shrines and some adz quarries.

D. Site may be likely to yield information important in prehistory or history.

- Virtually all sites from which information on their construction, age range, or function can be gained through excavation are included in this category. All sites containing cultural deposits are included namely permanent and temporary habitation structures, cave shelters and adz quarries.

E. Site has cultural significance to the Hawaiians or other ethnic group.

- This category includes religious sites—*heiau* (Site 14), fishing shrines (Sites 12A, 18D), small shrines including adz makers' shrines and sites containing burials (18H, 18F, 19B, 19E).

E (N.L.S.) No Longer Significant—Sites in this category are simple features with no cultural deposits and no interpretive value beyond the point at which they are located on a map and described. Included are *ahu* or small isolated shelters on bedrock.

G. (NS) Not Significant—These are sites which do not fit any of the above criteria and have no significance value. Included would be uninterpretable minimally modified natural features and modern fishing shelters.

Of the total of 75 archaeological features, six are evaluated as either not significant or no longer significant, leaving a total of 69 significant features.

Historical and Archaeological Context

The archaeological sites located along this dry leeward section of Lana'i's southern coast represent the remains of former prehistoric settlement whose economic basis was fishing and adz quarrying and manufacturing. Agricultural production would have been seasonal and limited by low rainfall and shallow soil deposits. Access to the shoreline was clearly a consideration in location of habitation features. The rocky beaches with low cliffs along the

eastern portion of the Project area (Palawai Ahupua'a) were more favored for habitation than the high inaccessible cliffs west of Kaluako'i Bay.

These factors gave rise to a closely clustered prehistoric settlement along the shoreline of Kapiha'a Bay. This settlement probably flourished during the middle to late prehistoric era and judging by the lack of foreign materials on the surface of these features, was abandoned at or just before European contact.

Although the project area includes 2 adjacent *ahupua'a* virtually all of the evidence of prehistoric activity is within Palawai to the east. In terms of the plentiful evidence of adz quarrying and manufacturing this *ahupua'a* context is of particular interest. Palawai is one of the 3 *ahupua'a* on Lana'i which extends across the top of the island to include a portion of the opposite coastline. The major adz quarry of Lana'i (*Ko'i*), located by Emory (1924) lies within this *ahupua'a*. There is a strong connection of this land unit to adz quarrying in general, and to an important exportable resource in Ancient Hawai'i.

The place name of the Bay—Kaluako'i—translates as "adz pit" and marks the western edge of quarrying activity in the project area.

Documentation of land use through search of historical record will be of little benefit. There are no land court awards within the project area and all indications from survey data suggest no habitation or significant activity in the area since European contact. A single broken wire fence near the western boundary and a long abandoned watering trough mark the only remains of former cattle grazing.

In general, the sites are well preserved and have been altered minimally since their abandonment. The variety of site types and functions give a complete picture of a self-sufficient isolated prehistoric community with closely clustered habitation features, a *heiau*, 2 fishing shrines, burial structures and many work and craft activity areas.

The Sites

Table 1 presents a list of archaeological sites within the project area. Each of the site categories is discussed briefly below (This information is abstracted from the 1988 survey report).

Table 1

Site and Feature List by Functional Groups

(Some features are listed under more than one category for example quarries with shrines or habitation sites with burials)

1. Permanent Habitation (habitation terraces, larger enclosures, platforms, 1 cave).

   Total Features—23

   List: 5, 13, 15, 18F, 18G, 18H, 18J, 18K (2 terraces), 18L (platform and terrace), 18M, 18O, 18P (3 terraces), 18Q, 19D, 19F 9 (*ko'i*) 20A, 20G, 20H, 20I.

2. Temporary Habitation (Small terraces, small platforms, small shelter enclosures, small cave shelters, work areas)

   Total Features—22

   List: 3, 4 (cave shelter), 8, 12B (cave shelter), 12D, 12E, 12F, 13D, 16, 17A, 17D, 17F, 17G, 18C, 18E, 20B, 20C, 20K, 20L, 22A, 22B, 22C.

3. *Heiau*, Site 14.

4. Large Shrines (*ko'a*?), Sites 12A, 18D.

5. Small Shrines—uprights, *ahu*, (adz maker shrines?)

   Total Features—8

   List: 9, 11A, 12C, 14D, 17B, 17C, 19A, 19C, 20E

6. Quarry Sites

   Total Features—7

   List: 1, 6, 7, 8, 9, 10, 11

7. Burials

   Total Features—4

   List: 18H (makai connected burial), 18F (internal feature), 19B, 19E (burial platforms)

8. Agricultural Features

   List: 20J (planting area), Agricultural terraces by Sites 4, 5, and 14

9. Miscellaneous

   Includes 1 petroglyph (Site 21), miscellaneous *ahu* of undetermined function (Site 2) and linear mounds (Site 20D)

Permanent Habitation Sites

These consist predominately of level terraces marked by alignments on at least one side and are characterized by scatters of cultural material in terrace soil deposits. Some habitation features are walled or consist of stone paved platforms. The permanent habitation features are generally distinguished from the temporary ones on the basis of: 1) size (say larger than 3 meters—10+ feet internal dimensions as a rough guide), 2) the quantity of scattered cultural material (a great many basalt flakes) and 3) perhaps most importantly in the case of this project—locational context. All permanent habitation sites as designated here, with 3 exceptions, are tightly clustered, even virtually continuous, on either side of one gulch. The exceptions are Sites 5, 13, and 15 which are within 1,000 feet of the gulch "village" *mauka* and to the west.

There are possibly meaningful distinctions between habitation features on the west (Complex 18) and east sides (Complex 20) of the gulch (for convenience referred to as Kapiha'a Gulch). The west side features are greater in number, more tightly clustered and are predominantly level terraced house "pads" without enclosing walls. The habitation features on the west side would make up a quantity of house sites (about 14) which far exceeds the size of an extended family *kauhale*. On the east side Features 20E, 20G, 20H and 20I could be visualized as a single large *kauhale* complex.

On both sides of the gulch there is plentiful evidence of basalt flaking on and around the sites. However, these flake scatters are much thicker and more widespread on the west side. The entire bluff slope west of Complex 18 is covered with lithic flaking debris (debitage). This may be explained by the proximity of this complex to the 3 large basalt quarries west and *mauka* of the gulch. Clearly, a major activity of the inhabitants of this community was adz manufacturing. In some cases water rounded boulders on the sites showed battering on the ends, indicating their use as anvil flaking stones (19E, 18J). Within some of the house sites are internal features such as interior alignments (20H) stone lined hearths (20I) adjacent burial features (18F—a coral pavement, 18H—a burial platform adjacent to the *makai* retaining wall), and small raised platforms (18I, 18M), and *ahu* (18N) adjacent to the house sites.

One isolated site classified as permanent (Site 5) barely qualifies by size, is isolated *mauka* of the main complexes. This small cluster of habitation features may owe its location to the nearby adz quarries (Sites 1, 9, 10).

Temporary Habitation Sites

These are smaller features consisting of small terraces, small platforms, shelter enclosures and a few cave shelters and flaking areas.

Some of these occur around the permanent habitation areas (Sites 6, 17, 18, 20) and are merely extensions of the activity areas associated with the larger sites. Others are locationally separated and are found along the coast line having the appearance of fishing shelters. The shelters at Site 12 and Site 22 are good examples of these. The Site 12 Complex deserves special mention as a very typical fishing oriented complex. Well constructed, but small structures are along the shore line (12D, 12F) and there is a high rectangular platform piled with branch coral which is a certain fishing shrine. Some of these shoreline fishing shelters show evidence of historic and modern use (12F, 17A). Sites 3 and 4 shelters, isolated far to the west of the main site complexes, may be agricultural shelters associated with nearby natural terraces modified for seasonal planting of dry crops.

Site 8 shelter is isolated along a high cliff on the west side of Kaluako'i Bay. It also shows evidence of modern use by fishermen, but was originally a lithic work shelter associated with an adjacent basalt dyke exposure.

Heiau

Although there is no positive identification of the large stone structure of Site 14 it is in all probability a *heiau*. It is over 40' square and has a *mauka* wall 5' high and nearly 6' thick. It is many times larger and more massive in terms of volume of rock work than the largest house sites in the project area and is entirely of distinctive design. It is easily the most visible site on the 1 inch = 200 foot aerial photograph. It stands in a separated location *mauka* and west of the main habitation complex and there is no heavy evidence of habitation on or immediately around the structure. Although some flakes and midden are visible on the main paving. Flake scatters and midden are very visible around all the main habitation sites in the project area. Of course, it is also possible that this site is a high status *hale mua* or men's house, but at present, it is interpreted as a small *heiau*.

Large Shrines

These are two features consisting of 3' - 4' high roughly square platforms which are characteristic shrines (12A, 14D). Site 12A is associated with shore line fishing shelters and is piled with large quantities of branch coral with the typical characteristics of a fishing shrine (*ko'a*). Emory (1924:70) refers to these as "heiaus of fishermen" and found many such structures along the coast line of Lana'i. He observed coral, shell and fish bone almost invariably associated with these structures.
Site 18D is a similarly shaped square platform, probably a *ko'a*, but there is a smaller coral pile. The structure has a small adjoining altar attached to the southwest wall and is surrounded by basalt flakes on the adjoining terraces.

Small Shrines

There are 8 smaller shrines, some of which are adjacent to habitation sites and some associated with adz quarries. This category is informally defined as a small structure such as an *ahu*, platform, or

even an enclosure which is too small to have had a habitation or shelter function and frequently has coral or slab uprights associated with it.

The most easily distinguished kind of small shrine is a simple *ahu* supporting a slab upright often collapsed. Sometimes these occur in multiple sets. Site 7A consists of a row of 7 *ahu* each of which formerly supported slab uprights 1' - 2' long. Some are in direct association with adz quarry sites (Site 9, 11A). Others are near lithic work areas. These structurally simple slab shrines occur in great numbers around the well-known adz quarry at Mauna Kea (McCoy 1982, 1984) and the authors have located additional examples on Mauna Kea and at Kaluako'i, West Moloka'i, in both cases near adz quarries (Hammatt, Borthwick: 1988; Hammatt, 1978). With the addition of the Lana'i examples the pattern of association includes 3 Hawaiian Islands. There is little doubt that these are "adz maker shrines" (for lack of a better term) and were constructed by the quarriers and flakers as *pohaku* offerings. Site 11 provides perhaps the best example. The shrines stand on a knoll directly overlooking the quarry and flaking area.

Quarry Sites

There are seven separate quarry areas distributed mostly in the *mauka* area between the eastern boundary of the project area and Kaluako'i. These are recognizable initially simply by the dense scatter of basalt flakes covering the rocky and loose soil terrain. In some cases (Sites 1, 6, 7) dyke formations from which the basalt was quarried are visible in bedrock outcrops. In other quarry areas the dyke stone had to be exposed for quarrying by actually digging away the overlying layer of loose rock and soil. In some cases rectangular boulders of dense basalt 2' in diameter were flaked along the edges to remove adz cores. Clearly, preform shaping took place at the actual quarry localities, as well as on and around habitation sites. The bluff line 100' or more to the west of the Site 18 Complex is literally covered with flaking debris on natural terraces and most of the house sites contain surface scatters of flake debris. The largest quarry is Site 7 which is defined by a flake scatter and small outcroppings of dyke material over an area 800' *mauka-makai* and 1-200' east-west. The location of the quarries—as distinguished from flaking stations—is determined by the dyke outcroppings wherever they may be. In some cases they are in level or gently sloping areas (Sites 7, 9, 11), in other cases they are along steep gully sides (Sites 1, 6, 10).

Another product of these quarries was volcanic glass which was observed in most of the quarry sites and occurs as veins along the edges of the basalt dykes. The scatter of volcanic flakes and cores in the quarry areas and habitation sites shows that this material was extracted from the quarries and carried to nearby habitation areas. In addition, there is evidence of quarrying of soft red porphyritic basalt (baked soil) which occurs along the edges of the dyke exposures at Site 7. An artifact, made of this material was observed at Site 15 (coffee bean sinker) and flake scatters of this material were found at habitation sites (Site 20, Feature H). This material, similar to scoria is useful for fishing sinkers, lures, files, abraders and other soft stone artifacts.

Burial Sites

Surprisingly there are only 2 discrete features which can be almost positively identified as burials. These are two monument burial platforms *mauka* of the Site 20 complex. Other burials may be present under an internal coral paving of Site 18F and under a small rectangular platform connected to the *makai* side of 18H. Of course, it was not uncommon for prehistoric Hawaiians to bury their dead under or adjacent to house sites. Excavation could yield multiple burials within habitation features. Although the definite burial features are few in number their presence does reinforce the identification of permanent habitation sites within the 18 and 20 Site complexes.

Agricultural Features

There is a single archaeological feature which can definitely be identified as agricultural. It is on the east side of Kapiha'a Gulch and is a walled rectangular enclosure with a soil filled interior (20J). It is a walled planting area, but the walls are only to define the field, as they are not high enough to exclude cattle.

Identification of other planting areas are somewhat more problematic. There are distinct areas on sloping land near gulches which have well formed natural terraces resulting from downslope sorting of rocks and expansion and contraction of soils during wet dry cycles. The terraces produced by this natural patterned ground phenomenon are well shaped, even symmetrical when viewed from downslope. In fact, an archaeologist unaware of this natural phenomenon could easily identify these areas as man-made planting features. However, there are three areas in which the terraces are particularly well shaped and in our judgment may have been modified by human hands—rock clearing from soil areas and stacking on retaining walls. These areas are marked on the project area map, but not given separate site numbers and the question of their use for planting is left unanswered until further examination is possible.

The question of the extent of native coastal agricultural on Lana'i is an important one. Kaschko (1987) argues from the sites at Manele that coastal agriculture was minimal and most of the food crops were brought from the *mauka* gardens. The seasonal cultivation of sweet potatoes in the winter months was certainly possible and it was potentially an important immediately available source of food for these coastal settlements. If these natural terrace areas

were used, they are certainly extensive enough in size to have supplied the entire community.

Miscellaneous Sites and Features

This category includes *ahu* and other features of unknown function, as well as one single isolated petroglyph (Site 21). This stick figure was drawn on a small boulder and may be a modern replication of an old design. It is surprising that other petroglyphs were not located within the project area, given the many suitable boulder faces and the many other petroglyph localities on the island (reported by Emory, 1924). The survey archaeologists located no other petroglyphs besides the single figure at Site 21. However, Gary Onuma (Personal Communication, 1988) has observed faint figures on near shore boulders above Kaluako'i Bay. He reports that they are only visible when viewed in oblique light early or late in the day.

At the *makai* end of the Site 20 Complex are a series of parallel connected linear mounds which are less than 2' high and 10' apart piled on a level shelf overlooking the shore. They are uniform to the point of almost appearing to be made by a tractor blade. However, they are considered to be associated with the prehistoric complex. They are probably net or fish drying areas.

Data Recovery Plan

Present Mitigation Plans

Mitigation of the impact of proposed golf course and residential development is to be treated in two courses of action.

1. Data recovery of those sites to be directly impacted by development.
2. Preservation of significant sites into archaeological preserves.

Consistent with the recommendations presented in the 1988 survey report, as well as subsequent community input, major habitation and religious sites which form an almost continuous complex on both sides of Kapiha'a Gulch will be preserved in place.

All other sites within the project will be impacted by golf course and residential construction and are to be subjected to data recovery.

Sites for Data Recovery

All archaeological sites outside of designated preserve areas face the likelihood of being directly impacted by construction activities. It may be possible, however, to incorporate some of the features into the golf course landscaping during construction but data should be collected from these sites because the extent of damages to them remains uncertain. Table 1 shows sites designated for data recovery. The site types are summarized as follows:

Permanent Habitation Sites – Site 5
  Total – 1
Temporary Habitation Sites – Site 3, 4, 8, 22A, 22B, 22C
  Total – 6
Small Shrines – 9, 11A, 12C, 19C
  Total – 4
Quarry Sites – 6, 7, 8, 9, 10, 11
  Total – 6
Agricultural Features
  Areas by Sites 4, 5, and 14
Miscellaneous Sites – Site 21, petroglyph
  Total – 1

There are a total of 18 sites to be impacted by construction. Two of these sites (Site 2 *Ahu*—Site 21 petroglyph) are listed as not significant. This leaves 16 sites in all which will require further research before construction impact.

Clearly, the sample of site types for excavation is not representative of the entire site assemblage in that nearly all of the permanent habitation features are in designated preserve areas and excluded from data recovery. Site 5 is the only permanent habitation site not in a preserve area and it is isolated *mauka* of the main complex. However, there are 6 temporary habitation sites (including workshop areas) and adz quarries are also well represented. Of the small shrines 2 are associated with adz quarries and the others are isolated features. These shrines have limited excavation potential but are important in their locational context and construction features.

In addition, there are areas of possible agricultural features to be impacted. Close examination of these features may be useful in determining the type and extent of human use for agricultural production.

Research Goals and Methods

In view of the kinds of sites designated for data recovery it should be possible to address the following research topics.

1. Chronology of settlement—This will involve collection of charcoal and volcanic glass samples from permanent and temporary habitation sites and if available from adz quarries to determine the time frame of occupation and hopefully the chronology of the use of the quarry sites.
2. Economic base of the community—This will be documented through controlled excavation of habitation sites, collection of marine and terrestrial faunal material with analysis to construct dietary patterns.
3. Patterns of use of the adz quarry sites including extraction techniques, possible use of fire for extraction, pre-shaping of adzes on the quarry site and variation in the materials quarried. This will be attempted through mapping, sampling of surface materials and some controlled excavation. There should be some basis, in terms of pre-form types and flaking patterns, for comparison to other quarries in Hawai'i (See Dye, Weisler and Riford 1985).
4. Religious implications of shrines, particularly in those associated with adz quarries. This is a difficult subject to document, but can be partly accomplished by comparison of construction, size and placement of shrines to known examples in other quarry areas, i.e. Moloka'i, Mauna Kea.
5. Evaluation of natural terraces to determine the extent of human modification and their use for dry land agricultural crops. Three possible agricultural terrace areas occur near sites 4, 5, 14. The most well-expressed of these terraces occur on the east slope of Kaluako'i Gulch. These areas will be examined closely for human modification and interpretation of the natural processes which operated to form them. One or two cross-section trenches will be excavated to expose profiles of the terraces to show possible agricultural soils and other signs of human alteration. The question of the extent of agricultural productivity in this dry coastal area is important for interpreting the economic basis of the settlement and the extent to which the inhabitants were dependent on upland food resources.

C-7

Field and Laboratory Methods

Sampling of Sites

It is not realistic or productive to excavate 100% of each site to be impacted by the golf course residential development. However, it is possible to test excavate all sites suspected of containing subsurface cultural material and to excavate sizeable samples of site areas to address the research goals outlined above. The following sampling strategy will guide the fieldwork.

Permanent Habitation Sites and Features

Only one of these types of sites is represented in the list of sites to be data recovered. It is believed that even substantial excavation of this site cannot yield sufficient information to reconstruct chronology and the economic basis of the prehistoric occupation of this community. Therefore, sampling of 15-20% of the features of Site 5 sill be supplemented by excavation of one square meter in the cave Site 19F. This cave is likely to yield datable material to document the longest chronological range of human occupation. One square meter will be excavated in one of the habitation terraces of Site 18 Complex. Both these features are designated as within the preserve area and are not to be directly impacted. However, there is always an increased likelihood of relic hunters doing unauthorized excavation and looting when the sites become accessible. This secondary impact is particularly likely at the small cave site (caves are favorite places for looters). For this reason, at least small scale testing to obtain chronological information is justified as part of the data recovery.

Temporary Habitation Sites

At least 1 square meter trench will be excavated within each of the 6 temporary habitation sites.

Expanded excavations will take place (4-5 square meters) at the larger of these features in which the testing results show analyzable and interpretable cultural material. The most likely examples are the features at Site 22.

Small Shrines

The 4 shrines within the development area are not the type of fea-

tures to contain subsurface cultural materials. They can be sufficiently documented with detailed mapping, photographs and written description of sizes and construction methods.

Quarry Sites At least 2 one meter square trenches will be placed within each of the 6 quarry sites to attempt to document stratigraphic context of the flaked quarry debris and to collect charcoal and volcanic glass for dating. Mapping and controlled surface collection will also be carried out to collect quantitative data on preform shapes and debitage.

Agricultural Features There are three areas of natural terraces designated within the development area. Detailed mapping will take place in selected areas of each of these 3 complexes. In addition at least 2 cross-section trenches will be excavated through terrace walls and soil deposits to document human modification and (if present) to collect datable samples.

Miscellaneous Small Sites Field visits to the survey area since the 1988 Cultural Surveys Hawaii fieldwork have shown 1-2 small features not recorded in the survey report and some possible petroglyphs at Kaluako'i. These features will be recorded, evaluated and treated according to this data recovery and preservation plan.

Excavation Methods The following methods will be used in the excavation of all trenches in cultural layers.

1. Screening of all sediments through 1/8 inch mesh screen;
2. Recovery of all artifacts and shell and bone midden;
3. Recovery of all charcoal both as *in situ* samples and from the screen;
4. Recording of stratigraphy by scale drawing of at least one profile in each 1-meter square trench;
5. All trenches will be excavated to culturally sterile soil deposits or bedrock;
6. The sites chosen for excavation will be mapped to scale showing all internal features and excavated trenches.

Laboratory Methods This phase of work will involve the following:

1. Identification and cataloging of artifactual material including both historic as well as prehistoric forms. Artifacts will be measured with representative samples drawn and/or photographed to scale.
2. Identification, weighing, and analysis of midden material to genus and species. This information will be tabulated for each layer within each stratigraphic unit within each site.
3. Preparation, submittal and dating of datable samples (volcanic glass and charcoal).

4. Dating and identification of historic era artifacts.

Report Preparation

The final report will contain the following:

1. An in-depth presentation of each research question, incorporating prior archaeological and historical studies in the area.
2. Site findings, maps, descriptions, surface collections for each site will be discussed separately. Site maps and stratigraphic profiles will be included. Summary tables—at least by layer—will be included and discussed.
3. A separate section on artifact analysis.
4. A separate section on midden analysis.
5. A separate section on volcanic glass and radiocarbon and historic period artifact chronology.
6. A summary chapter which re-evaluates the findings on each research question.
7. References.
8. Appendices.
   a. Master Artifact Catalog
   b. Volcanic Glass Dating Lab Report

Report Review Procedures A draft report will be submitted to the State Historic Preservation Office (SHPO) , Maui County Planning Departments and the Lana'i Historic Preservation Management Committee for review, to ensure all information is included and completely presented.

A final report shall then be produced, incorporating any recommended revisions. If Cultural Surveys Hawaii disagrees with recommended revisions, consultation will occur with the SHPO and the County Planning Department to resolve these problems. Consultation will occur with both of these offices before the final report is produced.

Report Dissemination Copies of the final report will be sent to Lanai Company Inc., The Lana'i Historic Preservation Management Committee, the State Historic Preservation office, Maui County Planning department, a Depository of the county's choice and the Office of Hawaiian Affairs (OHA).

Disposition of Finds and Documentary Data

All materials generated by this project will be deposited for curation at a facility acceptable to the State's SHPO and County's Planning Department, preferably on Lana'i.

Treatment of Burials

This data recovery plan includes provision for testing of suspected burial sites to determine location and number of burials. If burials are found their actual removal, treatment and final disposition will be handled separately and will be in accordance with Act 265 (Chapter 6E revised) which requires:

1. Notification of OHA by the State Historic Preservation Office, if skeletal remains are likely to be native Hawaiian.
2. Attempts to identify lineal descendants of those buried. If lineal descendants are found and do not wish osteological analyses to occur for their ancestors, such analyses shall not occur.
3. The State Historic Preservation Office (SHPO) is to determine final disposition after consultation with OHA, the landowner, and any identified lineal descendants. Practice has been to have OHA work up a written Memorandum of Agreement on disposition in consultation with the landowner and descendants, and the SHPO. The SHPO, thus, shall notify the landowner of this procedure, and the landowner and OHA are then expected to work up an agreement on final disposition. Once all parties sign this agreement, then final disposition shall occur—after all osteological analyses are completed.

In the meantime, it is recommended that an appropriate reburial place be set aside on the property as this is generally the preferred alternative. All burial treatment will also be in accordance with the Lana'i Burial Treatment Plan, as well as Attachment I of the Memorandum of Agreement Relating to Proposed Development at Hulopo'e and Manele Bays.

Plan for Preservation of Sites

The majority of significant sites are, fortunately for modern planning purposes, essentially clustered on both sides of Kapiha'a Gulch (Fig. 1). These include the major habitation and burial complex sites 18, 19, 20 as well as 2 fishing shrines and a *heiau*. The following preservation measures are to be undertaken. These plans have been arrived at through consultation with the Lana'i Historic Preservation Management Committee and have also considered comments in a lengthy review document by Dr. Matthew *Spriggs of Australia National University.*

The following preservation measures are to be undertaken.

1. Preservation of the complex of habitation and other types of sites on both sides of Kapiha'a Gulch comprising Site Complex 18, 19 and 20.
2. Preservation of the *heiau* (Site 14) *mauka* of Kapiha'a Gulch.
3. Preservation of a view plane with minimal land modifications from the *heiau* to the gulch sites and to the coast.
4. Preservation of the fishing shrine and associated structures *makai* of the *heiau* (Sites 12, 13) (except Site 12C).
5. Preservation of the adz quarry (Site 1) in the northeastern portion of the project area.

It is believed that through protection of these sites that the major features representing the totality of activities and beliefs of this former Hawaiian community can be preserved for future generations.

Protection of Preserve Areas Before and During Construction

In the past, archaeological sites have come under greatest pressure immediately before and during development construction. Relic hunting and disturbance of sites has been a particular problem when access roads are built into previously inaccessible areas. To prevent this, the public should not be allowed access to the sites until improvement work is ongoing on a full-time basis. At this time access will be limited to authorized people. Before any grubbing or grading takes place within surrounding areas the preserve area will be continuously flagged with heavy construction tape to include a buffer zone around site areas. An archaeological monitor should be on site during all grubbing and grading to insure that heavy equipment stays outside the area. During the many months of final layout and landscaping of the new golf course it should be

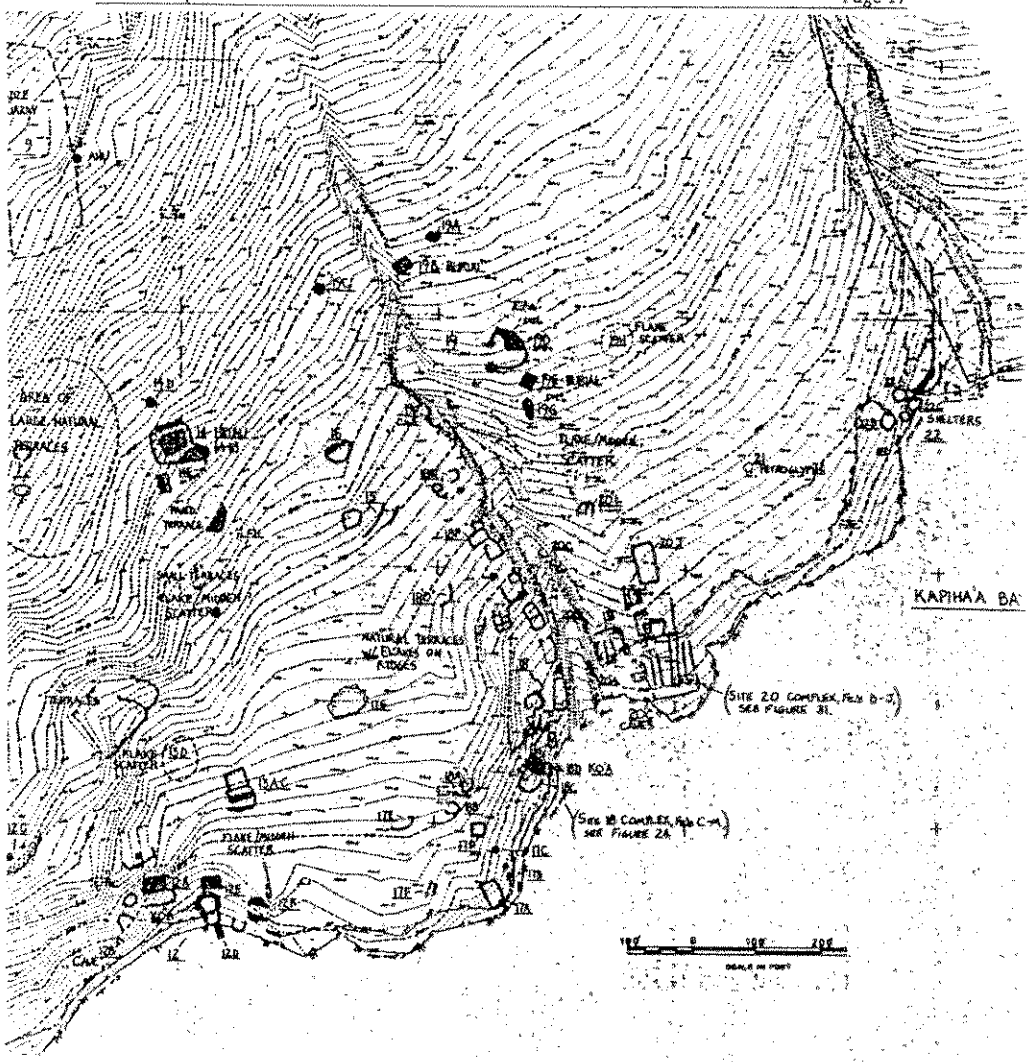

Fig. 1. Kapiha'a Gulch Showing Site Complexes 12-20.

the developer's responsibility to prevent any unauthorized excavation or relic hunting in the preserve areas. Posting of signs warning trespassers is advisable during this period.

Management of Preserve Areas

The purpose of designating these archaeological preserves is to make it possible for succeeding generations to view and appreciate the remnants of one of Lana'i's most intact and well preserved traditional complexes. However, to achieve this they must be protected and managed and maintained. A balance between the goals of protection and accessibility is difficult. The following management steps should allow for sufficient protection, access and appreciation.

1. The kiawe and clutter which now make portions of the preserve areas almost inaccessible were not there when the Hawaiians used this land. For now this thick exotic growth serves as a discouragement to visitation and will continue to be a protective cover during the development of the golf course. Only when the golf course is completed and when the preserve areas are secure as part of the functioning golf course should this vegetation be removed. When it is removed it should be done so by hand cutting and hand mowing with no mechanical equipment brought into the preserve areas. Kiawe stumps should be painted with growth preventing chemicals. The preserve areas should not be left bare of all vegetation. A thin grass cover to prevent continuous regrowth of high weeds in some areas would be suitable.
2. One or two entry routes should be made into each preserve and a small sign should be placed by the path which explains the significance and value of the site complex.
3. The preserve area of Kapiha'a Gulch is uniquely suited to a interpretive program by virtue of its well-preserved internal features as well as its central location. A stabilization, and interpretive program should be developed through consultation with Lanai Company, and Lana'i Historirc Preservation Management Committee, Maui County and the State Historic Preservation Office. The possibilities include revegetation with native plants, interpretive signs, outdoor displays, informational brochures, etc.

Summary of Recommendations for Data Recovery and Preservation

The following recommendations are made in this plan specific to both data recovery and preservation in the 300-acre Development Area.

Data Recovery

1. Excavation of Site 5, plus sampling of cave Site 19F and one major habitation site.
2. Sampling with selective expanded excavations at temporary habitation sites.
3. Complete documentation of all shrines in the development area.
4. Test excavations controlled surface collection and mapping of quarry sites.
5. Stratigraphic excavations and mapping at agricultural terraces.
6. If burials are located (which is unlikely)---The procedures of the Lana'i Burial Treatment Plan will be followed.
7. An archaeologist on site during grading and grubbing to advise on incorporation of archaeological features into the golf course, respond to unexpected findings and to insure avoidance of archaeological preserves.
8. Completion of a final report on all excavations of the development area.

Preservation

9. Continuous flagging, with warning signs around preserve areas before ground disturbance.
10. Maintain security of preserve areas in all phases of construction to prevent relic hunting and vandalism.
11. Hand-clear and poison exotic vegetation after development is complete and replacement with a thin grass cover around archaeological features to prevent weed regrowth.
12. Placement of signs at preserve areas explaining their significance and value.
13. Development of an interpretive program for the Kapiha'a Complex.

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Appendix

TABLE 1

SUMMARY LIST OF ARCHEOLOGICAL SITES WITH SIGNIFICANCE ASSESSMENTS

(22 Sites, 75 Features, 69 Significant Features – See End Sheet for Significance Codes: A-E, NS, NLS)

	Site/Feat. No.	Description/Comments	Recommendations	Significance
PRESERVED	1	Quarry/Utilizing Exposed dyke (prehistoric) (probably Athens, Site 1510, Feature D)	Test, Surface Collection	D
NOTHING	2	*Ahu*/possible trail marker Marker (prehistoric?)	None	NLS
min. 1m²	3	Terrace/Probable habitation Site; Visible midden (prehistoric)	Test	D
min. 1m² + TRENCH IN WEAKLY AG? TERRACE & map	4	Rock Shelter/Probable habitation site, Visible Midden with possible agricultural features *makai* (south) (prehistoric)	Test	D
15-20% OF EACH FEAT. & + AG (1m²) TERRACES	5	Habitation Site/Enclosure, terrace Cupboard; Midden and artifacts observed (prehistoric)	Test	D
2 m² min	6	Terrace and quarry/Possible habitation terrace; quarry utilizing exposed dyke; (prehistoric?)	Test	D
2m² min	7	Quarry/Large Surface Quarry with associated scatter of flakes (prehistoric?)	Test, Surface Collection	D
3 m² min	8	Shelter and Quarry/Probable habitatation shelter, few artifacts & midden observed; Quarry utilizes exposed dyke/prehistoric? but recently used by fishermen.	Test	D
2m² min.	9	Quarry, *Ahu*/Utilizes exposed dyke; *Ahu* associated with quarry (prehistoric?)	Test, Surface Collection	D
2 m² min.	10	Quarry, Terrace/Soil Terrace, Probable-"workshop" with adz preforms	Test	D

Site/Feat. No.	Description/Comments	Recommendations	Significance
	present (prehistoric?)		
11	Quarry, *Ahu/Ahu* (7) on bedrock bluff with quarry, on downslope side with midden observed (prehistoric?)	Test	D,E
12	Habitation Complex/Fishing related; consists of *ko'a*, platform, shelter, enclosure (prehistoric)	Test	C,D,E
12A	*Ko'a*: Plentiful coral	Preservation	C,E
12B	Overhang Shelter/Habitational Feature Midden observed	Test Preservation?	C,D,E?
12C	Upright Cupboard/Upright and cupboard in bedrock outcrop *mauka* of *ko'a*	Preservation?	E?
12D	Enclosure, and terraces/Habitational feature, midden and artifacts observed	Test	C,D
12E	Platform/Midden, artifacts observed	Test Preservation?	C,D
12F	Platform, enclosure/Historically modified to an enclosure, midden and artifacts facts observed, including some historics	Test	A?,D
13	Habitation Platform and flake scatter Probably associated with Site 12 Features (prehistoric?)	Test	D
13A B, C	Platform (A), Adjoining Terraces (B,C) /Probable hearth on platform, midden and artifacts observed	Test	D
13D	Flake Scatter/Surface Scatter in soil	Test Surface Collection	D
14A	Platform (A),adjoining terraces (B,C, E) and *ahu* (D)/Possible *heiau*, and associated features; midden, artifacts observed	Preservation Test?	D-E
15	Enclosure and adjoining Terrace/ Probable habitation site, midden and artifacts observed	Test	D
16	Enclosure/Probable habitation site; midden, artifacts observed	Test	D
17	Complex/habitation? and religious? Midden features	—	—
17A	Habitation shelter/Level area between bedrock boulders, shell, midden and	Test	D

Site/Feat. No.	Description/Comments	Recommendations	Significance
	historics, prehistoric with modern use		
17B	2 Small adjoining platforms/possible shrines, prehistoric	Test	D,E?
17C	Small platform/possible shrine prehistoric	Test	D,E?
17D	Enclosure/habitation enclosure with *makai* boulder terrace, midden, basalt flakes, prehistoric	Test	D
17E	Terrace/Possible habitation, no visible midden, prehistoric	none	N.S.
17F	Oval alignment/possible habitation, no midden observed, prehistoric	none	N.S.
17G	Wall and cupboard/short wall section and cupboard on bluff, pieces of branch coral adjacent, possible habitation shelter, prehistoric	none	N.L.S.
18	Habitation & Religious complex: 17 closely associated features, *ko'a*, house-sites, terraces, platforms, prehistoric	Preserve Limited testing?	A,C,D
18A	Coral paved terraces/probable shrine prehistoric	Preserve	D,E
18B	Terrace/habitation terrace, midden, flakes, prehistoric	Preserve or Test	D
18C	Terrace/habitation terrace with coral midden, flakes, adjacent to *ko'a*	Preserve	D
18D	Fishing Shrine, *Ko'a*/well constructed 6' max. height, has branch coral	Preserve	C,D,E
18E	2 Circular enclosures/prehistoric with evidence of modern use	Preserve	D
18F	Habitation, enclosures and terrace/ enclosure wall w/ uprights, enclosure and adjoining terrace, plentiful midden, flakes, and volcanic glass, stone lined hearth, 2 more terrace levels *makai*	Preserve	C,D
18G	Habitation/Partially walled soil deposits, plentiful midden, flakes, coral	Preserve	C,D
18H	Habitation terrace/on gulch edge, plentiful midden, flakes, possible burial platform on *makai* side	Preserve	C,D,E
18 I	Small enclosure/Associated with Horticulture	Preserve	D

Site/Feat. No.	Description/Comments	Recommendations	Significance
18J	Habitational Terrace/Adjacent to H & K, plentiful midden, coral, flakes	Preserve	C,D
18K	3 Adjoining Habitation Terraces/ plentiful midden, coral, flakes	Preserve	C,D
18L	2 Level Platform and habitation terrace/habitation platform	Preserve	C,D
18M	Habitation terrace and adjoining platform	Preserve	C,D
18N	Platform/depression in center, possible shrine	Preserve	C,D,E?
18O	Habitation terrace/plentiful basalt flakes, poorly defined alignments	Preserve	D
18P	3 Level Habitation terrace/Plentiful flakes, coral, midden, one coral file observed	Preserve	D
18Q	*Ahu* and habitation terrace/terrace has plentiful basalt flakes	Preserve	D
19	Complex/shelters, burials, cave	—	—
19A	*Ahu* and fence alignment/depression in center	Test	D
19B	Burial platform/probable burial next to gulch	Preserve	C,D,E
19C	*Ahu*/possible shrine(fallen upright) or burial (on west side of gulch)	Test	D
19D	Habitation shelters and terrace/ plentiful basalt flakes, 2 adjoining enclosures	Test	D
19E	Burial platform/rectangular with branch coral, cobble pebble paving	Test	C,D,E
19F	Habitation cave and terraces/cave has plentiful cultural material, cut into Hulopoe gravel, terrace on east side of gulch has midden, flakes coral	Test	C,D
19G	Piled boulders/some midden, flake in SE corner	none	D
19H	Flake scatter/flaking station	Surface collection	D
20	Complex/ Habitation	—	—
20A	Habitation terrace/next to gully, possible pavement, evidence of recent use	Preserve	D
20B	Overhang shelter/cut into Hulopoe gravel, good excavation potential	Preserve	D

Site/Feat. No.	Description/Comments	Recommendations	Significance
20C	Overhang shelters/Along sea cliff, 4 adjacent overhangs in soft gravel, some collapse	Preserve	D
20D	Linear mounds/parallel linear mounds possible fish or net drying areas, on bedrock shelf	Preserve	C,D
20E	Small Enclosure/possible shrine, has branch coral	Preserve	D,E?
20F	Small Enclosure and terraces/possible shrine with habitation terraces on *mauka* side, midden present	Preserve	D,E
20G	Enclosure and habitation terraces plentiful midden, flakes	Preserve	C,D
20H	Adjoining habitation terraces/2 main adjoining terraces, plentiful midden, flakes	Preserve	C,D
20 I	Habitation platform/level soil area with hearth, paved area to east, possibly main house site.	Preserve	C,D
20J	Enclosure/probable planting area	Preserve	C,D
20K	Habitation Terraces/small features	Test	D
20L	2 Semicircular enclosures/low walls heavy basalt flake scatter	Test	D
21	Isolated Petroglyph/may be modern?	none	N.L.S.
22	Small Complex of shoreline shelters /3 features	—	D
22A	Enclosure/Small shelter associated terraces	Test	D
22B	Enclosure/Soil floor, possible cupboard built in	Test	D
22C	2 Enclosures/both are 5.5' in diameter closure but partially bulldozed	Test	D

CODES FOR CRITERIA FOR SITE SIGNIFICANCE

NS	Not Significant
NLS	No Longer Significant
A	Site reflects major trends or events in the history of the state or nation
B	Site is associated with the lives of persons significant in our past

C	Site is an excellent example of a site type.
D	Site may be likely to yield information important in prehistory or history.
E	Site has cultural significance; probable religious structures (shrines, *heiau* and/or burials present).

E*	Signifies site is only a possible burial or religious feature.
(D)	Parenthesis used for feature criterion
D	No parenthesis used for site criterion

ARCHAEOLOGICAL INVENTORY SURVEY
OF A 173-ACRE PARCEL
PĀLĀWAI and KEĀLIA'AUPUNI, LĀNA' I

by

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LĀNAI COMPANY, INC.

by
Cultural Surveys Hawaii
February, 1990

Exhibit 15

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ABSTRACT

An archaeological inventory survey was conducted on approximately 173 acres of land west of Hulopo'e on the south coast of Lāna'i. The property is proposed for single-family residence development and includes the western seaward portion of Pālāwai and the eastern part of Keālia'aupuni Ahupua'a(s). Two archaeological sites were located, including a temporary habitation site and a historic wall and fenceline. Because of the possibility of buried cultural material at the habitation site, limited subsurface testing is recommended. The stone wall, most probably a historic era cattle wall extends 300' into the property. Since it is the only intact structural feature in the project area all or portions of it should be saved.

ACKNOWLEDGEMENTS

The field work was conducted by Douglas Borthwick, Mark Stride, Chris Bailey, Aaron Suzuki, Brad Taylor, and Don Hugo of Cultural Surveys Hawaii. We would like to thank Jeoff Gaeggel of the Lanai Company for his assistance in coordinating this project. We would also like to thank the M and E Pacific Survey crew and Tony Herrera for showing us the project area and for their general help on Lana'i. Mr. Tom Leppart arranged for providing maps through M and E Pacific. Dr. Vicki Creed of Windword Processing performed typing of this report.

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I. INTRODUCTION

This report presents the results of an archaeological inventory survey of 173 acres of land on the southern portion of Lāna'i, NW of the Hulopoe-Mānele area (Figs 1-4). The two sites are located on the project area map. Descriptions of each site are presented in Section VI.

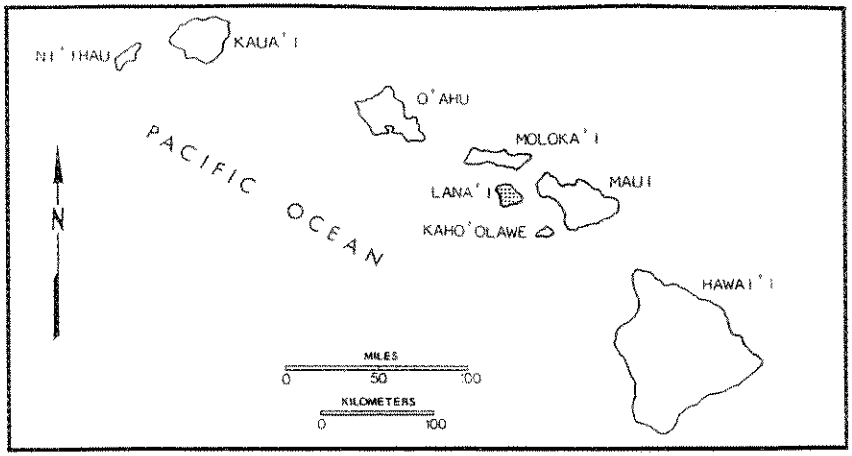

Fig.1. State of Hawaii.

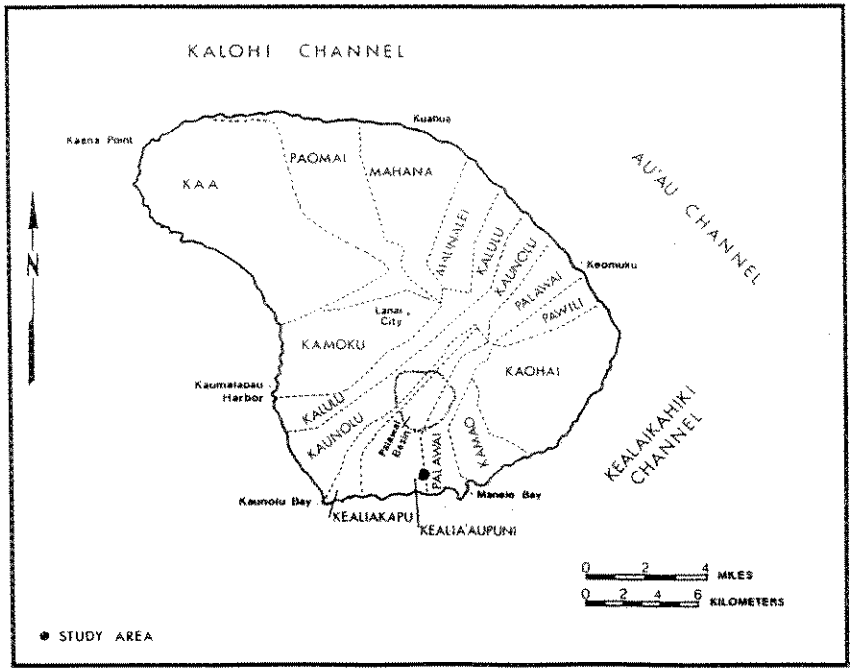

Fig.2. General Location Map Lana'i Island.

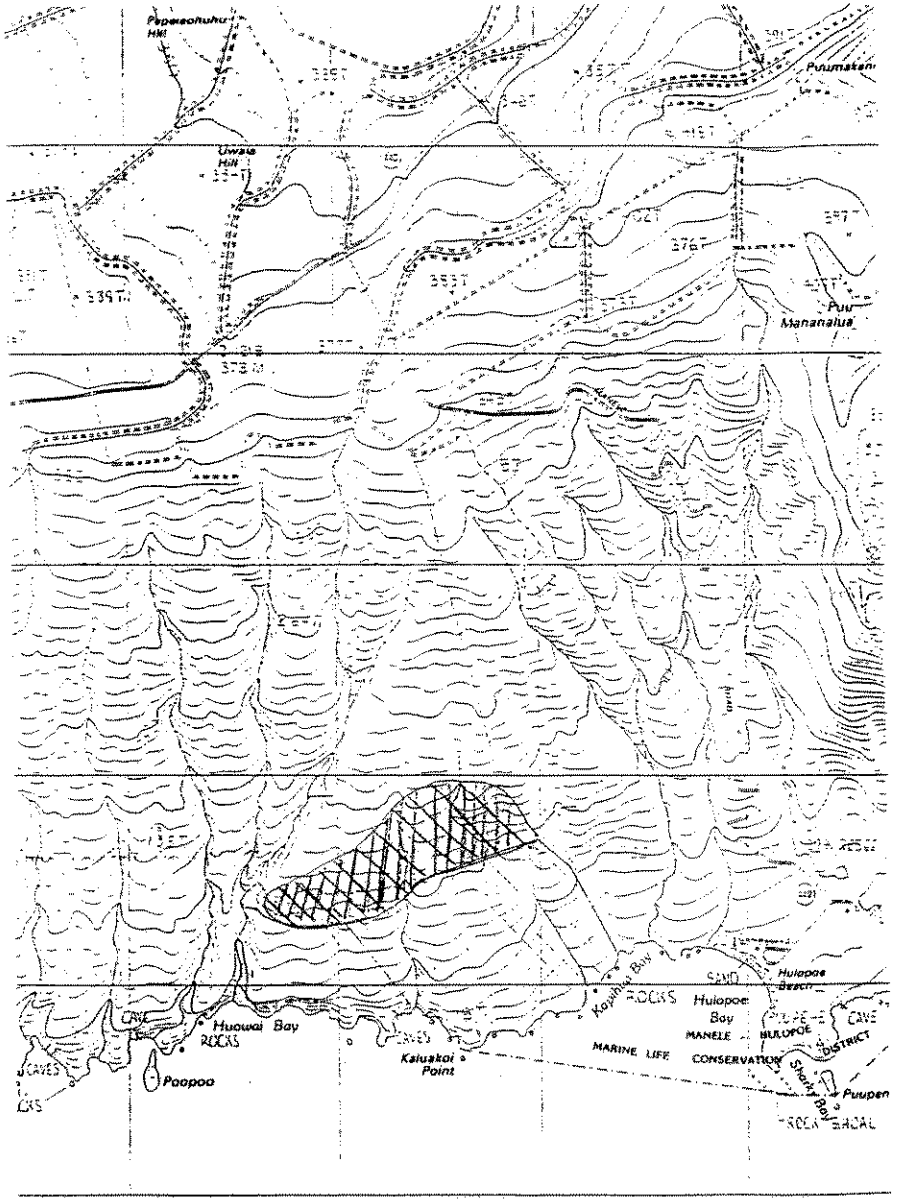

Fig.3 Lanai South USGS Map
Showing Project Area (Shaded)

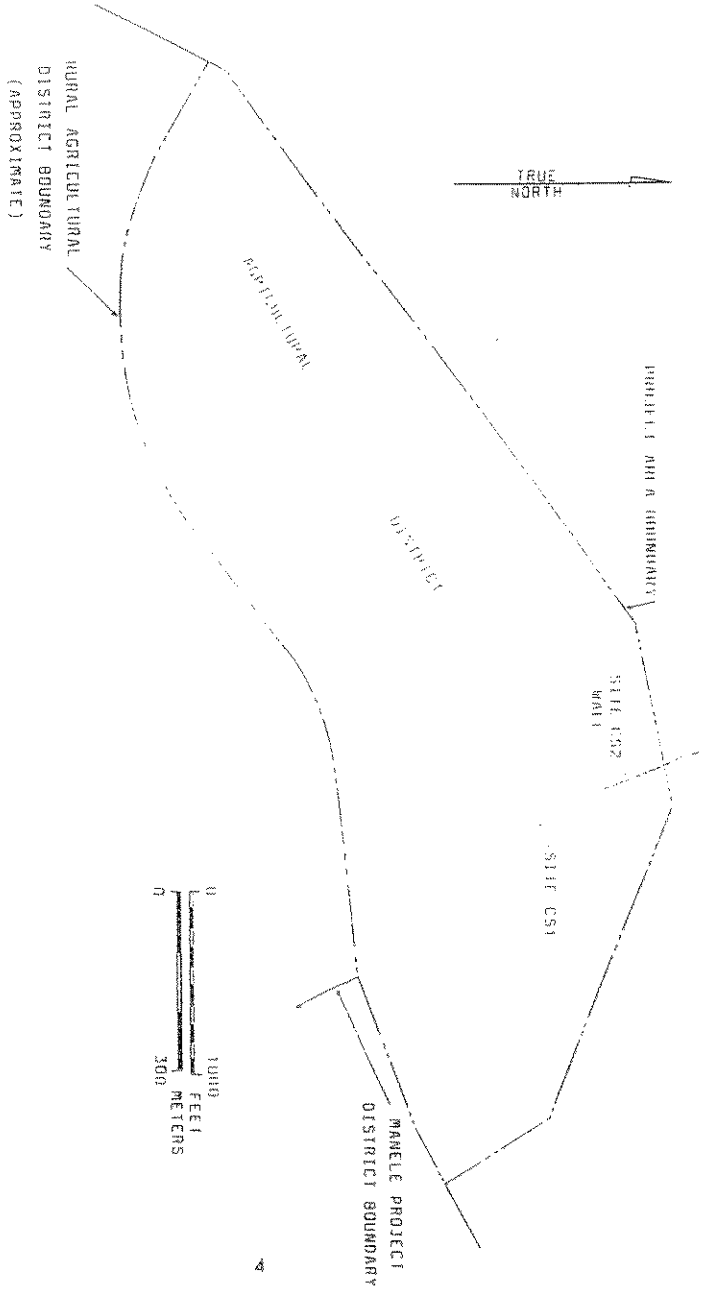

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Fig. 4. Project Area Showing Archaeological Site Locations

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II. PROJECT AREA DESCRIPTION

The project area covers approximately 173 acres of land on the southern coast of Lāna'i west of Hulopoe Bay. The parcel borders the northwestern boundary of the Mānele Hotel development now under construction and is proposed for single-family residences. The parcel extends from 310' elevation to approximately 610' elevation. The soils are described as very stony, overlying weathered volcanic rock and unsuitable for cultivation, but suitable for grazing and wild life habitat (Foote et al. 1972). This area of Lāna'i is arid with less than 15 inches of rain per year mostly falling in the late winter and early spring months.

Land Forms and Geology

The terrain is only slightly dissected with 4 relatively shallow gulch systems, only one of which extends into the Pālāwai Basin. The two eastern gulches drain into Kapiha'ā Bay which forms the western side of the large bay surrounding Hulopoe. The central gulch drains into Kaluako'i Bay in the center of the project area. A fourth and much larger gulch which is the western project area boundary drains in Huawai Bay. None of these gulches carries perennial water, but only flows during heavy rains.

Natural Terraces

The predominant land surface is extremely rocky, highly weathered a'a flows with thickly scattered loose boulders and

cobbles. There is natural rock sorting and patterning terracing along slopes and gully edges. Although the geomorphic explanation of this patterning is unclear, it is probably related to slope movement during soil wetting and drying cycles.

Vegetation

The vegetation is very typical of the arid coastal regions of the leeward islands. Kiawe (Prosopis pallida) is by far the dominant tree and is especially thick along gully slopes and bottoms. Koa-haole (Leucaena leucocephala) is present but not dominant. The generally thin understory cover is composed of ilima (Sida fallax), pili grass (Heteropogon contortus) and Hawaiian cotton (Cossypium sandwicense). The ground cover is generally thin and scattered except for short periods following winter rains. At the time of the present survey visibility of the ground surface was fair.

Place Names

The place names mentioned by Emory (1924:29-37) for the study area are the only ones available in readily accessible sources. It is of interest that the place names apparently refer only to bays and not to gulches or other terrestrial landmarks.

Kapiha'ā is the bay at the east side of the project area and is a descriptive reference to "the driftwood." The 1984 U.S.G.S. Lāna'i South Quadrangle Map has this bay misspelled as Kapihua.

Kaluako'i translates as the "adz pit' and is the name of the bay in the central portion of the project area.

Huawai is the bay at the base of a deep gully forming the western boundary of the survey area. It translates to a "water gourd."

Ahupua'a

The survey area is located within the southern portion of two adjacent ahupua'a. Pālāwai is to the east and includes all of the Mānele coastal area extending westward to the center of Kaluako'i Bay. Pālāwai is one of the 3 ahupua'a which extends across the center of the island all the way to the opposite shoreline at the northeast side of the island. Because of this configuration Pālāwai Ahupua'a also includes the Keomuku area on the opposite side. The adjacent ahupua'a to the west - Kealia'-apuni - 3 miles of shoreline (mostly cliff) extending from Kaluako'i westward to Anapuka. Kealia'apuni extends mauka only to the center of the island having a more typical configuration. Of the two, Pālāwai would have been the more important. Not only does this ahupua'a contain the major adz quarry but on the northeast coast it has the island's only 2 fish traps at Waiaopae and Haua (Emory 1924: 48-49).

Modern Use

At present, the study area is uninhabited and there is no obvious evidence of recent occupation or historic period settlement. However, historic use for ranching is indicated by lines of broken wire fencing running mauka-makai near the eastern portion of the project area and an abandoned pipeline supplying livestock. The area may have been used for aerial target practice during World War II as there are occasional scatters of shell casings found in the makai part of the present project area. Presently, the area supports herds of grazing deer which were seen periodically during the survey. There is vehicular access (a jeep road) from the Pālāwai Basin pineapple fields running makai to the mauka (northern) part of the project area.

III. SCOPE OF WORK AND SURVEY METHODS

Scope and Methods

The present project is an archaeological inventory survey of the 173-acre property to locate, map and document all archaeological sites and evaluate them according to the National Register of Historic Places criteria. The field work involved 3 days with 5 archaeologists between February 6 and 8, 1990. Coverage involved survey sweeps paralleling the coast with archaeologists spaced 50 - 100 feet apart depending on vegetation. There is reasonable confidence that all archaeological sites were located.

When an archaeological feature was found in a survey sweep the following routine was used.

1. The site or feature was located and mapped to scale on the 1 inch = 100 foot topographic map provided by M and E Pacific (subsequently reduced to 1 inch = 200 feet). Locations were made by triangulation to nearby survey points which were previously flagged and marked by the M and E survey crews and relocated by us. These survey points are marked on the site location map (Fig. 4).
2. The site was described verbally in a field notebook including sketches of configuration and internal features and mention of the context of nearby sites. Condition of site, probable function, excavation potential, presence of surface cultural material, internal

and external dimensions, wall heights and special characteristics were also mentioned.

3. Photographs were taken of all sites.

4. A survey flag was placed at the site with the site and feature number marked on it. A second flag was similarly marked and placed under a rock to provide a more permanent site marker.

IV. HISTORICAL BACKGROUND

There are several sources which offer general traditional and historic overviews of Lāna'i. These include K. Emory (1924), G. Munro (N.D.), L.K. Gay (1965), and R. Tabrah (1976).

The most comprehensive summary of traditional accounts dealing with the "formation of Lāna'i, first habitation, general traditions, early history and place names" appears in Kenneth P. Emory's The Island of Lāna'i: A Survey of Native Culture. Emory suggests through "genealogies and traditions" that Lāna'i "began to be populated by important numbers about 1400 A.D." (Emory 1924:123). Emory estimated the pre-1778 population to be around 3,000, basing this estimate on the number of house sites he saw, approximating five persons per household (Ibid.:122). The traditional life style was based on subsistence farming and fishing done within the context of the ahupua'a or traditional land unit.

The project area encompasses portions of two adjoining ahupua'a, Keālia'aupuni and Pālāwai (Fig. 5, 6). Keālia'aupuni "Government Salt Encrustation" (Pukui et al, 1974) or "Government Salt Pans" (Emory 1924) extends from the southern coast line to the central crest of Lāna'i (Lāna'ihale). Pālāwai (no definition given) extends across the island to the eastern shore (facing Maui).

At the end of the traditional period, coinciding with Captain Cook's second visit to Hawai'i (1778), Lāna'i was devastated by the army of Kalaniopu'u, King of Hawai'i. Kalaniopu'u was making war with Kahekili (King of Maui) for control of Maui.

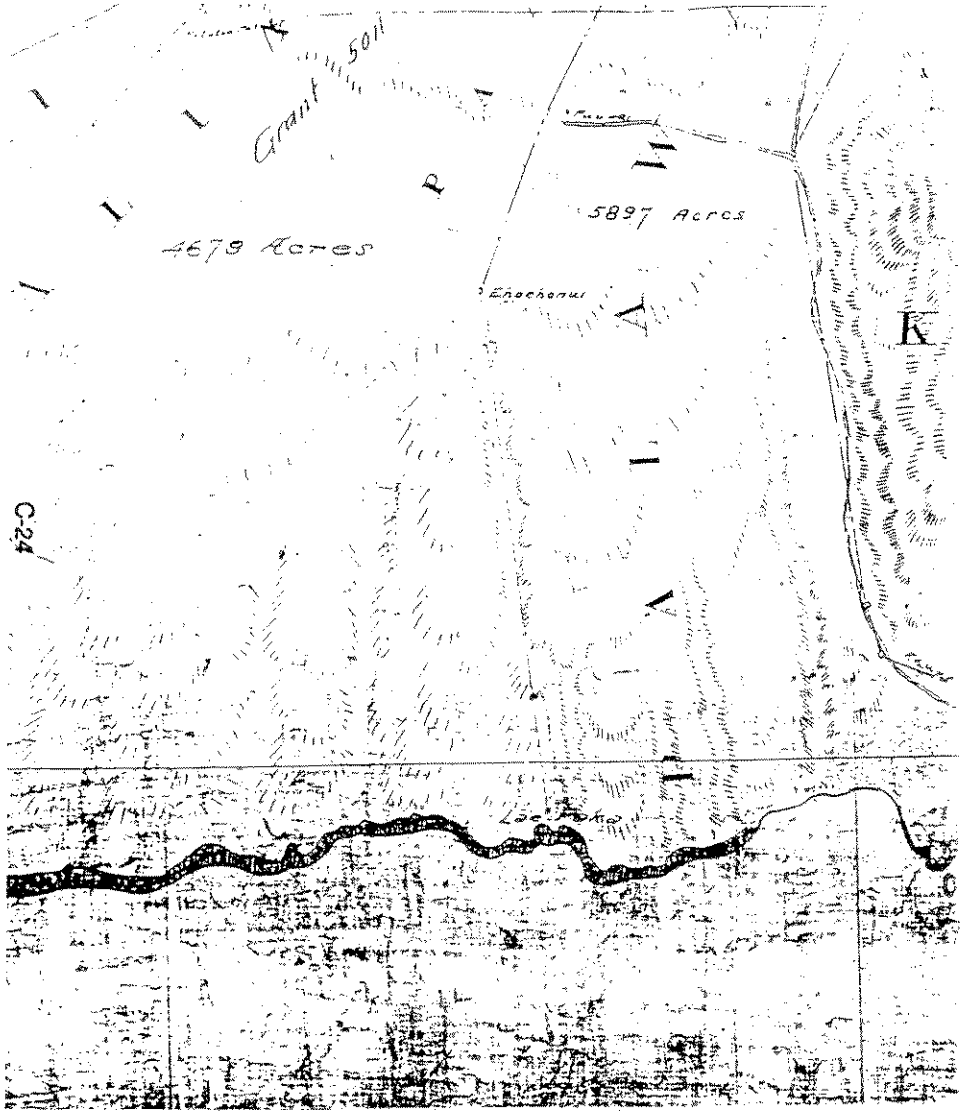

Fig. 5 Portion of 1878 Government Survey Map of Lāna'i, Map No. 1394.

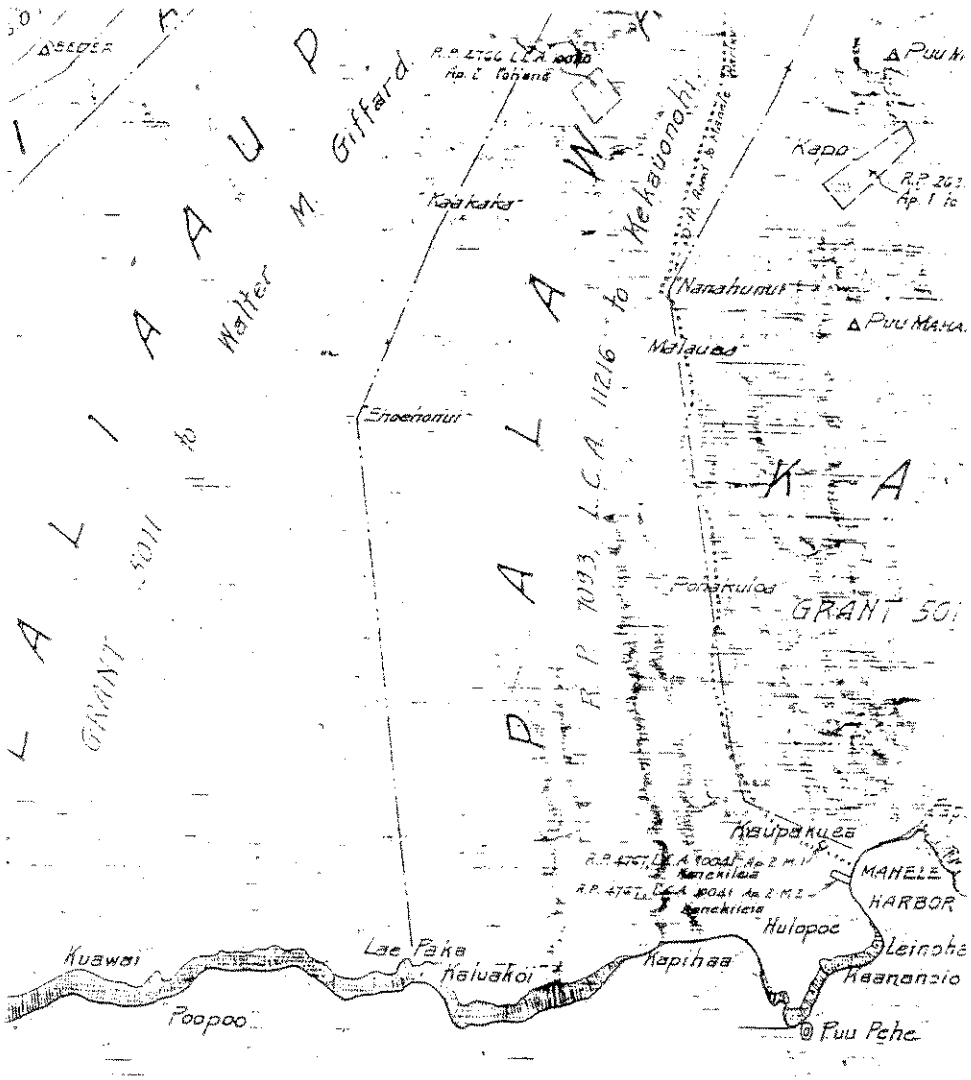

Fig. 6 Portion of 1929 Land Court Map of Lāna'i Showing Land Ownership and Land Commission Awards

Kalaniopu'u had suffered a number of defeats on Maui, and because of this, his army raided both Kaho'olawe and Lāna'i. The raid was described by Kahekili's brother Kamohomoho to Captain Vancouver in 1793.

> Rannai (Lanai) and Tohowrow (Kahoolawe) which had formerly been considered as fruitful and populous islands, were nearly overrun with weeds, exhausted of their inhabitants..." (in Emory 1924-:7).

The first European account of Lāna'i was by Captain King of Cook's expedition in 1779. He described Lāna'i as "appeared to be well inhabited..." and was "told that it produced very few plantains, and breadfruit trees, but that it abounds in roots such as yams, sweet potatoes, and tarrow" (Emory 1924: 6). In 1792 A. Menzies, surgeon with Vancouver's expedition, described Lāna'i in a different way: "observing the state and naked appearance of the island which seemed thinly covered with shrivelled grass in a scorched state. No hamlets or plantations were to be seen, no trees or bushes adorned the face of the country, which swelled out gradually to a moderate height, so that we have reason to think that the island is but very thinly inhabited" (Ibid.: 7). Emory suggests that the reason for the difference in descriptions was due to Kalaniopu'u's devastating raid.

The early 1800's began a time of great change for Hawaii. Kamehameha I had just consolidated his control over all the islands except Kaua'i. It was probably around this time (ca. 1800) that Kamehameha I used Kaunolu, a village at the southwest

tip of Lāna'i, as a part-time residence and a place "to fish and sport." Though foreigners were in Hawaii in small numbers their influence and actions were of growing importance. In 1802 sugar cane is boiled by "a Chinaman" producing the first raw sugar in the island. Both Lāna'i and Kaua'i lay claim to this first attempt at a sugar industry. Foreign vessels leave livestock of cattle, goats, sheep and horses on the islands. The sandalwood trade is started, first under the control of Kamehameha I, but with his death in 1819, the trade falls under the jurisdiction of local chiefs. The sandalwood trade is not only disastrous in terms of deforestation of large tracts of land, but Hawaiian royalty incurs insurmountable debts to the traders.

In 1820, the first missionaries arrive in Hawaii. Though Lāna'i does not have its own Missionary Station it is under the influence of the Lahaina Station on Maui. The Rev. William Ellis observes Lāna'i, in route from Honolulu to Maui, in 1823, and describes it is generally bare, but having "ravines and glens filled with thickets of small trees and to these many of the inhabitants of Maui repaired for the purpose of cutting posts and rafters for their small houses. The inhabitants are few, probably not exceeding 2,000. Native teachers are endeavoring to instruct them in useful knowledge and religious truth, but no foreign missionary has yet labored on this or the neighboring island of Molokai" (W. Ellis, in Emory, 1924: 7).

A converted Ka'ahumanu, Queen Regent, visits Lāna'i in 1829 "exhorting the people to listen to the word of God" (Ibid.: 8).

Leaders of the Lahaina Station, Rev. D. Baldwin and the Rev. W. Richards make a number of visits to Lāna'i in 1835 to check on students, preach, and take a census of the population. Though no ahupua'a specific totals were established, population estimates for the island were 1,600 for the 1832 government census (also based on missionary records) and 1,200 for the 1837 Baldwin census. These estimates appear to be relatively high, as of 1846 the population is reported to be 616 (from Jarves in Emory, 1924: 8) and 600 in 1853 "all of whom were Polynesians" (Coulter 1931: 24), indicating a relatively stable population.

During the mid 1800's a dramatic change in land tenure took place throughout Hawaii. The Great Mahele of 1848-1854 changed Hawaiian use rights of the land to one of private ownership. Lands were divided into government, crown and kuleana titles.

The ahupua'a of Keālia'aupuni was converted to government lands during the Mahele and administered by the Interior Department. The bulk of Pālāwai (5,897 acres) went to Miriam Kekauonohi (LCA 11216) who was a granddaughter of Kamehameha I and great granddaughter of Kahekili (King of Maui). Miriam Kekauonohi was also one of Liholiho's (Kamehameha II) wives, and after his death lived with Keliiahonui, son of Kaumualii (Kaua'i). She was appointed Governor of Kaua'i in 1842, and after Keliiahonui's death in 1849 Miriam Kekauonohi married Chief Levi Ha'alelea (M. Kelly 1983:21-23). There were no small kuleana parcels awarded for either ahupua'a within the project area.

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In the mid 1850's a small Mormon community was established within the Pālāwai basin. The commune was small and of relatively little importance. This changed almost immediately upon the arrival, in 1861, of Walter Murry Gibson. Walter M. Gibson would eventually become "Hawaii's Premier of Everything" (Adler and Kamins 1986). Under the auspices of the Mormon church W.M. Gibson applies for more land. In 1863 the MInister of the Interior writes to W. M. Gibson informing him that the proposed lease of the government lands on Lāna'i has been postponed and also authorizing him to take possession of what government lands he requires for cultivation until the government surveyor, Makalena, arrives to make the necessary surveys (Int. Dept. 1963). By 1864 Gibson is in control of four ahupua'a Pālāwai, Kealia(i), Kaa and Kaohai. The same year Gibson is excommunicated from the Mormon church over refusal to deed these lands to the church, as well as other "infractions." Gibson continues his pursuit of all Lāna'i, mainly by attaining leases. In 1873, he gets the government leases of Kealia (2), Pawili, and Kamao. However, Gibson is not without his detractors. Dwight Baldwin of the Lahaina Mission Station as early as 1863 "suspects" Gibson "will soon have the resources of the island under his control" (Emory 1924: 9). A letter to the Minister of the Interior, W. L. Moehuna, in 1876, by S. W. Mahelona and 67 others reads

> We the undersigned, residents of the Island of Lanai and occupants from our ancestors and who love the place of our birth, and who have been frequently molested by the foreigner W. M. Gibson if the whole of Lanai is acquired by him.

> Therefore, we ask that the lands of Kamoku, Kalulu, Kaunolu, the Kealias, Pawili and the Kamao, be sold to us absolutely, 20 cents for the poor places, and 50 cents an acre for good places, therefore, you consider this application of our people who humbly make this request. (Int. Dept 1876)

Gibson, however, retains the lands though government leases and starts a livestock ranch. In 1884 the Lāna'i Stock Ranch lists 40,000 head of sheep, 3,000 angora goats, 600 horses and 200 head of cattle (Polk-Husted 1884).

After W. M. Gibson's death, in 1888, his estate, mainly the lands of Lāna'i, go to his daughter Talula Hayselden. The Hayseldens are unable to retain control of Lāna'i and from 1902 to 1909 Lāna'i is converted to fee simple lands. This was accomplished by Charles Gay of the Gay/Robinson family of Ni'ihau and Kaua'i. However, Charles Gay also cannot retain control, because of incurred debts in acquiring virtually all of Lāna'i in fee. Lāna'i changes hands, in 1909 to W. G. Irwin, then to the Lāna'i Co. Ltd (a hui), in 1917 to F. F. and H. A. Baldwin and finally in 1922 to the Hawaiian Pineapple Co. (James Dole).

The project area was, like most of Lāna'i, subjected to over-grazing by goats, sheep, and cattle during the ranching era, from the late 1800's to the early 1900's. However, the dry coastal environment has excluded the area from the more serious impact of long-term commercial pineapple cultivation.

V. PREVIOUS ARCHAEOLOGICAL RESEARCH

There are no archaeological works known specific to the project area. There are a number of archaeological works concerning the Island of Lāna'i in general. The most relevant to the present project include, Emory (1924), the State of Hawaii Site Survey (Hommon, 1974), Kirch (1985:132-134), Kaschko and Athens (1987), A.T. Walker and A.E. Haun (P.H.R.I., 1987) and Hammatt (1988).

A brief discussion of the 1974 Lāna'i Survey and how "archaeological resources of Lāna'i may be treated by the State Review Board" is presented in "Comments on the Archaeological Sites on the Island of Lanai" (Hommon, 1974).

Kirch in his book Feather Gods and Fishhooks summarizes, as part of the regional archaeology of the Hawaiian Islands, Lāna'i Island Archaeology (Kirch, 1985: 132-134).

International Archaeological Research Institute, Inc. conducted "an intensive archaeological reconnaissance survey ... on a 422-acre parcel of Castle and Cook land on the south coast of Lanai." The survey was done in anticipation of the proposed Manele/Hulopoe resort hotel. The survey recorded "33 archaeological sites ... encompassing a total of 183 individually recorded features." The report includes, detailed site descriptions, including maps and photographs, historical summary and recommendations for mitigating adverse impacts (Athens and Kaschko, 1987)

Walker's and Haun's report details a "Reconnaissance Survey and Limited Data Recovery Excavations at the Proposed Sanitary

Landfill Site, Land of Kamoku." Five sites were located with some eleven test units excavated. The excavations yielded prehistoric artifacts and midden and sufficient quantities of charcoal for dating. The "radiocarbon age determinations indicate a pre-historic protohistoric period (AD 1450-1796 maximum span) of occupation for sites within the project area." The sites were interpreted to be "probably dryland agricultural features, temporary habitation features, and a possible trail marker." Recommendations, upon report completion, were for no further archaeological work, except for monitoring during site grading.

Hammatt's (1988) report details the excavation of two adjacent historic trash pits at Ko'ele. The excavations were undertaken in preparation for the new lodge to be built at Ko'ele. Ko'ele was the former site of the ranching center of Lāna'i (ca. 1880-1950). The report includes midden and artifact analysis which is correlated to historic events documented by persons who lived at the sites as well as a general historic overview of the ranching era of Lāna'i.

VI. SITE DESCRIPTIONS

Site 1, Circular Enclosure and Adjoining C-shape

Site 1 is located on the east side of Kapiha'a Gulch approximately 50' to the east of a fenceline running mauka-makai. The circular enclosure has an exterior diameter of 11' and an interior diameter of 7'. It is constructed of boulders and also utilizes some bedrock boulders. The walls stand at an average of 1 feet high. The interior consists of soil with loose rocks and pebbles. Two pieces of midden were observed on the surface.

Adjoining the enclosure from the east is the C-shape. It measures 9' N/S x 11' E/W exterior, 7' x 7' interior, and is open makai. This feature is constructed of a single alignment of boulders with a maximum height of 2 feet. The interior consists of soil and loose rocks. A few flakes, a possible hammerstone, 1 piece of midden and 1 piece of coral were observed on the surface. This temporary habitation site has fair excavation potential.

A survey point marked "RA 40" was found next to this site, but it is not the "RA 40" shown on the topographic map (Fig. 4). Site 1 was subsequently located to points 10 and 19.

Site 2, Historic Wall and Fenceline

A stone wall extends approximately 300' into the project area from the north on the east side of Kapiha'a Gulch. The walls stands 2-3' high and 2' thick and is constructed of boulders. The wall ends at approximately 300', then a fenceline

continues through the whole project area at roughly a northwest-southeast orientation. This wall and fenceline were probably utilized for livestock management

VII. SUMMARY OF RESULTS

Background

This archaeological inventory survey includes approximately 173 acres of land adjacent to the northwestern side of the Mānele Resort development area. The study area includes 4 relatively shallow gulch systems with the westernmost gulch draining into Huawai Bay and the easternmost gulch draining into Kapiha'a Bay. The project area includes portions of two adjoining ahupua'a, Pālāwai and Keālia'aupuni, on the southern coast of Lānai. The survey recorded only two sites, one being the historic cattle wall, the other a probable habitation feature.

Sites Types and Significance

Given the generally undisturbed condition of the archaeological sites and the fact that they are easily interpreted as to function on the basis of readily observable physical characteristics, categorization into function groups is fairly straight forward in this case. Site 1 has been categorized as a temporary habitation feature and Site 2 as a historic wall/fenceline associated with livestock management.

The wall and fenceline (Site 2) utilized for livestock control, would have no significance (NS) under the National and State Registers of Historic Places criteria. Site 1 would fall in Category D: "D. Site may be likely to yield information important in prehistory or history."

Virtually all sites from which information on their construction, age range, or function can be gained through excavation are included in this category.

VIII. RECOMMENDATIONS

Two archaeological sites were found within the project area, including a small habitation site marked by two small shelter structures and small scatter of midden and basalt flakes. Archaeological testing of subsurface deposits within and around this site is recommended to collect information of age and use of this site. Preservation of this site is not recommended. The second site is a 500' long historic cattle era wall, only 300' of which is in the project area. It is recommended that at least a portion of this wall be preserved and incorporated into the landscaping plans of the proposed development.

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X. PHOTO APPENDIX

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A) CSH 1 Temporary Shelter Site, Showing Opini Shell in Foreground (NW)

B) CSH2 General Terrain with Stone Wall in Background (NE)

C) General View Project Area, Looking Mauka (North

D) General View Project Area Looking Makai (SW

E) General View Project Area, Looking West

F) General View Project Area Looking Southwest, Hulopoe Beach and Hotel in Background

DATA RECOVERY AND PRESERVATION PLAN FOR THE 300-ACRE RURAL DISTRICT PĀLĀWAI AND KEALIAAUPUNI, LANA`I

by

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prepared for

LANAI COMPANY, INC.

by

Cultural Surveys Hawaii

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Introduction

This plan has been prepared as part of mitigation measures for significant archaeological sites within the approximately 300-acre rural district on the south coast of Lana`i west of Manele Bay. This rural district is part of the Manele Master Planned Area and is proposed for golf course and residential development.

The Project Area

The project area consists of rocky, thinly vegetated dry land stretching approximately 1 mile along the coast from the Manele District Boundary (the present Hotel site) westward to Huawai Gulch. The mauka boundary of the project extends to a maximum of 2,800 feet from the ocean. Elevation is from sea level to as much as 370 feet. The land is mostly gently sloping except where dissected by dry gulches. Two short gulches on the eastern side drain into Kapiha`a Bay, a central gulch drains over the sea cliffs into Kaluako`i Bay. The largest gulch--Huawai---forms the western boundary.

Previous Archaeological Research

Except for limited recording by Kenneth Emory (Emory 1922, 1924) and the Bishop Museum (Hammon 1974), the first systematic archaeological survey of the project area was conducted by Cultural Surveys Hawaii in 1988 (Hammatt et al. 1988). The reader is referred to this 1988 report for detailed background

information and descriptive data on archaeological sites. Most useful is the 1 inch = 200' map of the project area showing all site locations.

Number of Sites and Significance Evaluations

There were 27 archaeological sites including 78 individual features located in the 1988 survey and in subsequent fieldwork. The majority of these sites are located in the southeastern portion of the project area around the mouth of a small gully by Kapiha`a Bay. Much of the western portion of the study area is devoid of sites.

The archaeological sites were evaluated for significance within 7 categories applying the broad criteria established for the National and State Registers of Historic Places (See Table 2, Appendix). The seven categories (A - E and NLS and NS) are listed and generally applied to the archaeological sites in the project area as follows:

A. Site reflects major trends or events in the history of the state or nation.

-This criterion seems to have little or no application to the sites in the project area. Trends or events are not particularly discernable in the archaeological record at this inventory survey level.

B. Site is associated with the lives of persons significant in our past.

-None of the sites in the project area are likely to be

associated with specific individuals since they were abandoned in prehistoric times.

C. Site is an excellent example of a site type.

-This criterion addresses quality of construction and integrity of design as well as state of preservation and the degree to which a site illustrates a particular aspect of prehistory or history. Most of the sites within the 180-20 complex fit this criterion as well as the heiau, and fishing shrines and some adz quarries.

D. Site may be likely to yield information important in prehistory or history.

-Virtually all sites from which information on their construction, age range, or function can be gained through excavation are included in this category. All sites containing cultural deposits are included namely permanent and temporary habitation structures, cave shelters and adz quarries.

E. Site has cultural significance to the Hawaiians or other ethnic group.

-This category includes religious sites--heiau (Site 14), fishing shrines (Sites 12A, 18D), small shrines including adz makers' shrines and sites containing burials (18H, 18F, 19B, 19E).

F. (N.L.S.) No Longer Significant--Sites in this category are simple features with no cultural deposits and no interpretive value beyond the point at which they are located on a map and

described. Included are ahu or small isolated shelters on bedrock.

G. (NS) Not Significant--These are sites which do not fit any of the above criteria and have no significance value. Included would be uninterpretable minimally modified natural features and modern fishing shelters.

Of the total of 27 archaeological sites, 2 are evaluated as either not significant or no longer significant (Sites 2 and 24), leaving a total of 25 significant sites.

Historical and Archaeological Context

The archaeological sites located along this dry leeward section of Lana'i's southern coast represent the remains of former prehistoric settlement whose economic basis was fishing and adz quarrying and manufacturing. Agricultural production would have been seasonal and limited by low rainfall and shallow soil deposits. Access to the shoreline was clearly a consideration in location of habitation features. The rocky beaches with low cliffs along the eastern portion of the Project area (Pālāwai Ahupua'a) were more favored for habitation than the high inaccessible cliffs west of Kaluako'i Bay.

These factors gave rise to a closely clustered prehistoric settlement along the shoreline of Kapiha'a Bay. This settlement probably flourished during the middle to late prehistoric era and judging by the lack of foreign materials on the surface of these features, was abandoned at or just before European contact.

Although the project area includes 2 adjacent ahupua`a virtually all of the evidence of prehistoric activity is within Pālāwai to the east. In terms of the plentiful evidence of adz quarrying and manufacturing this ahupua`a context is of particular interest. Pālāwai is one of the 3 ahupua`a on Lana`i which extends across the top of the island to include a portion of the opposite coastline. The major adz quarry of Lana`i (ko`i), located by Emory (1924) lies within this ahupua`a. There is a strong connection of this land unit to adz quarrying in general, and to an important exportable resource in Ancient Hawai`i.

The place name of the Bay--Kaluako`i--translates as "adz pit" and marks the western edge of quarrying activity in the project area.

Documentation of land use through search of historical record will be of little benefit. There are no land court awards within the project area and all indications from survey data suggest no habitation or significant activity in the area since European contact. A single broken wire fence near the western boundary and a long abandoned watering trough mark the only remains of former cattle grazing.

In general, the sites are well preserved and have been altered minimally since their abandonment. The variety of site types and functions give a complete picture of a self-sufficient isolated prehistoric community with closely clustered habitation features, a heiau, 2 fishing shrines, burial structures and many work and craft activity areas.

The Sites

Table 1 presents a list of archaeological sites within the project area. Each of the site categories is discussed briefly below (This information is abstracted from the 1988 survey report).

Table 1

Site and Feature List by Functional Groups

(Some features are listed under more than one category for example quarries with shrines or habitation sites with burials)

1. Permanent Habitation (habitation terraces, larger enclosures, platforms, 1 cave).
   Total Features--23
   List: 5, 13, 15, 18F, 18G, 18H, 18J, 18K (2 terraces), 18L (platform and terrace), 18M, 18O, 18P (3 terraces), 18Q, 19D, 19F 9 (ko`i) 20A, 20G, 20H, 20I.
2. Temporary Habitation (Small terraces, small platforms, small shelter enclosures, small cave shelters, work areas)
   Total Features--24
   List: 3, 4 (cave shelter), 8, 12B (cave shelter), 12D, 12E, 12F, 13D, 16, 17A, 17D, 17F, 17G, 18C, 18E, 20B, 20C, 20K, 20L, 22A, 22B, 22C, 23.
3. heiau, Site 14.
4. Large Shrines (ko`a?), Sites 12A, 18D.
5. Small Shrines--uprights, ahu, (adz maker shrines?)
   Total Features--8
   List: 9, 11A, 12C, 14D, 17B, 17C, 19A, 20E

6. Quarry Sites

   Total Features--8

   List: 1, 6, 7, 8, 9, 10, 11, 25

7. Burials

   Total Features--5

   List: 18H (makai connected burial), 18F (internal feature), 19B, 19C (burial mound or small shrine), 19E (burial platforms) mound

8. Agricultural Features

   List: 20J (planting area), Agricultural terraces by Sites 4, 5, and 14

9. Miscellaneous

   Includes 1 petroglyph (Site 21), miscellaneous ahu of undetermined function (Sites 2, 24, 26) and linear mounds (Site 20D)

Permanent Habitation Sites

These consist predominately of level terraces marked by alignments on at least one side and are characterized by scatters of cultural material in terrace soil deposits. Some habitation features are walled or consist of stone paved platforms. The permanent habitation features are generally distinguished from the temporary ones on the basis of: 1) size (say larger than 3 meters--10+ feet internal dimensions as a rough guide), 2) the quantity of scattered cultural material (a great many basalt flakes) and 3) perhaps most importantly in the case of this

project--locational context. All permanent habitation sites as designated here, with 3 exceptions, are tightly clustered, even virtually continuous, on either side of one gulch. The exceptions are Sites 5, 13, and 15 which are within 1,000 feet of the gulch "village" mauka and to the west.

There are possibly meaningful distinctions between habitation features on the west (Complex 18) and east sides (Complex 20) of the gulch (for convenience referred to as Kapiha'a Gulch). The west side features are greater in number, more tightly clustered and are predominantly level terraced house "pads" without enclosing walls. The habitation features on the west side would make up a quantity of house sites (about 14) which far exceeds the size of an extended family kauhale. On the east side Features 20F, 20G, 20H and 20I could be visualized as a single large kauhale complex.

On both sides of the gulch there is plentiful evidence of basalt flaking on and around the sites. However, these flake scatters are much thicker and more widespread on the west side. The entire bluff slope west of Complex 18 is covered with lithic flaking debris (debitage). This may be explained by the proximity of this complex to the 3 large basalt quarries west and mauka of the gulch. Clearly, a major activity of the inhabitants of this community was adz manufacturing. In some cases water rounded boulders on the sites showed battering on the ends, indicating their use as anvil flaking stones (19F, 18J). Within some of the house sites are internal features such as interior

alignments (20H) stone lined hearths (20I) adjacent burial features (18F--a coral pavement, 18H--a burial platform adjacent to the makai retaining wall), and small raised platforms (18I, 18M), and ahu (18N) adjacent to the house sites.

One isolated site classified as permanent (Site 5) barely qualifies by size, is isolated mauka of the main complexes. This small cluster of habitation features may owe its location to the nearby adz quarries (Sites 1, 9, 10).

Temporary Habitation Sites

These are smaller features consisting of small terraces, small platforms, shelter enclosures and a few cave shelters and flaking areas.

Some of these occur around the permanent habitation areas (Sites 6, 17, 18, 20) and are merely extensions of the activity areas associated with the larger sites. Others are locationally separated and are found along the coast line having the appearance of fishing shelters. The shelters at Site 12 and Site 22 are good examples of these. The Site 12 Complex deserves special mention as a very typical fishing oriented complex. Well constructed, but small structures are along the shore line (12D, 12F) and there is a high rectangular platform piled with branch coral which is a certain fishing shrine. Some of these shoreline fishing shelters show evidence of historic and modern use (12F, 17A). Sites 3 and 4 shelters, isolated far to the west of the main site complexes, may be agricultural shelters associated with

nearby natural terraces modified for seasonal planting of dry crops.

Site 8 shelter is isolated along a high cliff on the west side of Kaluako'i Bay. It also shows evidence of modern use by fishermen, but was originally a lithic work shelter associated with an adjacent basalt dyke exposure.

Heiau

Although there is no positive identification of the large stone structure of Site 14 it is in all probability a heiau. It is over 40' square and has a mauka wall 5' high and nearly 6' thick. It is many times larger and more massive in terms of volume of rock work than the largest house sites in the project area and is entirely of distinctive design. It is easily the most visible site on the 1 inch = 200 foot aerial photograph. It stands in a separated location mauka and west of the main habitation complex and there is no heavy evidence of habitation on or immediately around the structure. Although some flakes and midden are visible on the main paving. Flake scatters and midden are very visible around all the main habitation sites in the project area. Of course, it is also possible that this site is a high status hale mua or men's house, but at present, it is interpreted as a small heiau.

Large Shrines

These are two features consisting of 3' - 4' high roughly

square platforms which are characteristic shrines (12A, 14D). Site 12A is associated with shore line fishing shelters and is piled with large quantities of branch coral with the typical characteristics of a fishing shrine (ko'a). Emory (1924:70) refers to these as "heiaus of fishermen" and found many such structures along the coast line of Lāna'i. He observed coral, shell and fish bone almost invariably associated with these structures.

Site 18D is a similarly shaped square platform, probably a ko'a, but there is a smaller coral pile. The structure has a small adjoining altar attached to the southwest wall and is surrounded by basalt flakes on the adjoining terraces.

Small Shrines

There are 8 smaller shrines, some of which are adjacent to habitation sites and some associated with adz quarries. This category is informally defined as a small structure such as an ahu, platform, or even an enclosure which is too small to have had a habitation or shelter function and frequently has coral or slab uprights associated with it.

The most easily distinguished kind of small shrine is a simple ahu supporting a slab upright often collapsed. Sometimes these occur in multiple sets. Site 7A consists of a row of 7 ahu each of which formerly supported slab uprights 1' - 2' long. Some are in direct association with adz quarry sites (Site 9, 11A). Others are near lithic work areas. These structurally

simple slab shrines occur in great numbers around the well-known adz quarry at Mauna Kea (McCoy 1982, 1984) and the authors have located additional examples on Mauna Kea and at Kaluako'i, West Moloka'i, in both cases near adz quarries (Hammatt, Borthwick: 1988; Hammatt, 1978). With the addition of the Lāna'i examples the pattern of association includes 3 Hawaiian Islands. There is little doubt that these are "adz maker shrines" (for lack of a better term) and were constructed by the quarriers and flakers as pohaku offerings. Site 11 provides perhaps the best example. The shrines stand on a knoll directly overlooking the quarry and flaking area.

Quarry Sites

There are eight separate quarry areas distributed mostly in the mauka area between the eastern boundary of the project area and Kaluako'i. These are recognizable initially simply by the dense scatter of basalt flakes covering the rocky and loose soil terrain. In some cases (Sites 1, 6, 7) dyke formations from which the basalt was quarried are visible in bedrock outcrops. In other quarry areas the dyke stone had to be exposed for quarrying by actually digging away the overlying layer of loose rock and soil. In some cases rectangular boulders of dense basalt 2' in diameter were flaked along the edges to remove adz cores.

Clearly, preform shaping took place at the actual quarry localities, as well as on and around habitation sites. The bluff line 100' or more to the west of the Site 18 Complex is literally

covered with flaking debris on natural terraces and most of the house sites contain surface scatters of flake debris. The largest quarry is Site 7 which is defined by a flake scatter and small outcroppings of dyke material over an area 800' mauka-makai and 1-200' east-west. The location of the quarries--as distinguished from flaking stations--is determined by the dyke outcroppings wherever they may be. In some cases they are in level or gently sloping areas (Sites 7, 9, 11), in other cases they are along steep gully sides (Sites 1, 6, 10).

Another product of these quarries was volcanic glass which was observed in most of the quarry sites and occurs as veins along the edges of the basalt dykes. The scatter of volcanic flakes and cores in the quarry areas and habitation sites shows that this material was extracted from the quarries and carried to nearby habitation areas. In addition, there is evidence of quarrying of soft red porphyritic basalt (baked soil) which occurs along the edges of the dyke exposures at Site 7. An artifact, made of this material was observed at Site 15 (coffee bean sinker) and flake scatters of this material were found at habitation sites (Site 20, Feature H). This material, similar to scoria is useful for fishing sinkers, lures, files, abraders and other soft stone artifacts.

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Burial Sites

Surprisingly there are only 2 discrete features which can be almost positively identified as burials. These are two monument

burial platforms mauka of the Site 20 complex. Other burials may be present under an internal coral paving of Site 18F and under a small rectangular platform connected to the makai side of 18H. Of course, it was not uncommon for prehistoric Hawaiians to bury their dead under or adjacent to house sites. Excavation could yield multiple burials within habitation features. Although the definite burial features are few in number their presence does reinforce the identification of permanent habitation sites within the 18 and 20 Site complexes.

Agricultural Features

There is a single archaeological feature which can definitely be identified as agricultural. It is on the east side of Kapiha'a Gulch and is a walled rectangular enclosure with a soil filled interior (20J). It is a walled planting area, but the walls are only to define the field, as they are not high enough to exclude cattle.

Identification of other planting areas are somewhat more problematic. There are distinct areas on sloping land near gulches which have well formed natural terraces resulting from downslope sorting of rocks and expansion and contraction of soils during wet dry cycles. The terraces produced by this natural patterned ground phenomenon are well shaped, even symmetrical when viewed from downslope. In fact, an archaeologist unaware of this natural phenomenon could easily identify these areas as man-made planting features. However, there are three areas in

which the terraces are particularly well shaped and in our judgment may have been modified by human hands--rock clearing from soil areas and stacking on retaining walls. These areas marked on the project area map, but not given separate site numbers and the question of their use for planting is left unanswered until further examination is possible.

The question of the extent of native coastal agricultural on Lāna'i is an important one. Kaschko (1987) argues from the sites at Mānele that coastal agriculture was minimal and most of the food crops were brought from the mauka gardens. The seasonal cultivation of sweet potatoes in the winter months was certainly possible and it was potentially an important immediately available source of food for these coastal settlements. If these natural terrace areas were used, they are certainly extensive enough in size to have supplied the entire community.

Miscellaneous Sites and Features

This category includes ahu and other features of unknown function, as well as one single isolated petroglyph (Site 21). This stick figure was drawn on a small boulder and may be a modern replication of an old design. It is surprising that other petroglyphs were not located within the project area, given the many suitable boulder faces and the many other petroglyph localities on the island (reported by Emory, 1924). The survey archaeologists located no other petroglyphs besides the single figure at Site 21. However, Gary Onoma (Personal Communication,

1988) has observed faint figures on near shore boulders above Kaluako'i Bay. He reports that they are only visible when viewed in oblique light early or late in the day.

At the makai end of the Site 20 Complex are a series of parallel connected linear mounds which are less than 2' high and 10' apart piled on a level shelf overlooking the shore. They are uniform to the point of almost appearing to be made by a tractor blade. However, they are considered to be associated with the prehistoric complex. They are probably net or fish drying areas.

Data Recovery Plan

Present Mitigation Plans

Mitigation of the impact of proposed golf course and residential development is to be treated in two courses of action.

1. Data recovery of those sites to be directly impacted by development.

2. Preservation of significant sites into archaeological preserves.

Consistent with the recommendations presented in the 1988 survey report, as well as subsequent community input, major habitation and religious sites which form an almost continuous complex on both sides of Kapiha'a Gulch will be preserved in place.

All other sites within the project will be impacted by golf course and residential construction and are to be subjected to data recovery.

Sites for Data Recovery

All archaeological sites outside of designated preserve areas face the likelihood of being directly impacted by construction activities. It may be possible, however, to incorporate some of the features into the golf course landscaping during construction but data should be collected from these sites because the extent of damages to them remains uncertain. Table 1 shows sites designated for data recovery. The site types are summarized as follows:

Permanent Habitation Sites--Site 5

Total--1

Temporary Habitation Sites--Site 3, 4, 8, 2, 23

Total--5

Small Shrines-- 9, 11A, 12C

Total--3

Quarry Sites--6, 7, 8, 9, 10, 11, 25

Total--7

Agricultural Features

Areas by Sites 4, 5, and 14

Miscellaneous Sites--Site 24 ahu, Site 26 ahu

Total--2

There are a total of 20 features to be impacted by construction. Two of these sites (Site 2 Ahu--Site 24 Ahu) are listed as not significant. This leaves 18 features in all which will require further research before construction impact.

Clearly, the sample of site types for excavation is not representative of the entire site assemblage in that nearly all of the permanent habitation features are in designated preserve areas and excluded from data recovery. Site 5 is the only permanent habitation site not in a preserve area and it is isolated mauka of the main complex. However, there are 6 temporary habitation sites (including workshop areas) and adz quarries are also well represented. Of the small shrines 2 are associated with adz quarries and the other one is an isolated

feature. These shrines have limited excavation potential but are important in their locational context and construction features.

In addition, there are areas of possible agricultural features to be impacted. Close examination of these features may be useful in determining the type and extent of human use for agricultural production. Additional features within the preserve area will be tested as per DLNR Letter, dated 8/15/89.

Research Goals and Methods

In view of the kinds of sites designated for data recovery it should be possible to address the following research topics.

1. Chronology of settlement--This will involve collection of charcoal and volcanic glass samples from permanent and temporary habitation sites and if available from adz quarries to determine the time frame of occupation and hopefully the chronology of the use of the quarry sites.
2. Economic base of the community--This will be documented through controlled excavation of habitation sites, collection of marine and terrestrial faunal material with analysis to construct dietary patterns.
3. Patterns of use of the adz quarry sites including extraction techniques, possible use of fire for extraction, pre-shaping of adzes on the quarry site and variation in the materials quarried. This will be attempted through mapping, sampling of surface materials and some controlled excavation. There should be some basis, in terms of pre-form types and flaking patterns, for comparison to other quarries in Hawai'i (See Dye, Weisler and Riford 1985).
4. Religious implications of shrines, particularly in those associated with adz quarries. This is a difficult subject to document, but can be partly accomplished by comparison of construction, size and placement of shrines to known examples in other quarry areas, i.e. Moloka'i, Mauna Kea.
5. Evaluation of natural terraces to determine the extent of human modification and their use for dry land agricultural crops. Three possible agricultural terrace areas occur near sites 4, 5, 14. The most well-expressed of these terraces occur on the south slope of Kaluako'i Gulch. These areas will be examined closely for human modification and interpretation of the natural processes which operated to form them. One or two cross-section trenches will be excavated to expose profiles of the terraces to show possible agricultural soils and other signs of human alteration. The question of the extent of agricultural productivity in this dry coastal area is important for interpreting the economic basis of the settlement and the extent to which the inhabitants were dependent on upland food resources.

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Field and Laboratory Methods

Sampling of Sites

It is not realistic or productive to excavate 100% of each site to be impacted by the golf course residential development. However, it is possible to test excavate all sites suspected of containing subsurface cultural material and to excavate sizeable samples of site areas to address the research goals outlined above. The following sampling strategy will guide the fieldwork.

Permanent Habitation Sites and Features

Only one of these types of sites is represented in the list of sites to be data recovered. It is believed that even substantial excavation of this site cannot yield sufficient information to reconstruct chronology and the economic basis of the prehistoric occupation of this community. Therefore, sampling of 15-20% of each of the features of Site 5 will be supplemented by excavation of one square meter in the cave Site 19F. This cave is likely to yield datable material to document the longest chronological range of human occupation. One square meter will be excavated in one of the habitation terraces of Site 28 Complex. Both these features are designated as within the preserve area and are not to be directly impacted. However, there is always an increased likelihood of relic hunters doing unauthorized excavation and looting when the sites become accessible. This secondary impact is particularly likely at the small cave site (caves are favorite places for looters). For this reason,

at least small scale testing to obtain chronological information is justified as part of the data recovery. Other sites within the designated preserve area will be tested to provide information for interpretive programs. Testing of these sites will follow the recommendations of a Aug. 14 letter from DLNR.

Temporary Habitation Sites

At least 1 square meter trench will be excavated within each of the 5 temporary habitation sites.
Expanded excavations will take place (4-5 square meters) at the larger of these features in which the testing results show analyzable and interpretable cultural material.

Small Shrines

The 3 shrines within the development area are not the type of features to contain subsurface cultural materials. The can be sufficiently documented with detailed mapping, photographs and written description of sizes and construction methods.

Quarry Sites

At least 2 one-meter square trenches will be placed within 7 quarry sites to attempt to document stratigraphic context of the flaked quarry debris and to collect charcoal and volcanic glass for dating. Mapping and controlled surface collection will also be carried out to collect quantitative data on preform shapes and debitage.

Agricultural Features

There are three areas of natural terraces designated within the development area. Detailed mapping will take place in selected areas of each of these 3 complexes. In addition at least 2 cross-section trenches will be excavated through terrace walls and soil deposits to document human modification and (if present) to collect datable samples.

Miscellaneous Small Sites

Field visits to the survey area since the 1988 Cultural Surveys Hawaii fieldwork have located small features and petroglyphs not recorded in the survey report. These features will be recorded, evaluated and treated according to this data recovery and preservation plan.

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Excavation Methods

The following methods will be used in the excavation of all trenches in cultural layers.

1. Screening of all sediments through 1/8 inch mesh screen;
2. Recovery of all artifacts and shell and bone midden;
3. Recovery of all charcoal both as "in situ" samples and from the screen;
4. Recording of stratigraphy by scale drawing of at least one profile in each 1-meter square trench;
5. All trenches will be excavated to culturally sterile

soil deposits or bedrock;

6. The sites chosen for excavation will be mapped to scale showing all internal features and excavated trenches.

Laboratory Methods

This phase of work will involve the following:

1. Identification and cataloging of artifactual material including both historic as well as prehistoric forms. Artifacts will be measured with representative samples drawn and/or photographed to scale.
2. Identification, weighing, and analysis of midden material to genus and species. This information will be tabulated for each layer within each stratigraphic unit within each site.
3. Preparation, submittal and dating of datable samples (volcanic glass and charcoal).
4. Dating and identification of historic era artifacts.

Report Preparation

The final report will contain the following:

1. An in-depth presentation of each research question, incorporating prior archaeological and historical studies in the K165loa area.
2. Site findings, maps, descriptions, surface collections for each site will be discussed separately. Site maps, and stratigraphic profiles will be included. Summary

tables of artifacts and midden--at least by layer--will be included and discussed.

3. A separate section on artifact analysis.
4. A separate section on midden analysis.
5. A separate section on volcanic glass and radiocarbon and historic period artifact chronology.
6. A summary chapter which re-evaluates the findings on each research question.
7. References.
8. Appendices.
   a. Master Artifact Catalog
   b. Volcanic glass dating lab report

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Report Review Procedures

A draft report will be submitted to the State Historic Preservation Office (SHPO) and Maui County Planning Departments for review, to ensure all information is included and completely presented.

A final report shall then be produced, incorporating any recommended revisions. If Cultural Surveys Hawaii disagrees with recommended revisions, consultation will occur with the SHPO and the County Planning Department to resolve these problems. Consultation will occur with both of these offices before the final report is produced.

Report Dissemination

Copies of the final report will be sent to Lanai Company Inc. the State Historic Preservation office, Maui County Planning department, a Depository of the county's choice and the Office of Hawaiian Affairs (OHA).

Disposition of Finds and Documentary Data

All materials generated by this project will be deposited for curation at a facility acceptable to the State's SHPO and County's Planning Department, preferably on Lāna'i.

Treatment of Burials

This data recovery plan includes provision for testing of suspected burial sites to determine location and number of burials. If burials are found their actual removal, treatment and final disposition will be handled separately and will be in accordance with Act 265 (Chapter 6E revised) which requires:

1. Notification of OHA by the State Historic Preservation Office, if skeletal remains are likely to be native Hawaiian.
2. Attempts to identify lineal descendants of those buried. If lineal descendants are found and do not wish osteological analyses to occur for their ancestors, such analyses shall not occur.
3. The State Historic Preservation Office (SHPO) is to determine final disposition after consultation with

OHA, the landowner, and any identified lineal descendants. Practice has been to have OHA work up a written Memorandum of Agreement on disposition in consultation with the landowner and descendants, and the SHPO. The SHPO, thus, shall notify the landowner of this procedure, and the landowner and OHA are then expected to work up an agreement on final disposition. Once all parties sign this agreement, then final disposition shall occur--after all osteological analyses are completed.

In the meantime, it is recommended that an appropriate reburial place be set aside on the property as this is generally the preferred alternative. All burial treatment will also be in accordance with the Lana`i Burial Treatment Plan, as well as Attachment I of the Memorandum of Agreement Relating to Proposed Development at Hulopo`e and Manele Bays.

Plan for Preservation of Sites

The majority of significant sites are, fortunately for modern planning purposes, essentially clustered on both sides of Kapiha`a Gulch (Fig. 1). These include the major habitation and burial complex sites 15, 16, 17, 18, 19, 20 as well as 2 fishing shrines and a heiau. The following preservation measures are to be undertaken. These plans have been arrived at through consultation with the Lāna`i Archaeological Committee and have also considered comments in a lengthy review document by Dr. Matthew Spriggs of Australia National University.

The following preservation measures are to be undertaken.

1. Preservation of the complex of habitation and other types of sites on both sides of Kapiha`a Gulch comprising Site Complex 15, 16, 17, 18, 19 and 20.
2. Preservation of the heiau (Site 14) mauka of Kapiha`a Gulch.
3. Preservation of a view plane with minimal land modifications from the heiau to the gulch sites and to the coast.
4. Preservation of the fishing shrine and associated structures makai of the heiau (Sites 12, 13) (except Site 12C).
5. Preservation of the adz quarry (Site 1) in the northeastern portion of the project area.

As development plans have progressed other site areas have been set aside for preservaton through the efforts of Lanai Co.

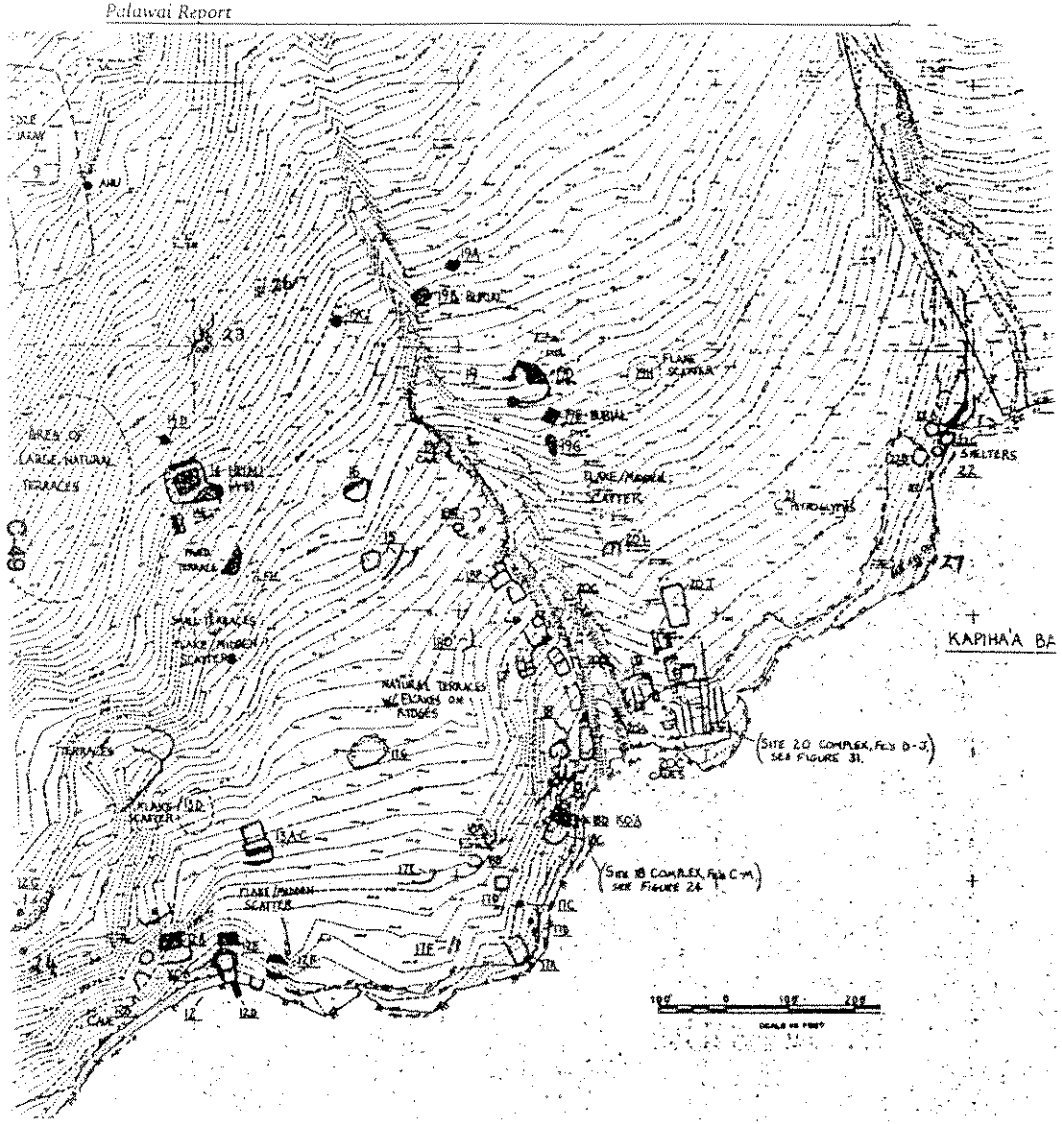

Fig. 1. Kapiha'a Gulch Showing Site Complexes 12-20.

These include Quarry Sites 6, 10, portions of Site 7 and all of habitation Sites 22 and 27. Also it has been agreed that Site 21 petroglyph will be preserved by moving it into the Site 12-20 preserve area.

It is believed that through protection of these sites that the major features representing the totality of activities and beliefs of this former Hawaiian community can be preserved for future generations.

Protection of Preserve Areas Before and During Construction

In the past, archaeological sites have come under greatest pressure immediately before and during development construction. In an area relic hunting from sites has been a particular problem when access roads are built into previously inaccessible areas. To prevent this, no access roads will be made to the preserve area until improvement work is ongoing on a full-time basis. At this time access will be limited to authorized people. Before any grubbing or grading takes place within surrounding areas the preserve area will be continuously flagged with heavy construction tape to include a buffer zone around site areas. An archaeological monitory should be on site during all grubbing and grading to insure that heavy equipment stays outside the area.

During the many months of final layout and landscaping of the new golf course it should be the developer's responsibility to prevent any rock robbing or unauthorized excavation or relic hunting in the preserve areas. Posting of signs warning trespas-

sers is advisable during this period.

Management of Preserve Areas

The purpose of designating these archaeological preserves is to make it possible for succeeding generations to view and appreciate the remnants of one of Lanai's most intact and well preserved traditional complexes. However, to achieve this they must be protected and managed and maintained. A balance between the goals of protection and accessibility is difficult. The following management steps should allow for sufficient protection, access and appreciation.

1. The kiawe and clutter which now make portions of the preserve areas almost inaccessible were not there when the Hawaiians used this land. For now this thick exotic growth serves as a discouragement to visitation and will continue to be a protective cover during the development of the golf course. Only when the golf course is completed and when the preserve areas are secure as part of the functioning golf course should this vegetation be removed. When it is removed it should be done so by hand cutting and hand mowing with no mechanical equipment brought into the preserve areas. Kiawe stumps should be painted with growth preventing chemicals. The preserve areas should not be left bare of all vegetation. A thin grass cover to prevent continuous regrowth of high weeds in some areas

would be suitable.

2. One or two entry routes should be made into each preserve and a small sign should be placed by the path which explains the significance and value of the site complex.

3. The preserve area of Kapiha'a Gulch is uniquely suited to a interpretive program by virtue of its well-preserved internal features as well as its central location. A stabilization, and interpretive program should be developed through consultation with Lanai Company, and Lana'i Archaeological Committee, Maui County and the State Historic Preservation Office. The possibilities include revegetation with native plants, interpretive signs, outdoor displays, informational brochures, etc.

Summary of Recommendations for Data Recovery and Preservation

The following recommendations are made in this plan specific to both data recovery and preservation in the 300-acre Development Area.

Data Recovery

1. Excavation of Site 5, plus sampling of cave Site 19F and one major habitation site and other sites within the preserve area to develop information for interpretive programs.
2. Sampling with selective expanded excavations at temporary habitation sites.
3. Complete documentation of all shrines in the development area.
4. Test excavations controlled surface collection and mapping of quarry sites.
5. Stratigraphic excavations and mapping at agricultural terraces.
6. If burials are located (which is unlikely)--preparation of a burial treatment plan
7. An archaeologist on site during grading and grubbing to advise on incorporation of archaeological features into the golf course, respond to unexpected findings and to insure avoidance of archaeological preserves.
8. Completion of a final report on all excavations of the development area.

Preservation

9. Continuous flagging, with warning signs around preserve areas before ground disturbance.
10. Maintain security of preserve areas in all phases of construction to prevent relic hunting and vandalism.
11. Hand-clear and poison exotic vegetation after development is complete and replacement with a thin grass cover around archaeological features to prevent weed regrowth.
12. Placement of signs at preserve areas explaining their significance and value.
13. Development of an interpretive program for the Kapiha a Complex.

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Appendix

Table 2
SUMMARY LIST OF ARCHEOLOGICAL SITES WITH SIGNIFICANCE ASSESSMENTS
(22 Sites, 75 Features, 69 Significant Features--
See End Sheet for Significance Codes A-E, NS, NLS)

Site/Feat. No	Description/Comments	Recommendations	Significance
1	Quarry/Utilizing Exposed dyke (prehistoric)(probably Athens Site 1510 (Feature D)	Test, Surface Collection	D
2	Ahu/possible trail marker Marker (prehistoric?)	None	NLS
3	Terrace/Probable habitation Site; Visible midden (prehistoric)	Test	D
4	Rock Shelter/Probable habitation site, Visible Midden with possible agricultural features makai (south)(prehistoric)	Test	D
5	Habitation Site/Enclosure, terrace Cupboard; Midden and artifacts observed. (prehistoric)	Test	D
6	Terrace and quarry/Possible habitation terrace; quarry utilizingexposed dyke; (prehistoric?)	Test	D
7	Quarry/Large Surface Quarry with associated scatter of flakes (prehistoric?)	Test, Surface Collection	D
8	Shelter and Quarry/Probable habitation shelter, few artifacts & midden observed; Quarry utilizes exposed dyke/prehistoric? but recently used by fishermen.	Test	D
9	Quarry, Ahu/Utilizes exposed dyke; Ahu associated with quarry (prehistoric?)	Test,Surface	D

10	Quarry, Terrace/Soil Terrace, Probable "workshop" with adz preforms present (prehistoric?)	Test	D
11	Quarry, Ahu (7) on bedrock bluff with quarry, on downslope side with midden observed (prehistoric?)	Test	D,E
12	HabitationComplex/Fishing related; consists of Ko'a, platform, shelter, enclosure (prehistoric)	Preserve	C,D,E
12A	Ko'a Plentiful coral	Preserve	C,E
12B	Overhang Shelter/Habitational Feature Midden observed	Test Preserve?	C,D,E?
12C	Upright Cupboard/Upright and cupboardin bedrock outcrop mauka of Ko'a	Preserve	E?
12D	Enclosure, and terraces/ Habitationalfeature, midden and artifacts observed	Test	C,D
12E	Platform/Midden, artifacts observed	Test Preserve?	C,D
12F	Platform, enclosure/ Historically modified to an enclosure, midden and artifacts observed, including some historics	Test	A?,D
13	Habitation Platform and flake scatter. Probably associated with Site 12 Features (prehistoric?)	Preserve	D
13A	Platform (A),Adjoining Terraces(B,C)B,C /Probable hearth on platform, midden and artifacts observed	Preserve	D
13D	Flake Scatter/Surface Scatter in Soil	Preserve	D

14A Platform(A),adjoining terraces (B,C, E) and ahu (D)/Possible heiau, and associated features; midden, artifacts observed	Preserve Test?	D-E
15 Enclosure and adjoining Terrace/Probable habitation site, midden and artifacts observed	Preserve	D
16 Enclosure/Probable habitation site; midden, artifacts observed	Preserve	D
17 Complex/habitation? and religious? Midden features	Preserve	D
17A Habitation shelter/Level area between bedrock boulders, shell, midden and historics, prehistoric with modern use	Preserve	D
17B 2 Small adjoining platforms/possibleshrines, prehistoric	Preserve	D,E?
17C Small platform/possible shrine prehistoric	Preserve	D,E?
17D Enclosure/habitation enclosure with makai boulder terrace, midden, basalt flakes, prehistoric	Preserve	D
17E Terrace/Possible habitation, no visible midden, prehistoric	Preserve	D
17F Oval alignment/possible habitation, no midden observed, prehistoric	Preserve	D
17G Wall and cupboard/short wall section and cupboard on bluff, pieces of branch coral adjacent, possible habitation shelter, prehistoric	Preserve	D

18 Habitation & Religious Complex, 17 closely associated features, ko'a, housesites, terraces, platforms, prehistoric	Preserve Limited testing?	A,C,D
18A Coral paved terraces/probable shrine prehistoric	Preserve	D,E
18B Terrace/habitation terrace, midden, flakes, prehistoric	Preserve	D
18C Terrace/habitation terrace with coral midden, flakes, adjacent to ko'a	Preserve	D
18D Fishing Shrine, Ko'a/well-constructed, 6' max. height, has branch coral	Preserve	C,D,E
18E Circular enclosures/prehistoric with evidence of modern use	Preserve	D
18F Habitation, enclosures and terrace/ enclosure wall w/ uprights, enclosure and adjoining terrace, plentiful midden, flakes, and volcanic glass, stone-lined hearth, 2 more terrace levels makai	Preserve	C,D
18G Habitation/Partially walled soil deposits plentiful midden, flakes, coral	Preserve	C,D
18H Habitation terrace/on gulch edge, plentiful midden, flakes, possible burial platform on makai side	Preserve	C,D,E
18I Small enclosure/Associated with Horticulture	Preserve	D
18J Habitational Terrace/Adjacent to H & K, plentiful midden, coral, flakes	Preserve	C,D
18K 3 Adjoining Habitation Terraces/ plentiful midden, coral, flakes	Preserve	C,D

18L 2 Level Platform and habitation terrace/habitation platform	Preserve	C,D
18M Habitation terrace and adjoining platform	Preserv	C,D
18N Platform/depression in center, possible shrine	Preserve	C,D,E?
18O Habitation terrace/ plentiful basalt flakes, poorly defined alignments	Preserve	D
18P 3 Level Habitation terrace/Plentiful flakes, coral, midden, one coral file observed	Preserve	D
18Q Ahu and habitation terrace /terrace has plentiful basalt flakes	Preserve	D
19 Complex/shelters, burials, cave	Preserve	D
19A Ahu and fence alignment/ depression in center	Preserve	D
19B Burial platform/probable burial next to gulch	Preserve	C,D,E
19C Ahu/possible shrine(fallen upright) or burial (on west side of gulch)	Preserv	D
19D Habitation shelters and terrace/ plentiful basalt flakes, 2 adjoining enclosures	Preserve	D
19E Burial platform/rectangular with branch coral, cobble pebble paving	Preserve	C,D,E
19F Habitation cave and terraces/cave has plentiful cultural material, cut into Hulopoe gravel, terrace on east side of gulch has midden,flakes coral	Preserve	C,D

19G Piled boulders/some midden, flake in SE corner	Preserve	D
19H Flake scatter/flaking station	Preserve	D
20 Complex/ Habitation	Preserve	D
20A Habitation terrace/next to gully, possible pavement, evidence of recent use	Preserve	D
20B Overhang shelter/cut into Hulopoe gravel, good excavation potential	Preserve	D
20C Overhang shelters/Along sea cliff, 4 adjacent overhangs in soft gravel, some collapse	Preserve	D
20D Linear mounds/parallel linear mounds possible fish or net drying areas, on bedrock shelf	Preserve	C,D
20E Small Enclosure/possible shrine, has branch coral	Preserve	D,E?
20F Small Enclosure and terraces/possible shrine with habitation terraces on mauka side, midden present	Preserve	D,E
20G Enclosure and habitation terraces plentiful midden, flakes	Preserve	C,D
20H Adjoining habitation terraces/2 main adjoining terraces, plentiful midden, flakes	Preserve	C,D
20I Habitation platform/level soil area with hearth, paved area to east, possibly main house site.	Preserve	C,D
20J Enclosure/probable planting area	Preserve	C,D
20K Habitation Terraces/small features	Preserve	D

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20L 2 Semicircular enclosures/ low walls heavy basalt flake scatter	Preserve	D
21 Isolated Petroglyph/may be modern?	Move to preserve	D
22 Small Complex of shoreline shelters /3 features	Test/Pres.	D
22A Enclosure/Small shelter associated terraces	Test	D
22B Enclosure/Soil floor, possible cupboard built in	Test	D
22C 2 Enclosures/both are 5.5' in diameter, enclosure but partially bulldozed	Test	D
23 Temporary habitation shelter	Test	D
24 Ahu	None	NLS
25 Quarry	Map/Test	D
26 Ahu	Map	D
27 Habitation Site	Preserve	D

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Codes for Criteria for Site Significance

NS	Not Significant
NLS	No Longer Significant
A	Site reflects major trends or events in the history of the state or nation
B	Site is associated with the lives of persons significant in our past
C	Site is an excellent example of a site type.
D	Site may be likely to yield information important in prehistory or history.
E	Site has cultural significance; probable religious structures (shrines, heiau) and/or burials present).
E*	Signifies site is only a possible burial or religious feature.
(D)	Parenthesis used for feature criterion
D	No parenthesis used for site criterion

CULTURAL SURVEYS HAWAII
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June 28, 1990
Received July, 1990

Dr. Don Hibbard, Director
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Dept. of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Subject: Post field work Summary Report
Palawai and Kealia'aupuni, Lanai
TMK 4-9-02: pori (Rural district).

Dear Don:

Please excuse the delay in responding. This is a follow up on your April 12 letter requesting a summary report on data recovery work and changes in the data recovery and preservation plan for the above project. As you know there have been a number of meetings between the Lanai Archaeological Committee and Lanai Company and there have been adjustments in the development plans to address archaeological sites. The dispositions of a few of the sites has changed as a result. The following is, to the best of our knowledge, a summary of the most recent information. The data recovery and preservation plan has been revised to include these changes and is being submitted separately. Included with this letter is a site and feature list which describes data recovery work accomplished and disposition of each of the features. A verbal summary is provided as follows.

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Sites for Preservation

All sites and features listed in the June 1989 Data Recovery and Preservation Plan for preservation are still slated for preservation. However, some sites have been added to the list as follows:

1) Sites 15, 16, and 17 were in the originally designated preservation area but were not specifically mentioned as preserved sites in the 1989 plan. These sites are listed in the revised plan and are in central locations within the preserve area and will be preserved. No data recovery has taken place at any features of these three sites and they should be left as is.

2) Three adz quarry sites have been added to the preservation list making a total of four adz quarries for preservation. Site 1 was on the original list. Sites 6 and 10 are to be saved in the entirety as offered by Lanai Co. Also the three dyke exposures at site 7 quarry will be preserved but not the makai portion of the site which consists of surface scatters of flaking debris.

3) Site 22 which consists of four seperate clustered features along the shoreline at the east boundary of the project area was not listed for preservation in the 1989 plan but given it's location within the shoreline setback it will be preserved with an appropriate buffer. Newly designated site 27, south of site 22 will also be preserved within the shoreline setback.

4) Site 21 which consists of a single petroglyph figure on a portable rock southwest of site 22 was not listed for preservation in the 1989 plan. However, during discussions with the DLNR representative it was agreed that the rock will be transported to the preserve area 200-300 feet to the west and saved.

Additional Sites

Five additional sites were discovered following the initial survey, during subsequent field trips, and data recovery field work. These are briefly described as follows:

CSH 23: A small enclosure incorporating insitu boulders and bedrock, with a stacked boulder wall on the northern side; a 1 meter square trench was excavated in the central soil area of the enclosure to a maximum depth of 70 cm. below surface, no cultural material was present; probable agricultural feature.

CSH 24: A roughly rectangular shaped ahu measuring 1m x 1.8 x .8 (ht.) constructed of stacked boulders on a low bedrock outcrop, possible collapsed upright boulder in center of ahu.

CSH 25: Quarry site utilizing insitu boulders and bedrock ledge; area measures roughly 30 feet (9m) E/W by 75 feet (22.5m) N/S, scale map drawn, collection of hammerstones, high percentage of large flakes present.

CSH 26: Ahu, NW of site 19 feature C, measures approximately 1 meter in diameter and is a maximum of 1 meter high, constructed of stacked boulders on a bedrock ledge.

CSH 27: A cluster of three fairly indistinct features some 150 feet south of site 22, site 27 is situated on the edge of the shoreline cliff within the 100 foot shoreline setback, features include an ahu (.8 meters in diameter by .3 meters in height), a boulder alignment (3 meters long by .25 meters in height), the relatively poor condition of the features, which are constructed on Hulpoe Gravel, may be due to them being washed by occasional high surf.

Lanai Rural District
DRP Preliminary results

Data recovery work within the rural district was carried out between Dec. 1989 and Feb. 1990. Work included detailed mapping, surface collection(s) and excavations. This is presented in table form which accompanies this report.

There were approximately 43 trenches excavated which included excavation of sites both in and out of preserve areas. The excavations can be broken down to 5 general site types. These include, permanent habitation, temporary habitation, religious, quarries, and agricultural. The following will be a brief and preliminary discussion by site type.

Permanent habitation: The excavations indicate quite clearly that only the sites at the mouth of Kapihaa Gulch can be specifically listed within this category. The one mauka site (site 5) which was tentatively identified as a permanent habitation appears to be a temporary but recurrent uses type site. These assesments are generally based on the quantity of midden present.

The makai sites (12, 18, 19, 20) contain plentiful and varied midden as well as relatively plentiful artifacts. This is especially true for site 18 complex which contains dense cultural deposits.

Temporary habitation: Examples include sites 3, 4, 5, 8, and 22 which actually represents a range from recurrent use (5, 22) to possible one time usage (4). These sites were characterized by sparse midden and artifacts as well as a limited variety of midden and range of artifacts.

Religious: These sites include 14 (Heiau) and 19C which was tentatively identified as a possible burial. Trenches dug in these sites were backfilled and/or reconstructed to their former state. Excavations were negative in terms of recovery materials from 14 which would have helped in interpretation of the different components of the site. Site 19C did not contain a burial but was reconstructed.

Quarries: These include 6, 7, 9, 10, 11, and 25, for the most part work consisted of detailed mapping and surface collection of flakes to preforms. Nearly 200 pounds of flaked materials were collected for analysis. Excavations at the quarries yield virtually no midden material. However, through detailed mapping an excavations quantitative differences between quarries became more evident, Hence the recommendations for preservation of 6, portions of 7, and 10. Quarry site CSH 1 was already slated for preservation as part of site 1510 complex (Athen's).

Agricultural: Features tested included areas associated or in proximity to CSH 4, 5, 14. No cultural materials (ie. midden or artifacts) were observed in these excavations. Soil column samples were collected from each excavation for later analysis.

Preliminary Obervations

Dating of sites: The general absence of historic artifacts in site excavations suggests abandonment prior to major influence of the historic period. Also, the absence of high walls for livestock exclusion is further evidence of early abandonment of the sites, (this was also mentioned in the original D.R.P.), the historic items that were present were obviously related to use of the areas by modern day fishermen; dating of the bulk of sites tested and/or excavated appears somewhat to be problematic in that there was generally few good samples available, however a few samples with quantities sufficient for C^{14} analysis were collected and will be sent off shortly. There was also very little volcanic glass present in any of the sites, and no dating analysis of the relatively few flakes will be undertaken.

Quarries: At quarries 6, 7, and 10 there was plentiful evidence of preliminary stages of adz manufacturing, with very plentiful flakes and relatively plentiful blanks and preforms present; detailed maps show where flake concentrations occur indicating on site adz reduction, no finishing of adzes appear to have taken place at the quarries. The quantities of preforms/blanks suggest an export industry. Sizes of the blanks/preforms is suggestive of preference for relatively large adzes. Quarries also show utilization of various rock types, generally identified by raw material color differences.

Habitation sites: Excavations definitely indicate that the best examples of habitation sites in terms of architecture and material culture are within the large preservation area (ie. sites 12, 18, 19, 20 ect.). In general sites tested in the preserve area contain plentiful and varied midden components. This is especially true for the site 18 complex. Though there were plentiful basalt flakes present the main focus of these sites, as one would suspect, relates to fishing and collection of near shore marine resources. Though these sites were only tested there appears to be a low percentage of polished flakes and other finished adz material, again somewhat suggestive that the quarries in the area and their products were exported from the general site area. However, one cannot discount the probability of many surface artifacts, adzes, etc., having been removed (looted) from these open sites as their proximity to the coastal trail allows for easy access. The abundance of basalt flakes in the general vicinity of site 18 does however suggest adz manufacturing, but may also represent substitution of the sharp small basalt flakes for volcanic glass flakes so common in most hawaiian sites:

These are just preliminary observations, prior to actual analysis of collected materials, and should be viewed as such. Further development and alternative ideas will be part of the laboratory and report process. However, it is clear, as mentioned previously, that in terms of architecture and material culture that sites slated for preservation are definitely the best examples within the Rural District. This is especially true of the large some what triangular shape preserve area that encompasses what can be called "Kapiha'a Village" which includes the Heiau (site 14), two fishing shrines (sites 12A, 18D) probable burial features (sites 19B, 19E) and the habitation terraces of site 18.

Sincerely,

Doug F. Barthel

FOR; Hallett H. Hammatt, Ph.D.

HH/jd

Lanai Rural District Proposed Golf Course Archaeological Site List

Site/Feat. No	Description/Comments	Work Accomplished	Disposition	Comments
1	Quarry/Utilizing Exposed dyke (prehistoric)(probably Athens, Site 1510, Feature D)	Mapped,photographed	ToBePreserv'd with buffer as part of Site 1510	Excellent small quarry site
2	Ahu/possible trail marker Marker (prehistoric?)	Mapped,photographed	not to be preserved	In extreme western portion
3	Terrace/Probable Habitation Site Visible midden (prehistoric)	Mapped, photographed 1 Trench excavation	not to be perserved	Isolated site in central area no findings
4	Rock Shelter/Probable Habitation Site, Visible Midden w/ possible agricultural features makai (south) (prehistoric)	2 trenches excavated mapped, photographed	not to be preserved	few pcs of shell midden on surface
5	Habitation Site/Enclosure, terrace Cupboard; Midden & artifacts observed (prehistoric)	Mapped in detail 11 trenches excev. Site dismantled	not to be preserved	midden and artifacts
6	Terrace & quarry/Possible habitation terrace; quarry utilizing exposed dyke; (prehistoric?)	Detailed mapping,surface coll. 2 trenches	Lanai Co. will preserve site area	excellent quarry site
7	Quarry/Large Surface Quarry w/ associated scatter of flakes (prehistoric?)	Detailed mapping,surface coll.,2 trenches excavated	Exposed dyke por.of site ToBePreserved	good quarry site
8	Shelter & Quarry/Prob.habitation shelter, few artifacts & midden obsv'd;Quarry utilizes exposed dyke/prehistroic? but recently used by fishermen	3 trenches excavated Mapped, surface collection	will be preserved because on shoreline cliff	limited findings site on cliff top over ocean
9	Quarry, Ahu/Utilizes exposed dyke;Ahu associated w/quarry (prehistoric?)	Detailed mapping Surface collection 2 trenches excavated	not to be preserved	limited findings prob. not archaeol. site, exc. ahu
10	Quarry, Terrace/Soil Terrace Probable "workshop" w/ adz preforms present (prehis.?)	Detailed mapping Surface collection 2 trenches excavated	Lanai Co.will preserve site area	excellent quarry site
11	Quarry,Ahu(?)on bedrock bluff w/ quarry,on downslope side w/midden observed (prehis.?)	Surface collection detailed mapping 2 trenches excavated	not to be preserved	poor example of quarry site
12	Habitation Complex/Fishing related; consists of ko'a, platform, shelter,enclosure (prehistoric)	Mapped	To be preserved	
12A	Ko'a; plentiful coral	Mapped, trench excavated,on makai side	To be preserved	
12B	Overhang Shelter/Habitational Feature, Midden observed	Mapped	To be preserved	
12C	Upright Cupboard/Upright & cupboard in bedrock outcrop mauka of ko'a	Mapped	To be preserved?	
12D	Enclosure, & terraces/Habitational feature, midden & artifacts observed	Mapped	To be preserved	
12E	Platform/Midden, Artifacts observed	Mapped	To be preserved	
12F	Platform, enclosure/Historically modif'd to an enclosure midden & artifacts observed including some historics	Mapped, 1 trench excavated	To be preserved	

Lanai Rural District Proposed Golf Course Archaeological Site List

Site/Feat. No	Description/Comments	Work Accomplished	Disposition	Comments
13	Habitation Platform & flake scatter,Prob. associated w/ Site 12 features (prehis.?)	Mapped	To be preserved	
13A	Platform (A), Adjoining terraces (B,C)	Mapped	To be preserved	
B&C	Prob. hearth on platform midden & artiafacts observed	Mapped	To be preserved	
13D	Flake scatter/surface scatter in soil	Mapped	To be preserved	
14A	Platform (A),adjoining terraces(B,C,E) & ahu(D)/poss. heiau, & assoc. features midden, artifacts observed	Mapped, three trenches reconstructed	To be preserved	virtually no midden or artifacts
15	Enclosure & adjoining Terrace Prob. habitation site,midden & artifacts observed	Mapped	To be preserved	
16	Enclosure/prob. habitation site;midden, artifacts obs'd	Mapped	To be preserved	
17	complex/habitation? & religious?; Midden features	Mapped	To be preserved	
17A	Habitaton shelter/Level area between bedrock boulders, shell, midden & historics, prehistoric w/ mod. use	Mapped	To be preserved	
17B	2 small adjoining platforms poss. shrines, prehistoric	Mapped	To be preserved	
17C	Small platform/poss.shrine prehistoric	Mapped	To be preserved	
17D	Enclosure/habitation enclos. w/ makai boulder terrace, midden, basalt flakes,prehis.	Mapped	To be preserved	
17E	Terrace/poss.habitation, no visible midden, prehistoric	Mapped	To be preserved	
17F	Oval alignment/poss. habitation,no midden obs'ved,prehis.	Mapped	To be preserved	
17G	Wall & cupboard/short wall sect. & cupboard on bluff, pieces of branch coral adjacent,poss.hab.shelter,prehis.	Mapped	To be preserved	
18	Habit. & religious complex 17 closely assoc. features ko'a,house sites,terraces, platforms, prehistoric	Mapped	To be preserved	
18A	Coral paved terraces/prob. shrine, prehistoric	Mapped	To be preserved	
18B	Terrace/habitation terrace, midden flakes, prehistoric	Mapped	To be preserved	
18C	Terrace/habitation terrace w/ coral midden, flakes, adjac't to ko'a	Mapped	To be preserved	
18D	Fishing shrine,ko'a/wall constructed 6' max. height,has branch coral	Mapped	To be preserved	
18E	2 circular enclosures/prehis. w/ evidence of mod. use	Mapped	To be preserved	

Lanai Rural District Proposed Golf Course Archaeological Site List

Site/Feat. No	Description/Comments	Work Accomplished	Disposition	Comments
18F	Habitation, enclosures & terrace/enclos. wall w/uprights, enclos. & adj. ter., plentiful midden, flakes, & vol. glass, stone lined hearth, 2 more terr. levels makai	Mapped	To be preserved	
18G	Habitation/partially walled soil deposits, plentiful midden, flakes, coral	1 trench excavated Mapped	To be preserved	
18H	Habitation terr./on gulch edge, plentiful midden,flakes poss. burial platform on makai side	Mapped	To be preserved	
18I	Small enclosure/assoc. w/ horticulture	Mapped	To be preserved	
18J	Habitational terrace/Adjacent to H & K, plentiful midden, coral, flakes	Mapped	To be preserved	
18K	3 adjoining hab. terraces/ plentif.midden, coral, flakes	Mapped	To be preserved	
18L	2 level platform & habitation terrace/hab. platform	Mapped	To be preserved	
18M	Habitation terrace & adjoin. platform	1 trench excavated mapped	To be preserved	
18N	Platform/depression in center possible shrine	Mapped	To be preserved	
18O	Habitation terrace/plentiful basalt flakes, poorly defined alignments	Mapped	To be preserved	
18P	3 level habitation terrace/ plentiful flakes, coral, midden, 1 coral file observed	Mapped	To be preserved	
18Q	Ahu & habitation terrace/has plentiful basalt flakes	Mapped	To be preserved	
19	Complex/shelters, burials, cave	Mapped	To be preserved	
19A	Ahu & fence alignment/depression in center	Mapped	To be preserved	
19B	Burial platform/prob. burial next to gulch	Mapped	To be preserved	
19C	Ahu/poss. shrine(fallen upright) or burial(on west side of gulch	1 trench excavated mapped	To be preserved?	reconstructed
19D	Habitation shelters & terrace/ plentiful basalt flakes, 2 adjoining enclosures	1 trench excavated mapped	To be preserved	
19E	Burial platform/rectangle w/ branch coral, cobble paving	mapped	To be preserved	
19F	Habitation cave & terraces/ cave has plentiful cultural material, cut into Hulopoe gravel, terrace on east side of gulch has midden,flakes, coral	1 trench excavated mapped	To be preserved	

Lanai Rural District Proposed Golf Course Archaeological Site List

Site/Feat. No	Description/Comments	Work Accomplished	Disposition	Comments
19G	Piled boulders/some midden, flake in SE corner	1 trench excavated mapped	To be preserved	
19H	Flake scatter/flaking station	Mapped	To be preserved	
20	Complex/habitation	Mapped	To be preserved	
20A	Habitaton terrace/next to gully, poss. pavement, evid. of recent use	Mapped	To be preserved	
20B	Overhang shelter/sut into Holopoe gravel, good excavation potential	Mapped	To be preserved	
20C	Overhang shelters/Along sea cliff, 4 adjac. overhangs in soft gravel, some collapse	Mapped, photographed	To be preserved	
20D	Linear mounds/parallel linear mounds poss. fish or net drying areas, on bedrock shelf	Mapped, photographed	To be preserved	
20E	Small enclosure/poss.shrine, has branch coral	Mapped, photographed	To be preserved	
20F	Small enclosure & terraces poss. shrine w/ habitation terraces on mauka side, midden present	1 trench excavated mapped	To be preserved	
20G	Enclosure & habitation terraces/plentiful midden,flakes	Mapped, photographed	To be preserved	
20H	Adjoining habitation terraces 2 main adj. terraces, plentiful midden, flakes	1 trench excavated mapped	To be preserved	
20I	Habitation platform/level soil area w/ hearth, paved area to east, poss. main house site	Mapped, photographed	To be preserved	
20J	Enclosure/prob. planting area	Mapped, photographed	To be preserved	
20K	Habitation terraces/small features	Mapped, photographed	To be preserved	
20L	2 semicircular enclosures/low walls, heavy basalt flake scatter	Mapped, photographed	To be preserved	
21	Isolated petroglyph/modern?	Mapped	To be moved & preserved	
22	Small Complex of shoreline shelters/3 features	Mapped	To be preserved	
22A	Enclosure/small shelter assoc terraces	2 trenches excavated	To be preserved	
22B	Enclosure/soil floor, poss. cupboard built in	Mapped	To be preserved	
22C	2 enclosures/both 5.5'(1.7 m) in diameter, closure but partially bulldozed	1 trench excavated	To be preserved	
23	Shelter site 125'(38m) NE of Site 14	1 trench excavated mapped, photographed	Not for preservation	No cultural material found/no longer signific.

Lanai Rural District Proposed Golf Course Archaeological Site List

Site/Feat. No	Description/Comments	Work Accomplished	Disposition	Comments
24	Ahu west of Site 12C	mapped, photographed	Not for preservation?	no longer signif.
25	Quarry site nr. Site 7	Mapped, Surface collection	Not for preservation	mostly larger flakes
26	Ahu NW of Site 19C	Mapped	Not for preservation	
27	Ahu, alignment,terrace south of Site 22	Mapped, photos	To be preserved	Indistinct features
			68 of the 78 features to be preserved	

Agricultural Features Excavated

Site			
4		Mapped, soil samples	Not for Preservation
5		Mapped, soil samples	Not for Preservation
14		Mapped, soil samples	Not for Preservation

Summary

There are a total of 78 archaeological features within the proposed Golf Course. Of these 68 are to be preserved, making a total of 87% of all features for preservation. All religious features, all major habitation features and all major quarries are to be preserved with adequate buffers. The majority of features in the area are to be preserved within a single, large contiguous preserve area to include two fishing shrines, all of the large habitation sites and a heiau. The ten features outside these preserve areas have been fully documented by mapping, excavation, surface collection and photography, according to a plan approved by the State Historic Preservation Office.

Within the mauka 173-acre residential acre 2 archaeological sites have been found. Both of these are to be preserved, which comprise 100% archaeological preservation for this area.

Considering both areas together, 70 of 80 archaeological features will be preserved, comprising 87% archeological preservation. All preserve areas will be protected by buffer zones of 50-100 feet (31 m.).

MANELE'S GOLF COURSE INTEGRATED MANAGEMENT PLAN

Prepared By:
Jack Nicklaus Golf Services
W. Kent Alkire, II
Director of Environmental Services

D-1

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2.00 Manele Golf Course

2.01 Golf Course Description

A. Goals and Objectives
B. Water Saving Features
C. Surface Water Collection and Drainage

2.02 Golf Course Construction

2.03 Existing Conditions and Topsoil Placement

3.00 Integrated Pest Management

A. Introduction

3.01 Components of Integrated Pest Management

A. Pest Identification and Probable pest Occurrence
B. Structural Control Program
C. Cultural Control Program
D. Mechanical Control Program

3.02 Turf Selection

3.03 Chemical Control

A. Introduction and Definition of Terms
B. Methods
C. Analysis

1. First Screening
2. Second Screening
3. Exposure Routes

PETITIONER'S EXHIBIT NO. 24

3.04 LEACHM

3.05 Fertilizers

3.06 Surface Runoff Of Pesticide and Fertilizers

4.00 Draft Management Guideline

4.01 Introduction

4.02 IPM Program Implementation

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2. Green Specification
3. Infiltration Sump Detail
4. Windfoil
5. Windfoil Schematic

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1. Potential Manele Golf Course Pesticides
2. Fungicide Relative Toxicity
3. Herbicide Relative Toxicity
4. Insecticide Relative Toxicity
5. IPM Implementation Schedules
6. Fertilizers Annual Usage
7. Pesticide Annual Usage
8. Environmental Fate of Various Materials as Predicted by LEACHM

TECHNICAL DATA SHEETS

BIBLIOGRAPHY

REFERENCES

1.00 INTRODUCTION

The Jack Nicklaus Organization and the Lanai Company, Inc. is committed to producing and maintaining the highest quality of golf courses. An intrical part of our ability to do this is to protect and preserve the golf course turf, trees, and other vegetation, as well as the associated landscapes and natural environment around and within the project site. Both the developed and natural environment are equally important to the success of the project.

The Manele project is an 18-hole Jack Nicklaus designed golf course on the island of Lanai, Hawaii.

This project is designed to be a recreational land use option, which will provide an attraction for the beach hotel and will enhance the quality of the living experience for the visitors and residents of the island.

This golf course, with approximately 100 acres of turf, will do much to improve and enhance the present land use, as well as improve the overall environment. Specifically the construction of a golf course will accomplish or lend to the following:

- Will help cool the micro climate of the site
- Will contribute to the cooling of the overall macro climate
- Will provide soil stability to the landscaped site
- Will help to build the organic and nutrient content of the soil used on the site
- Will filter out salts and other contaminates from the marginal irrigation water sources being used for the project
- Will provide a desirable habitat for birds and other wildlife
- Will convert carbon dioxide from the atmosphere
- Will produce and contribute oxygen to the atmosphere for animal and human use

- Absorbs air born pollutants and contaminants
- Reduces glare, thus, creating a more comfortable recreation and living experience
- Reduces fire risks by acting as a fire retardant buffer
- Will enhance and compliment the aesthetics of the present land use
- Will help to control pollen and dust which lowers allergy problems
- Will increase the accessibility of the property to visitors and residents alike.
- Will reduce noise by absorbing, deflecting, reflecting and refracting sounds

2.00 MANELE GOLF COURSE

2.01 GOLF COURSE DESCRIPTION

A. GOALS AND OBJECTIVES

The goals of this project is to build a world class golf course which reflects and integrates the natural beauty and features of the site. To accomplish this we will designate, preserve and protect those land forms and vegetative features which can be integrated into the golf course plans. These features will be located in the field and designated on the plans and in the field as "protected".

The design concepts of the golf course are developed around both the integration of value site specific natural features and the following considerations:

1. Shot Values - How well does the collection of holes present various risks and rewards to the player and test accuracy, length and finesse without overemphasizing any one skill over the other two?

2. Design Balance - How varied is the course in terms of differing lengths, differing configurations (including straight holes, doglegs right and left, uphill and downhill sots), differing hazard places and differing green shapes and contours?

3. Memorability - How well do the design features (including tees, fairways, greens, hazards, terrain, and vegetation) provide both individuality to each hole and a collective continuity from first tee to last green?

4. Aesthetics - How well do the scenic values of the course (including those of its surroundings and backdrops) add to the pleasure and enjoyment of the round?

5. Conditioning - How would a golfer rate the playable areas (tees, fairways, and greens) on the date the course was last played?

B. WATER SAVING FEATURES

The Manele golf course will be a target style course. This concept is being used to limit the total number of acres of turf, thus, the quantity of water, materials and associated management practices will be reduced accordingly.

Also, the use of the Maxi-V irrigation system will be used to monitor the water replacement value of the site and by virtue of the systems site specific water management capabilities will then replace only the water amount needed to meet the specific areas water needs.

C. SURFACE WATER COLLECTION AND DRAINAGE

The intention of both the contour design plans and the internal drainage features of the golf course are to retain for normal soil percolation and sump drain the majority of the water which is applied to or falls onto the golf course turf areas.

2.02 GOLF COURSE CONSTRUCTION

The golf course will be built by a qualified contractor in accordance to strict construction guidelines. The construction process will be reviewed by JNGS's on-site representative as well as by visiting representatives of our design and technical staff.

2.03 EXISTING CONDITIONS AND TOPSOIL PLACEMENT

The site of the proposed golf course project is primarily made up of dense lava. In accordance with the contour grading plan the

base material will be broken up and redistributed to create the basic golf course land form.

The golf course will have a soil layer plated onto the rock and gravel subgrade. The depth and type of material to be used will be based on laboratory analysis and the quantity needed to adsorb the nutrients and other materials.

3.00 INTEGRATED PEST MANAGEMENT

A. Introduction

The Manele golf course will be developed and managed according to the major concepts of Integrated Pest Management (IPM). The comprehensive development of the golf course will allow for the structural development of features and systems which enhance the effectiveness of IPM. As a program, IPM combines the use of structural, physical/mechanical, cultural and chemical controls of the numerous pests that may attack a golf course. The goal of the IPM program is to produce a high-quality turf which can sustain the use for which it is intended and prevent environmental degradation.

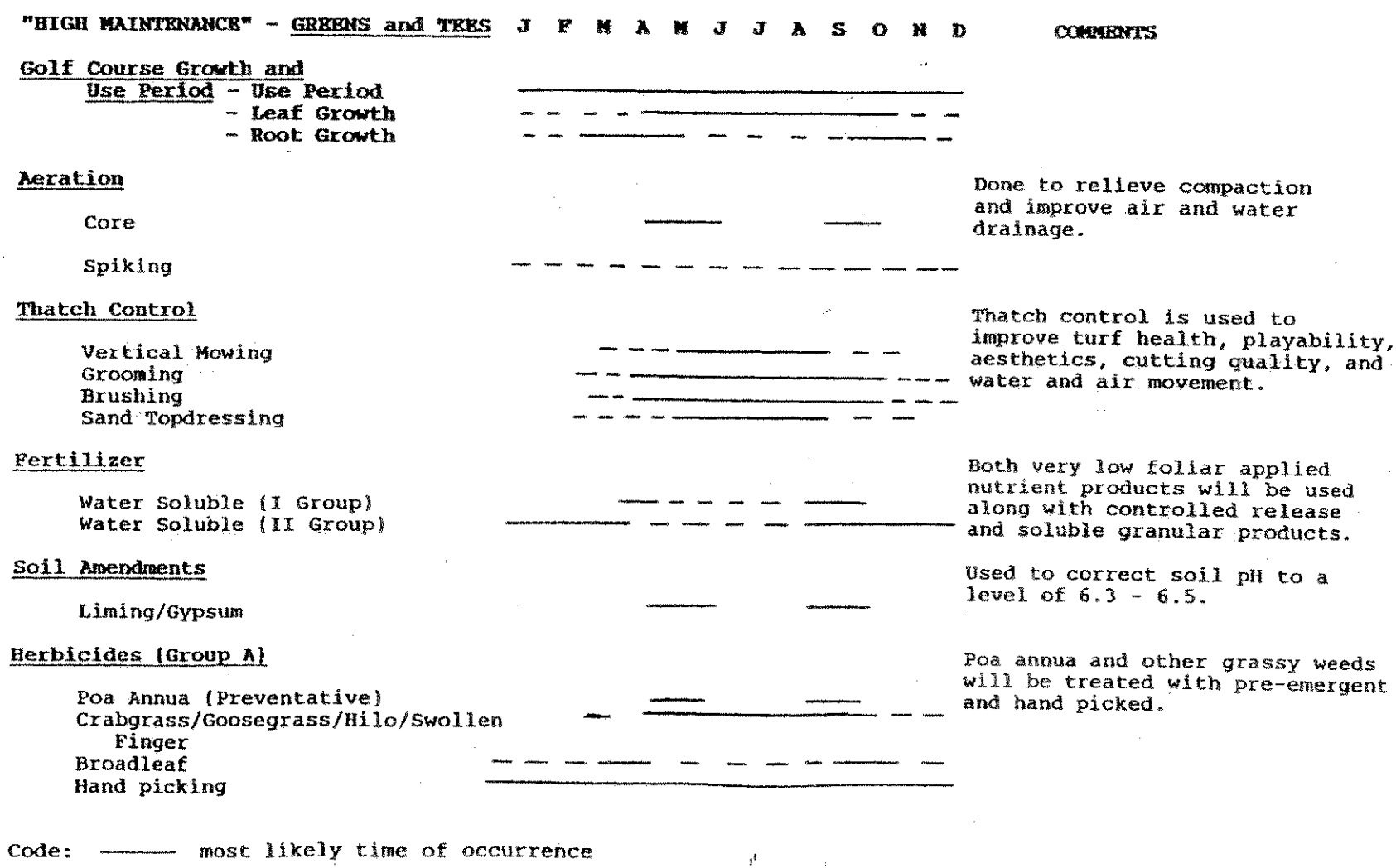
The implementation of an IPM program free of chemical use is constrained by the high demands placed on golf turf (Foy 1988). "The grounds manager has to decide how much insect damage is acceptable, says Dr. Warren Johnson, professor of entomology at Cornell University in Ithaca, New York. If he wants 95 percent control, he needs to understand that pesticide applications will be necessary. Integrated pest management (IPM) programs, those which rely heavily on monitoring and biological controls, will not provide that degree of control" (Sports Turf, May 1988). Ultimately, the implementation of an IPM program requires that all methods of control be available to the manager, and that appropriate controls be selected for the combined circumstances that have caused the specific problem. Maintaining healthy turf by the prudent use of fertilizer, pesticides and cultural practices will prevent environmental degradation (Harrison, 1989).

The IPM program will function by reducing the potential occurrence of pests by the modification of the turfgrass environment. This opportunity to provide a negative environment for pests is provided by the proposed comprehensive construction program of the golf course. Following the construction of the golf course, other negative pest simulations will take place by the institution of specific cultural or mechanical practices.

TABLE 5

IPM IMPLEMENTATION SCHEDULES FOR MANELE GOLF COURSE

LEVEL OF MANAGEMENT:



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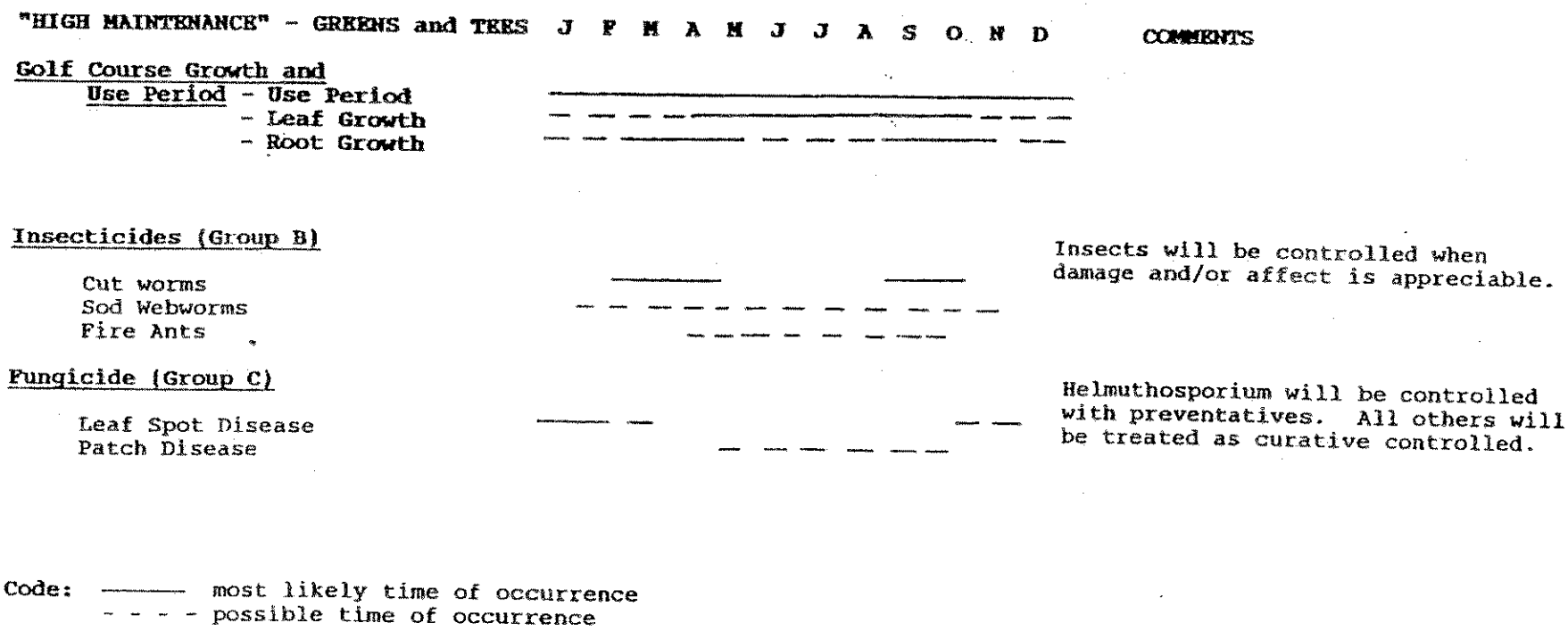
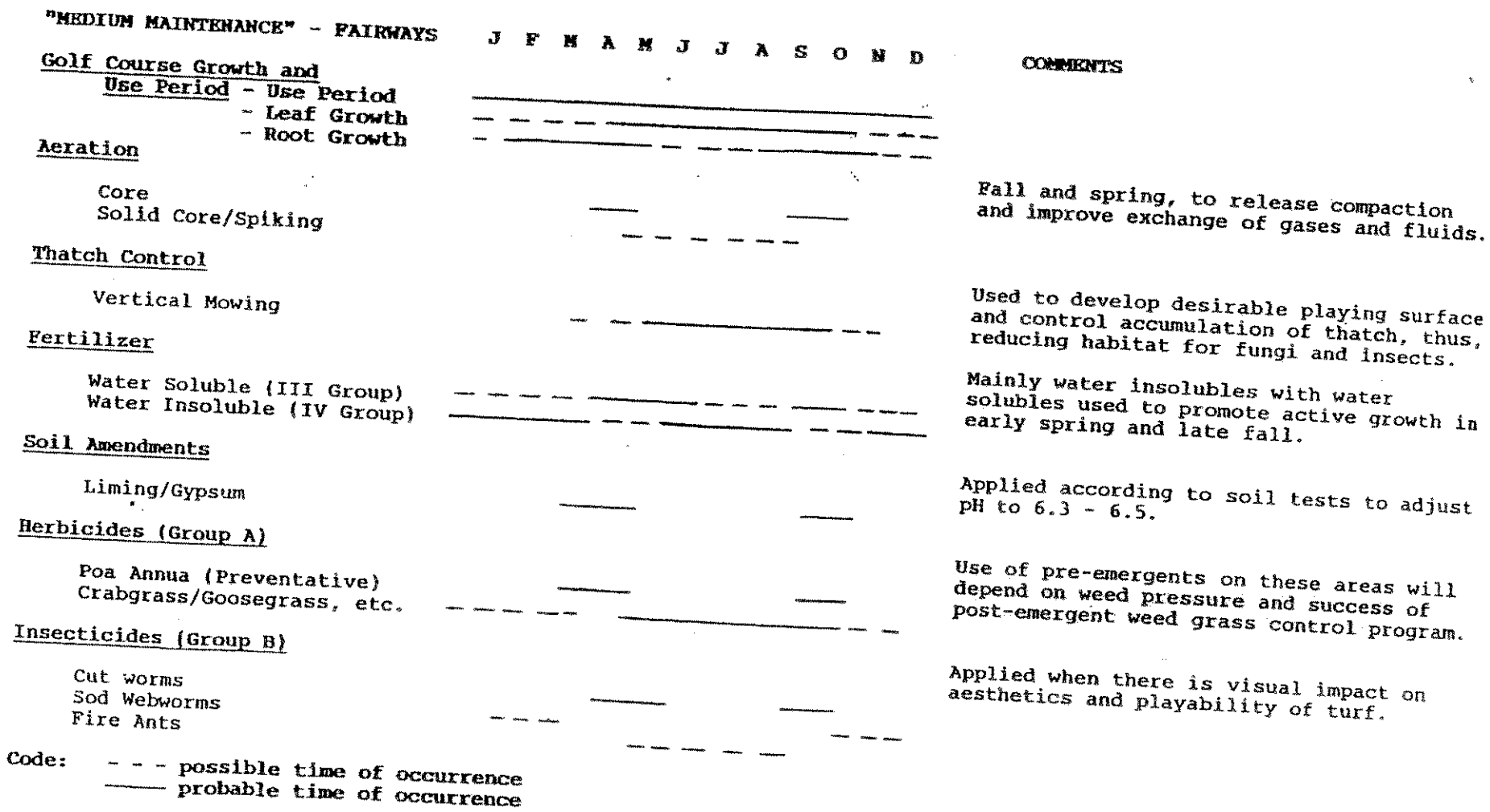
LEVEL OF MANAGEMENT (CONT'D):

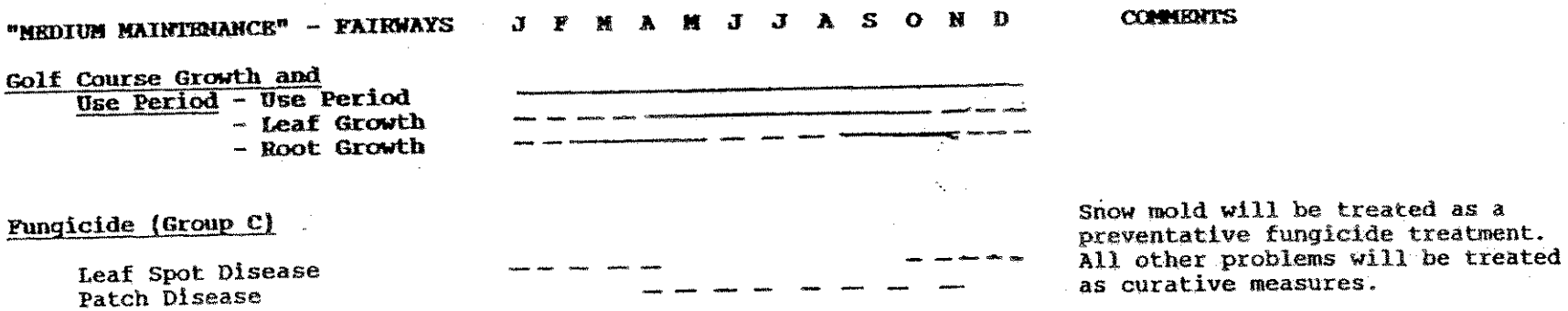


Code: ——— most likely time of occurrence
- - - - possible time of occurrence

LEVEL MANAGEMENT:



LEVEL MANAGEMENT (CONT'D):



Code: - - - possible time of occurrence
_____ probable time of occurrence

LEVEL OF MANAGEMENT:

"LOW MAINTENANCE" - ROUGHS	J	F	M	A	M	J	J	A	S	O	N	D	COMMENTS
Golf Course Growth and Use Period - Use Period	———	———	———	———	———	———	———	———	———	———	———	———	
- Leaf Growth	- - -	- - -	- - -	- - -	———	———	———	———	———	———	- - -	- - -	
- Root Growth	- -	- -	———	———	———	- - -	- - -	———	———	———	- -	- -	
Aeration													Fall to help relieve compaction and make better spring recovery.
Core			———						———				
Fertilizer													1 lb. Nitrogen for each application gives resistence to weeds, insects and other diseases.
Water Soluble (IV Group)	- - -	- - -	———	———	- - -	- - -	- - -	———	———	- - -	- - -	- - -	
Soil Amendments													To correct pH to 6.3 - 6.5.
Liming/Gypsum									———				
Herbicides (Group A)													Hand pick broadleafs.
Grassy Weeds	- - -	- - -	- - -	- - -	- - -	———	———	———	———	———	- - -	- - -	
Insecticides (Group B)													Only treated in safe areas and as curative under extreme conditions.
Sod Webworms		- - -	- - -	- - -							- - -		
Cutworms				- - -	- - -					- - -			
Fungicide (Group C)													Only treated in safe areas and as curative under extreme conditions of damage.
Leaf Spot Disease		- - -	- - -	- - -						- - -	- - -	- - -	
Patch Disease				- - -	- - -	- - -	- - -	- - -	- - -				

Code: - - - - - possible time of occurrance
——— probable time of occurrance

TABLE 6

FERTILIZER ANNUAL USAGE

I. Group

Water Solubles[1]		Single Application Rates	Maximum Yearly Application Rates
1. Gro Mores	27-9-18	.1-.2 lb/N/1000 sq. ft.	High Int. Areas 6-8 lbs/N/1000 sq. ft. total
2. Gro Mores	12-62-0	.1-.2 lb/N/1000 sq. ft.	
3. Gro Mores	20-5-30	.1-.2 lb/N/1000 sq. ft.	
4. Gro Mores	12-0-45	.1-.2 lb/N/1000 sq. ft.	
5. Area	45-0-0	.3-.75 lb/N/1000 sq. ft.	
6. Gro-Power	6-2-8	.3-.75 lb/N/1000 sq. ft.	

II. Group

1. Scotts	22-0-16	.5-.75 lb/N/1000 sq. ft.	High Int. Areas 4-6 lbs/N/1000 sq. ft. total
2. Scotts	19-26-5	.5-.75 lb/N/1000 sq. ft	
3. Scotts	15-0-30	.5-.75 lb/N/1000 sq. ft.	
4. STEP (true elements)[2]		.5-.75 lb/N/1000 sq. ft.	
5. Par Ex	31-0-0	.5-.75 lb/N/1000 sq. ft.	
6. Par Ex	21-3-16	.5-.75 lb/N/1000 sq. ft.	
7. Par Ex	12-3-34	.5-.75 lb/N/1000 sq. ft.	

Total of combined products will be 10-12[3] lb/N/1000 sq. ft.. In high maintenance area

III. Group

1. Area	45-0-0	.50-1.0 lb/N/1000 sq. ft.	Med. Int. Area Total 4-6 lbs/N/1000 sq. ft. Low Int. Areas 3-4 lbs/N/1000 sq. ft.
2. Calcium Nitrate	15-0-0	.50-1.0 lb/N/1000 sq. ft	
3. Ammonium Nitrate	34-0-0	.50-1.0 lb/N/1000 sq. ft.	
4. 21-7-14 Turf Royal		.50-1.0 lb/N/1000 sq. ft.	
5. 16-6-8 Best		.50-1.0 lb/N/1000 sq. ft.	
6. Ammonium Sulfate	21-0-0	.50-1.0 lb/N/1000 sq. ft.	

IV. Group

Water Insolubles			Single Application Rates	Maximum Yearly Application Rate
1.	31-0-0	Par Ex	.75-2.0 lb/N/1000 sq. ft.	Med. Int. Area 6-8 lbs/N/1000 sq. ft. Total Low Int. Area 4-6 lbs/N/1000 sq. ft.
2.	24-4-12	Par Ex	.75-2.0 lb/N/1000 sq. ft.	
3.	10-18-22	Par Ex	.75-2.0 lb/N/1000 sq. ft.	
4.	28-3-8	Par Ex	.75-2.0 lb/N/1000 sq. ft.	
5.	32-3-10	Scotts	.75-2.0 lb/N/1000 sq. ft.	
6.	22-0-22	Scotts	.75-2.0 lb/N/1000 sq. ft.	

Total N/1000 sq. ft. On:

Medium Intensity - - 8-10 lbs/N/1000 sq. ft.

Low Intensity - - - 6-8 lbs/N/1000 sq. ft.

[1]Formulations will be selected in accordance to field inspection and soil and tissue testing.

[2]Trace elements will be added according to soil tests.

[3]Tees typically use 20-30% more "N" than do greens.

TABLE 7

PESTICIDE ANNUAL USAGE APPLICATIONS

Group A	Estimated # of Applications for the golf areas of Maintenance		
Herbicides	Low	Med	High
Roundup	Spot Treat		
MSMA	2	4	0
Sencor	2	4	0
Ronstar G	2	2	0
Image	2	2	1
Betasan 7-G	0	2	2
Group B			
Insecticides			
Pyrethrins	2	2	2
Dursban	2	2	2
Oftanol	0	1	1
Group C			
Fungicides			
Daconil 2787	0	1	2
Chipco 26019	0	0	2

TABLE 8

ENVIRONMENTAL FATE OF VARIOUS MATERIALS AS PREDICTED BY LEACHM

	Label Rate (A.I.)	mg/m² Equiv. (A.I.)	# Appl. in 5 Yrs.	Total Applied (mg/m²)	Amount Leached (mg/m²)	% Leached	Amount Still in Profile (mg/m²)	% Still in Profile
FAIRWAY								
MSMA	4lbs/Acre	448	20	8960	760.7	8.5	6917	77
Ronstar G	4lbs/Acre	448	10	4480	0	0	238	5.3
Dursban	4lbs/Acre	448	10	4480	0	0	60	1.3
Roundup	65.6oz/Acre	460	20	9200	0	0	320	3.4
Image	1 oz/1000sf	52	20	1040	80.5	7.7	120	11.5
Sencor	2lbs/Acre	224	20	4480	549.8	12.3	1152	25.7
Daconil	180g/100m²	1800	10	18000	59.0	0.3	807	4.4
USGA PUTTING GREEN								
Ronstar G	4lbs/Acre	448	10	4480	0	0	245	5.5
Dursban	4lbs/Acre	448	10	4480	0	0	61	1.3
Roundup	65.6oz/Acre	460	20	9200	0	0	321	3.4
Image	1 oz/1000sf	52	20	1040	20.3	1.9	2	0.2
Daconil	180g/100m²	1800	10	18000	0	0	189	1.0

MATERIAL SAFETY DATA SHEET

MOBAY CHEMICAL CORPORATION
AGRICULTURAL CHEMICALS DIVISION
P.O. Box 4913, Hawthorn Road
Kansas City, Missouri 64120

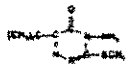
ISSUE DATE 07/01/85
SUPERSEDES 12/01/80

TRANSPORTATION EMERGENCY: CALL CHEMTREC
TELEPHONE NO: 800-424-9300 DISTRICT OF COLUMBIA: 202-483-7616

MOBAY NON-TRANSPORTATION EMERGENCY NO.
(816) 242-2582

I. PRODUCT IDENTIFICATION

PRODUCT NAME.....: SENCOR Technical
PRODUCT CODE NUMBER.....: Formula No. 014170
CHEMICAL FAMILY.....: Triazinone herbicide
CHEMICAL NAME.....: 4-Amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one
SYNONYMS.....: Metribuzin, Lexone
CAS NUMBER.....: 21087-64-9
T.S.C.A. STATUS.....: Registered under FIFRA
STRUCTURE.....:



II. HAZARDOUS INGREDIENTS

COMPONENTS:	%:	CURRENT TLV:
SENCOR	90	5 mg/m³

III. PHYSICAL DATA

APPEARANCE.....: Solid
COLOR.....: White
ODOR.....: Slight musty
MOLECULAR WEIGHT.....: 214.3
MELT POINT.....: 125.5-126.5°C
BOILING POINT.....: NA
VAPOR PRESSURE.....: NA
VAPOR DENSITY (AIR=1).....: NA
SPECIFIC GRAVITY.....: 1.31 @ 20°C
BULK DENSITY.....: 33 lbs./cu. ft.
SOLUBILITY IN WATER.....: 980 ppm @ 20°C
% VOLATILE BY VOLUME.....: NA

IV. FIRE & EXPLOSION DATA

FLASH POINT °F(°C).....: NA

FLAMMABLE LIMITS -
Lel.....: NA
Uel.....: NA
EXTINGUISHING MEDIA.....: Water spray

SPECIAL FIRE FIGHTING PROCEDURES/UNUSUAL FIRE OR EXPLOSION HAZARDS:
Keep out of smoke, cool exposed containers with water spray. Fight fire from upwind position. Use self-contained breathing apparatus. Contain run-off by diking to prevent entry into sewers or waterways. Equipment or materials involved in pesticide fires may become contaminated.

V. HEALTH EFFECTS DATA

ANIMAL TOXICITY -
ORAL, LD50
(INGESTION).....: Male Rat 1,090 mg/kg; Female Rat 1,200 mg/kg
DERMAL, LD50
(SKIN CONTACT).....: Rabbit greater than 20,000 mg/kg
INHALATION, LC50.....: Rat greater than 20 mg/l/hr. (nominal value/DOT)

FISH, LC50.(96 hr.).....: Bluegill 80 ppm
Rainbow Trout 64 ppm
EYE EFFECTS.....: Slight irritation
SKIN EFFECTS.....: Not Irritating

HUMAN EFFECTS
OF OVEREXPOSURE.....: No definite symptoms. Poisoning sometimes accompanied by sedation and breathing difficulties.

EXPOSURE GUIDELINES:.....: ACGIH-TLV 5 mg/m³ for SENCOR

VI. EMERGENCY & FIRST AID PROCEDURES

IN CASE OF POISONING.....: Call a physician or poison control center
EYE CONTACT.....: Flush with water for at least 15 minutes. Get medical attention.
SKIN CONTACT.....: Wash skin immediately with soap and water. If irritation occurs, get medical attention.
INHALATION.....: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. Get medical attention.
INGESTION.....: Administer water freely and induce vomiting by by giving one dose (½ oz. or 15 ml) of syrup of ipecac. If vomiting does not occur within 10-20 minutes, administer second dose. If syrup of ipecac is not available, induce vomiting by sticking finger down throat. Repeat until vomit fluid is clear. Never give anything by mouth to an unconscious person. Get medical attention immediately.

EYE PROTECTION.....	Safety glasses
SKIN PROTECTION.....	Latex or neoprene gloves; rubber boots & apron
RESPIRATORY PROTECTION...:	Wear a respirator jointly approved by the Mining Enforcement & Safety Administration (formerly U.S. Bureau of Mines) and by the National Institute for Occupational Safety & Health under the provisions of 30 CFR Part 11. In Canada, obtain this information from your dealer.
VENTILATION.....	Maintain exposure levels below exposure limits through use of general and local exhaust ventilation.
OTHER.....	Launder clothing daily after use. Wash thoroughly after handling.

VIII. REACTIVITY DATA

STABILITY.....	Stable
POLYMERIZATION.....	Will not occur.
CONDITIONS TO AVOID.....	Sustained temperatures above 100°F.
INCOMPATIBILITY (MATERIALS TO AVOID)...:	Highly alkaline conditions for extended periods of time
HAZARDOUS DECOMPOSITION PRODUCTS.....	CO_2, SO_2, methyl mercaptan, amines

IX. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Avoid breathing dusts. Contain spilled material through use of plastic film covering. Sweep up spilled material and place in covered container. Scrub contaminated area with alcohol and caustic solution. Repeat and rinse with water. Do not allow dust to drift onto vegetation.

WASTE DISPOSAL METHOD: Bury in EPA-approved landfill or burn in an incinerator approved for pesticide destruction.

XI. SHIPPING DATA

D.O.T. SHIPPING NAME.....:	NA
TECHNICAL SHIPPING NAME..:	Metribuzin
D.O.T. HAZARD CLASSIFICATION.....:	NA
UN/NA NO.....:	NA
REPORTABLE QUANTITY.....:	NA
D.O.T. LABELS REQUIRED...:	None
D.O.T. PLACARDS.....:	None
FRT. CLASS BULK.....:	Compounds, Tree or Weed Killing, O/T Liquid
FRT. CLASS PKG.....:	Compounds, Tree or Weed Killing, O/T Liquid

XII. DOCUMENTATION

REASON FOR ISSUE.....:	Revise to new format
APPROVED BY.....:	William J. Brinkman
TITLE.....:	Industrial Hygiene Manager
DATE APPROVED.....:	July 1, 1985

MATERIAL SAFETY DATA SHEET

RHONE-POULENC AG COMPANY
P.O. Box 12014, T.W. Alexander Drive, Research Triangle Park, NC 27709
24-HOUR EMERGENCY TELEPHONE 1-800-334-7577 OR CHEMTREC 1-800-424-9300

Effective Date: NOV 7, 1988 Date Printed: NOV 11, 1988

PRODUCT CODES: H86750, 58079680ZLB

EPA Registration Number: 264-445 Page: 1

PRODUCT NAME: CHIPCO(R) RONSTAR(R) BRAND G HERBICIDE

I. IDENTIFICATION

CHEMICAL NAME: 2-tert-butyl-4-(2,4-dichloro-5-isopropylphenyl)-Δ2-1,3,4-oxadizolin-5-one

FORMULA: C15H18Cl2N2O3 MOLECULAR WEIGHT: 345.2

SYNONYMS: Oxadiazon, RP 17623

CAS # & NAME: 19666-30-9 1,3,4-Oxadiazol-2(3H)-one, 3-(2,4-dichloro-5-(1-methylethoxy)phenyl)-5-(1,1-dimethylethyl)-

IMPORTANT HEALTH EFFECT INFORMATION

WARNING

HARMFUL IF SWALLOWED.

Oxadiazon has been classified by EPA as a Class C oncogen.

See Section IV for complete Health Hazard Data.

NATIONAL FIRE PROTECTION ASSOCIATION RATING (Recommended by Rhone-Poulenc Ag Company)

KEY	Health
	2
4=Extreme	Fire
3=High	1
2=Moderate	Reactivity
1=Slight	1
0=Minimum	

SARA TITLE III HAZARD CLASSIFICATION

Immediate (acute) Health	YES
Delayed (chronic) Health	YES
Fire	NO
Sudden Release of Pressure	NO
Reactive	NO

(continued on page 2)

II. HAZARDOUS INGREDIENTS

MATERIAL	WEIGHT %
(1) Oxadiazon	2.0
(2) Petroleum distillates (Trade Secret)	
(3) Other ingredients (Trade Secret)	

EXPOSURE LIMITS:
Petroleum distillates: 100 ppm for an 8 hour workday (recommended by supplier)
Ingredient is a nuisance dust which may contain 3% quartz. Based on this quartz content, the resulting exposure limits for this ingredient are:
2 mg/cubic meter air, respirable dust (OSHA)
6 mg/cubic meter air, total dust (OSHA)

III. PHYSICAL DATA

BULK DENSITY:	37 Lbs/ cubic foot
BOILING POINT, 760 mm Hg, Degrees C (F):	Not applicable
MELTING POINT, Degrees C (F):	Not known
FREEZING POINT, Degrees C (F):	Not applicable
VAPOR PRESSURE, Degrees C:	Not known
VAPOR DENSITY (air=1):	Not known
pH:	Not applicable
SOLUBILITY IN WATER, @ Degrees C:	Product is insoluble.
@ 20 Degrees C:	0.0007g/L for oxadiazon
APPEARANCE AND ODOR:	Gray to white flowable solid; slight odor.

IV. HEALTH HAZARD DATA

TOXICOLOGY DATA:
Oral LD50 (rats): > 5,000 mg/kg body weight
Dermal LD50 (rabbits): > 2,000 mg/kg body weight
Inhalation LC50 (rats - 4 Hour Exposure): > 200 mg/L (nominal conc.)
Skin Effects (rabbits): Moderate irritant
Eye Effects (rabbits): Mild-transient irritant

CARCINOGENICITY, TERATOGENICITY, MUTAGENICITY:
Oxadiazon has been shown to cause liver tumors at doses that are hepatotoxic. This compound is not genotoxic, not a reproductive toxicant and not a teratogen.

(continued on page 3)

IV. HEALTH HAZARD DATA (continued)

EFFECTS OF SINGLE OVEREXPOSURE:

Swallowing:
Harmful if swallowed. (See TOXICOLOGY DATA)
Note: This product contains petroleum distillates as a part of the granule. It does not constitute a petroleum distillate inhalation hazard if product is swallowed and then vomited.

Skin Absorption:
No evidence of adverse effects from available information.

Inhalation:
Harmful if inhaled.
May be irritating to the respiratory tract.

Skin Irritation:
Causes skin irritation, seen as marked redness and swelling. (See TOXICOLOGY DATA)

Eye Contact:
Causes temporary eye irritation, seen as tearing and redness. Irriation will be alleviated by rapidly washing eyes.

EFFECTS OF REPEATED OVEREXPOSURE:
Repeated inhalation of excessive concentrations of this dust may lead to a benign lung condition called siderosis.

OTHER EFFECTS OF OVEREXPOSURE:
No evidence of adverse effects from available information.

EXISTING MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Skin irritation may be aggravated in persons with existing skin lesions.
Breathing of dust may aggravate acute or chronic asthma and chronic pulmonary disease such as emphysema or bronchitis.

(continued on page 4)

IV. HEALTH HAZARD DATA (continued)

EMERGENCY AND FIRST AID PROCEDURES:

Remove the patient from immediate source of exposure and assure that the individual is breathing. If not breathing, use cardio-pulmonary resuscitation or artificial respiration. GET MEDICAL ATTENTION.

Swallowing:
If patient is conscious and alert, give 2-3 glasses of water or milk to drink. Give one tablespoon of Syrup of Ipecac to induce vomiting. If vomiting has not occurred in 20 minutes, the same dose of Syrup of Ipecac may be repeated one additional time. Alternatively, induce vomiting by touching back of throat with finger. Do not make an unconscious person vomit. GET MEDICAL ATTENTION.

Skin:
Immediately wash skin with plenty of soap and water, while removing contaminated clothing and shoes. Wash clothing separately before reuse.

Inhalation:
Remove victim to fresh air. If not breathing, administer cardio-pulmonary resuscitation or artificial respiration. If breathing is difficult, administer oxygen. GET MEDICAL ATTENTION.

Eyes:
Hold eyelids open and flush with a steady, gentle stream of water for at least 15 minutes. GET MEDICAL ATTENTION.

NOTES TO PHYSICIAN:

No specific antidote is available.

Treat symptomatically. Consideration should be given to the possibility that overexposure to materials other than this product may have occurred.

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V. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT Degrees C (F): Noncombustible

EXPLOSIVE LIMITS IN AIR (ounces/cubic foot):
Lower: Not applicable
Upper: Not applicable

AUTOIGNITION TEMPERATURE Degrees C (F): Not applicable

EXTINGUISHING MEDIA: Not combustible. Use appropriate extinguishing media for material that is supplying fuel.

SPECIAL FIRE FIGHTING PROCEDURES: Wear protective clothing and use self-contained breathing apparatus. Dike area to prevent runoff and contamination of water sources.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
Thermal decomposition products may be hazardous. These may include hydrogen chloride, aldehydes, and the oxides of carbon and nitrogen.

VI. REACTIVITY DATA

STABILITY:
Stable

CONDITIONS TO AVOID:
None known

MATERIALS TO AVOID:
Mineral acids, strong bases, oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS:
Decomposition products may be hazardous. These may include hydrogen chloride, aldehydes, and the oxides of carbon and nitrogen.

HAZARDOUS POLYMERIZATION:
Will not occur.

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MATERIAL SAFETY DATA SHEET

RHONE-POULENC AG COMPANY
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VII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
To the extent possible, clean up spillage using shovels. Carefully scoop up loose material and place it in appropriate containers so as to avoid dust generation. Stand upwind if possible.
Residual spillage that cannot be removed by shovelling should be cleaned from hard surfaces as appropriate.
If spilled on the ground, the affected area should be scraped clean and the material placed in an appropriate container for disposal.
Do not flush material to public sewer systems or any waterways.
Wear appropriate protective clothing and equipment (see below) during cleanup activities.
Ensure adequate decontamination of tools and equipment following cleanup.

WASTE DISPOSAL METHOD:
Dispose of in accordance with local, state and federal regulations.

VIII. SPECIAL PROTECTION INFORMATION

PROTECTIVE EQUIPMENT SHOULD BE USED DURING THE FOLLOWING PROCEDURES:
- Manufacture or formulation of this product
- Repair and maintenance of contaminated equipment
- Clean-up of leaks and spills

RESPIRATORY PROTECTION: Use NIOSH/MSHA approved respirator for pesticide dust when handling spills or leaks, or when airborne concentrations exceed allowable exposure limits.

VENTILATION: Local exhaust ventilation as required to maintain dust concentration below allowable exposure limits.

PROTECTIVE GLOVES: Chemical-resistant gloves.

EYE PROTECTION: Goggles, eye bath.

OTHER PROTECTIVE EQUIPMENT: Protective clothing, safety shower.

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MATERIAL SAFETY DATA SHEET

RHONE-POULENC AG COMPANY
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Effective Date: NOV 7, 1988 Date Printed: NOV 11, 1988
Page: 7

PRODUCT NAME: CHIPCO(R) RONSTAR(R) BRAND G HERBICIDE

IX. SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:

Do not ingest. Avoid exposure by inhalation. Avoid getting in eyes, on skin or on clothing.

Do not store near food, feedstuffs, fertilizers, or seed.
Do not contaminate water, food, or feed by storage or disposal.

X. REGULATORY STATUS

EPA Registration No.:	264-445
RCRA Hazardous Waste:	Not applicable
SARA Title III	
Section 302 Extremely Hazardous Substances List:	Not listed
Section 313 Toxic Chemicals:	Not listed
Reportable Quantity (RQ), under, U.S. EPA CERCLA:	Not applicable

The information herein is given in good faith but no warranty, expressed or implied, is made.

CHIPCO is a registered trademark of Rhone-Poulenc.
RONSTAR is a registered trademark of Rhone-Poulenc for oxadiazon herbicide.

A in margin indicates additional information since last revision.
R in margin indicates a revision.

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MATERIAL SAFETY DATA SHEET

PERMENTA ASC CORPORATION
9966 Hamley Road, P.O. Box 8000
Mentor, Ohio 44061-8000

General Information No. 216 / 357-4100
Emergency Telephone No. 216 / 357-7070

May 2, 1989

DCPA TECHNICAL

GENERAL INFORMATION

1 Slight Health Hazard 0 Noncombustible 0 Nonreactive

Ratings based upon NIOSH "Identification System for Occupationally Hazardous Materials" (1974)

TRANSPORTATION INFORMATION

This product is regulated for transportation purposes as follows:

	Yes	No
IATA (air)		X
IMO (water)		X
DOT (land)		X

Contact the Transportation Department at (216) 357-4138 for any additional information.

SARA TITLE III INFORMATION

313 Inventory Ingredients: HCB, as Benzene, hexachloro*
312 Hazards Classification: chronic health (HCB)*

* HCB may be present in this product as an impurity, at a maximum level of 0.3% with the average level being less than 0.1%.

I PRODUCT IDENTIFICATION

Product Name: DCPA TECHNICAL
Synonyms: Dimethyl tetrachloroterephthalate, DCPA, DAC-893, Chlorthal dimethyl, Dacthal

II HAZARDOUS INGREDIENTS

The substances listed below are those identified as hazardous chemicals under the criteria of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

COMPONENT	CAS No.
Dimethyl tetrachloroterephthalate	1861-32-1
Hexachlorobenzene (HCB)*	118-74-1

*HCB may be present as a manufacturing impurity.

Exposure Limits for DCPA TECHNICAL:
ACGIH-TLV: Not Established
OSHA-PEL: Not Established

Exposure Limits for HCB:
ACGIH-TLV: Not Established
OSHA-PEL: Not Established

III PHYSICAL DATA

Boiling Point, 760 mm Hg: Not Determined
Melting Point Range: 153 to 162°C
Freezing Point: Not Applicable
Specific Gravity (H_2O=1): 1.6
Vapor Pressure: 1.8 to 2.5 x 10^{-4} torr @ 25°C
Vapor Density (Air=1): Not Applicable
Solubility in H_2O, % by Wt.:
Active Ingredient: 0.2 to 0.5 ppm
% Volatiles by Vol.: Less than 0.1%
Evaporation Rate (Butyl Acetate=1): Not Applicable
Appearance and Odor: Fine off-white powder (after grinding) or light yellow-orange flake; slightly aromatic
Bulk Density at 20°C / (lbs/ cu ft): 46.7
pH: 5.0 - 5.5 at 25°C

IV FIRE AND EXPLOSION DATA

Flash Point: Not Applicable
Autoignition Temperature: Not Applicable
Flammable Limits in Air, % by Vol.: Noncombustible
Lower: Not Determined
Upper: Not Determined
Extinguishing Media: Carbon dioxide, dry chemicals or water spray.
Special Fire Fighting Procedures: Wear personal protective clothing and self-contained breathing apparatus.
Unusual Fire and Explosion Hazards: Under fire conditions, the product may decompose to liberate hydrogen chloride gas which is an irritant of the respiratory tract.

V HEALTH HAZARD INFORMATION

Health Hazard Data
Acute Oral LD_{50}: Greater than 12.5 g/kg (rat);
Greater than 10.0 g/kg (dog)

All information contained in this Material Safety Data Sheet is furnished free of charge and is intended for your convenience, at your request. The information in this Material Safety Data Sheet is believed to be correct; however, it is your responsibility to determine the suitability of the information for your use. You are advised not to construe the information as absolutely complete since additional information may be necessary or desirable when necessary, consequences or variations exist or because of additional laws or governmental requirements. Therefore, you should use the information only as a supplement to other information gathered by you and you must make independent determinations of the suitability and completeness of the information from all sources to assure that anyone who uses your material purchased hereon does so safely and legally. Accordingly, we assume no responsibility and disclaim all liability for the results of the use of the information set forth herein.

Acute Dermal LD_{50}: Greater than 2 g/kg (rabbit)
Inhalation (4-hour) LC_{50}: It was not possible to aerosolize significant concentrations of respirable particles of this product to test on animals. A similar product, 90% Dimethyl-T yielded a 4 hr LC_{50} greater than 20.7 mg/L (nominal; rat).
Primary Dermal Irritation Index: 1.0/8.0 (rabbit); mild irritant; no edema or other dermal findings were observed.
Dermal Sensitization (Guinea Pig): Exhibited no potential to produce sensitization.
Primary Eye Irritation Index: Maximum mean Draize score = 8.0/110 at 1 hr (rabbit); slight corneal epithelial effects in 2 of 6 animals during exam with fluorescein at 72 hrs., no other corneal effects were observed at anytime; mild conjunctival irritation; no iridal or other ocular effects were observed.

Effects of Exposure
Inhalation: May cause slight irritation to the respiratory passages.
Skin Contact: Little or no irritation expected.
Skin Absorption: Little absorption expected.
Eye Contact: Slightly irritating. Minimal reversible corneal effects may occur.
Ingestion: No significant hazard.

Effects of Chronic Overexposure
Human experience in production of the technical material has revealed no adverse effects. HCB, which may be present in this product at less than 0.3 % as an impurity, is listed as a chemical which may reasonably be anticipated to be a carcinogen by NTP based on sufficient evidence for carcinogenicity in experimental animals (The Fourth Annual Report on Carcinogens, list 2).

Emergency and First Aid Procedures
Eyes: IMMEDIATELY flush eyes with plenty of water for at least 15 minutes, holding eyelids apart to ensure flushing of the entire eye surface. Seek medical attention immediately if irritation persists.
Skin: Wash exposed areas with soap and water.
Inhalation: Avoid inhaling dust. If symptoms develop, get person out of contaminated area to fresh air.
Ingestion: If swallowed, do not induce vomiting. If vomiting occurs spontaneously, keep airways clear. NEVER give anything by mouth to an unconscious person. Seek medical attention immediately.

Notes to Physician
None.

VI REACTIVITY DATA

Conditions Contributing to Instability: Under normal use conditions, this product is stable.
Incompatibility: Avoid contact with heat or open flame.
Hazardous Decomposition Products: May decompose under fire conditions to release hydrogen chloride gas which is an irritant of the respiratory tract.
Conditions Contributing to Hazardous Polymerization: None observed.

VII SPILL OR LEAK PROCEDURES

Steps to be Taken if Material is Released or Spilled: Stop leaks. Contain spill. Remove as much as possible, including contaminated soil. Shovel up and sweep up, place in closed, labeled container in a safe place out of doors to await proper disposal.
Neutralizing Chemicals: None required.
Waste Disposal Method: Re-use spilled material if possible, otherwise, dispose in accordance with all Federal, State and local health and pollution regulations. Dispose via approved incinerator or a licensed chemical waste hauler to a landfill approved for pesticides.

VIII INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation Requirements: Use in a well ventilated area. In industrial environments, the work area should be isolated and provided with adequate local exhaust ventilation.
Specific Personal Protective Equipment
Respiratory: Use a NIOSH approved respirator for dust.
Eye: Use chemical goggles.
Gloves: Chemical resistant gloves to minimize skin contact.
Other Clothing and Equipment: Good industrial hygiene practices dictate that standard work clothing, consisting of long sleeve shirt and long pants, be worn when handling pesticides. Clothing should be changed at least daily and laundered before rewearing.

IX SPECIAL PRECAUTIONS

Environmental Hazards
Do not apply directly to water. Do not contaminate water by cleaning of equipment or disposal of wastes. Do not discharge into lakes, streams, ponds, or public waters unless in accordance with an NPDES permit. For guidance, contact your Regional Office of the EPA.
Storage and Disposal
Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited.
Storage: Store in a dry place.
Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.
Container Disposal: Completely empty bag into formulating equipment and dispose of empty bag in a sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

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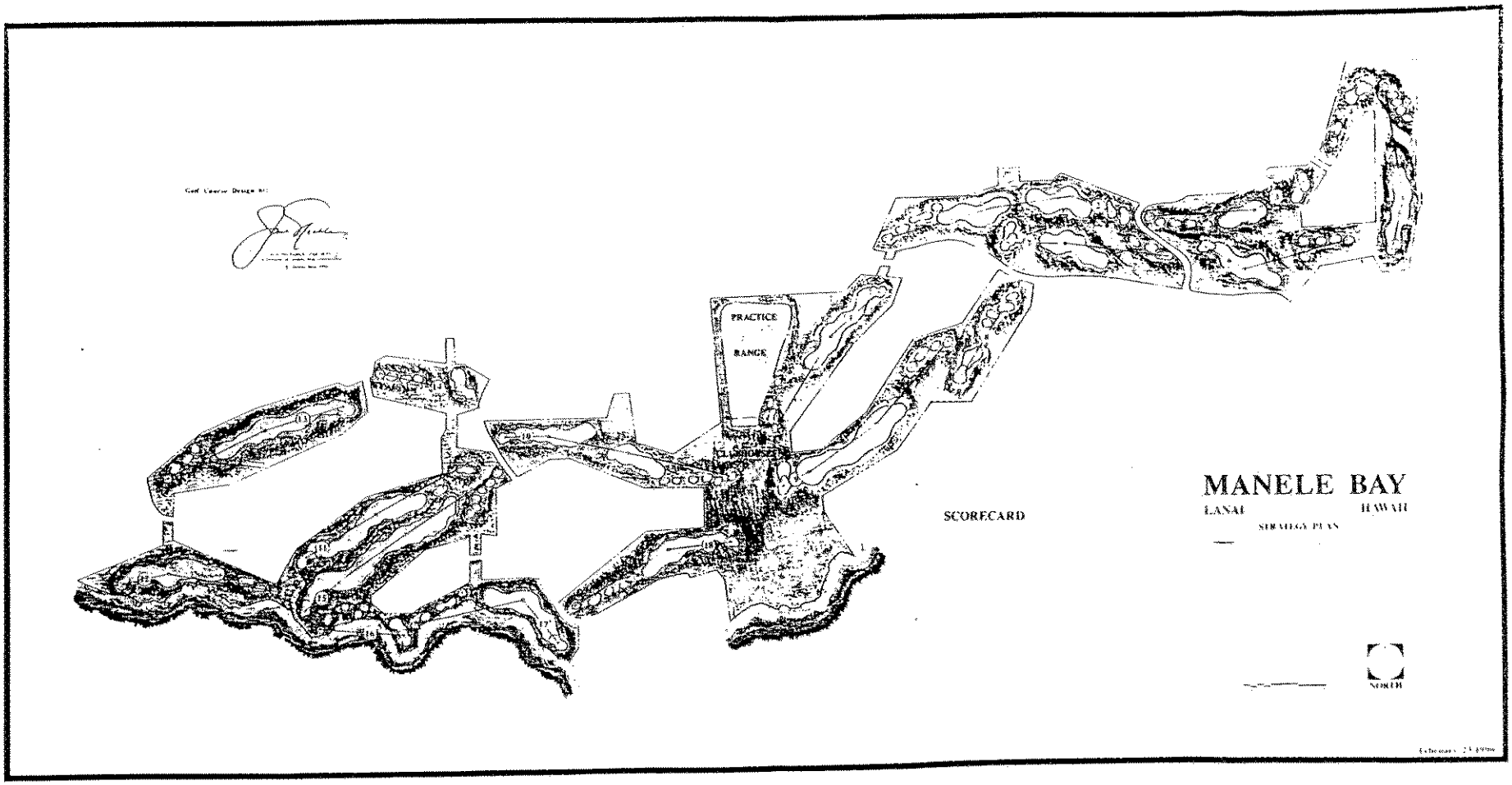

PETITIONER'S EXHIBIT NO. 35

AN ASSESSMENT OF THE USES OF FERTILIZERS AND BIOCIDES

SUPPLEMENT TO ENVIRONMENTAL ASSESSMENT MANELE GOLF COURSE AND RESIDENTIAL DEVELOPMENT LANAI, HAWAII

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PETITIONER'S EXHIBIT NO. 20

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INTRODUCTION

Additional information and analysis are presented herein to supplement the Environmental Assessment prepared for the Manele Golf Course at the request of reviewing agencies and organizations.

Fertilizers and biocides are within the scope of this supplement as used in the context of golf course operation and maintenance. In a broader sense, these chemicals have been used over decades in agriculture on a macroscale and in residential lawns and landscape on a microscale.

Except for the synthetic chemicals, fertilizer components are chemicals that occur naturally as part of the hydrologic cycle. As such, their pathways and movement in the environment have been researched extensively and certain generalizations can be made about their potential impact on groundwaters, and subsequently on the adjoining coastal waters.

With the advent of water reclamation projects with wastewater effluents, the addition of the same chemicals to the hydrogeologic process has received considerable attention by researchers around the world.

The conclusion is that nitrate nitrogen is freely mobile in percolating waters and that phosphorus compounds are not. Moreover, nitrogen is an essential nutrient in the coastal water ecosystem, but it can cause undesirable stresses on the system. The ecological response is fundamentally a concentration-time (or intensity-duration) phenomenon. For this case, the consideration is on the steady state condition, or analyzing the concentration expected for the duration of the project and on the regional scale.

WATER QUALITY MANAGEMENT

Water quality management process and procedures have been institutionalized by programs of the Department of Health, State of Hawaii. The State's Safe Drinking Water Act, HRS 340E, prohibits the construction of drinking water sources in areas subject to significant contamination. Moreover, the Department's Underground Injection Control Program prohibits the injection of wastewaters in groundwaters that could conceivably be developed for drinking water. Further developments in management of groundwater quality in the Department's program are the identification and control of critical groundwaters subject to any kind of contamination, especially from toxic and hazardous substances.

In the coastal zone, the Water Quality Standards are delineated according to flow-restricted embayments and to open coast regimes, which recognize the differences in the residence time scale of transport of pollutants in addition to their concentrations. Fundamentally, the standards are directed toward a concentration-time analysis as the basis for decisions on water quality management in the coastal zone.

Definite criteria have evolved over time to analyze the significance of potential factors which can impair water quality.

For the proposed Manele Golf Course, the coastline fronting the length of the course is for the most part in the open coast regime. Hulopoe Beach is in an embayment but not of an estuarine configuration. For one thing, residence time of potential pollutants is not a problem, based on experience with water quality sampling under similar fundamental conditions. Moreover, the mass emissions of these potential pollutants are small compared to experience elsewhere, for example, in the Pearl Harbor Basin. Concentrations in the coastal zone are a linear function of the mass emission rates of substances. Therefore, the analysis here focuses first on mass emissions to the coastal environment and then analyzing the concentrations probable from those emissions.

Groundwater quality for drinking water is not a consideration for the groundwaters underlying the golf course at Manele. No drinking water sources are planned. Groundwater here is too brackish and there is a question of its adequacy even for irrigation of turfgrass without treatment.

The drinking water standard for nitrate nitrogen is 10 mg/l. Nowhere in this State is a municipal water supply being threatened by high nitrate nitrogen concentrations despite heavy usage of fertilizer by agriculture and the occurrence of cesspools overlying groundwater aquifers. This is not to say that nitrate nitrogen contamination is insignificant. There are many localities on the mainland and in other parts of the world where nitrate nitrogen has become a problem in drinking water. The prevention of similar problems in our State is a credit to the institutional policies and programs on water quality management.

NITRATE NITROGEN EMISSIONS

Nitrogen emissions from the proposed Manele Golf Course are evaluated here as they relate to potential coastal water impacts. The rate of nitrate nitrogen applied as fertilizer is estimated from experience with golf courses maintenance,

and the magnitude of likely leaching from the surface layers is evaluated from experience with relevant situations elsewhere.

It should be noted that there is an ongoing baseline and monitoring program for the coastal waters off Manele to document the effects, if any, of the proposed overall resort activity. This work is being undertaken by Dr. Richard Brock under contract with Lanai Company.

Irrigation water rates and leaching potential.

The irrigation rate was estimated as an annual average based on pan evaporation. The design of the golf course is being completed, and refinements to the irrigation rates and maintenance provisions are being worked on. It is sufficient for the present purpose to base the requirement on the irrigated acreage anticipated (120 acres) at a rate equal to the estimated theoretical optimum evapotranspiration rate for turfgrass. (For this case 90 inches/year is assumed).

The actual water used may vary from this estimate based on the final design details and the choice of turfgrass. The estimate being derived here is considered to be the upper limit. Any refinement should decrease the irrigation requirement by building into the system irrigation efficiencies and by choosing a turfgrass that utilizes less water for its maintenance.

Experience with existing golf courses in climates and locations similar to the proposed Manele Golf Course provides the facts to corroborate the projections of potential impact at Manele.

Calculations. The calculated irrigation water rate and the probable variation of that rate are given in Table 1. The acreage analyzed is 120 acres. This may vary by 10% either way. Moreover, the evapotranspiration rates have been assumed to be 90 inches/year. Keahole on the Big Island has a higher rate at 100 inches/year, which is in the realm of variation worked into the sensitivity analysis.

Given the variation in the values of the parameters, the extreme values for irrigation may range from 0.81 mgd to 1.22 mgd, depending upon the choice of design options. It is emphasized that it is a choice. The philosophy of design as described in the initial assessment is what is called "target golf." The play is more difficult but it will use less water.

The irrigation efficiency is stated at 80%. Of the remainder, 15% is estimated to be evaporation from sprinkler

TABLE 1. CRITERIA FOR THE EVALUATION OF THE PROPOSED MANELE GOLF COURSE.

BASIC INFORMATION AND CRITERIA.

RAINFALL, INCHES/YEAR	15	
ACREAGE IRRIGATED	120	
IRRIGATION EFFICIENCY	0.8	
EVAPOTRANSPIRATION, ET	90	INCH/YR ASSUMED FOR MANELE

COMPARISON TO OTHER AREAS FOR ET.

LAHAINA	85	INCH/YEAR
KAILUA KONA	60	
KEKAHA	80	
EWA	90	

MANELE GOLF COURSE IRRIGATION ALTERNATIVE SCENARIOS

ACRES	ET IN/YR	ET IN/DAY	ET GPD/AC	IRR. EFF.	IRR GPD/AC	ET MGD	IRR MGD
120	90	0.25	6695	0.8	8369	0.80	1.00

Influence of irrigated acreage and ET (+/- 10% variation in parameters).

132	99	0.27	7365	0.8	9206	0.97	1.22
108	81	0.22	6026	0.8	7532	0.65	0.81

COMPARISON WITH GOLF COURSE EXPERIENCE.
(Private communications Art Rego, President, Golf Plus.)

	Irrigation (mgd)		Irrig. (gpd/acre)		ET
	Acres	Ave.	Max	Ave.	Max.	in/year
Kona Country Club	160	0.90	1.48	5625	9250	60
Maunakea Golf Course	150	0.80	1.00	5333	6667	100
Waikaloa (2 courses)	300	3.00	3.50	10000	11667	100

irrigation and 10% from percolation. Sprinkler irrigation efficiency is drawn from Ekern and Chang (1985).

Compare the calculated values with experience in Table 1. Actual water usage by golf courses in the Keahole-Kona area is less than the values calculated from the evapotranspiration rate. In one case, it is comparable as assumed here. For one thing, turfgrass need not be maintained at optimum growth as long as the result is deemed satisfactory. For another, the preparation of the substrata is important for its water holding capacity, or specific retention. In some cases, the underdrain can be collected and recycled. In other cases, advocates of wetting agents have claimed reduction in irrigation requirement.

The analysis of impact here assumes conventional and more conservative (higher) estimates for percolation. A figure of 5% percolation, ignoring rainfall contribution, would amount to 40,000 gpd to 60,000 gpd on the average. This corresponds to 0.01 to 0.02 in/day. A higher value of 20% percolation would give a rate of 160,000 gpd to 240,000 gpd. It turns out that the impact on the coastal water would still be inconsequential. The analysis leading to this conclusion is developed in later sections of this report.

Note that the rate of irrigation being considered is 0.28 to 0.34 in/day. This is a high rate comparable to what the Waikoloa courses have reported to be their application rates.

Application of Fertilizers. The element of significance here is fertilizer nitrogen. Other fertilizer elements would prove to be of no consequence on coastal water quality impact.

Different forms of nitrogen are used, and they may or may not have a practical influence to leaching in the percolate. Other factors play a part; the more significant ones are described below.

The application rate of fertilizer nitrogen anticipated is about one pound per month per 1000 square foot (1 lb/mo./1000 sq.ft.). (Private communication, Art Rego, President, Golf Plus, 1990). Normalized over a day in an acre, this amounts to 1.5 lb/acre/day. The range of application over 108 to 132 acres would be 162 to 198 lb/day over the entire golf course. The frequency of application can vary, depending upon the form from one month to three months.

Fate of applied nitrogen. Fertilizer nitrogen in the soil environment has been extensively studied by the HSPA with N15, the radioisotope. (Takahashi, 1964, 1967, 1968, and 1970). Other research focused on the percolation of

nitrogen from sewage effluents used to irrigate Californiagrass (Handley and Ekern, 1981). On a national scale, guidelines have been evaluated on the leaching of nitrate nitrogen to groundwater from sewage effluent applications to land (Broadbent and Reisenauer, 1986).

The experiences cited are transferable to the project being proposed for Manele. Experience directly related to golf courses and water quality impact is documented by Chang and Young (1977) and Dollar and Smith (1988).

Chang and Young investigated the impact of irrigation of sewage effluent on the Klipper Golf Course at the Kaneohe Marine Corps Air Station. Sewage effluent is being reclaimed for irrigation water after secondary treatment with a polishing pond. Shallow test wells were used to sample groundwater receiving percolate from irrigation. The estimated rate of application was 0.4 inches/week for the fairways and 2.2 inches/week for the greens. Nitrogen removals was 98.2%, phosphorus 100%, and coliform 100%. A complete study was done, but the attention here is on the leaching of nitrogen. The conclusion of Chang and Young is that the applied nitrogen and phosphorus is not a source of contamination of the adjacent surface waters. About 1.8% of the applied nitrogen leached to groundwater. The remainder was retained in the soil, taken up by turfgrass, or denitrified. Denitrification would give gaseous nitrogen which volatilizes to the atmosphere.

Dollar and Smith (1988) sampled sites offshore adjacent to existing golf courses in West Hawaii and found no measurable dissolved inorganic nitrogen concentrations attributable to golf course leachates to the open coast regime but found nitrogen increase in the Keauhou embayment. Despite evidence of nitrogen subsidy, the authors concluded that mixing in the coastal water was sufficiently rapid to mask any increases in biological uptake.

In a different application, more severe in terms of percolation rates, is the work of Handley and Ekern (1981). In lysimeter studies at the Mililani Wastewater Treatment Plant over a 17-month period, sewage effluent was used to irrigate Californiagrass as high as 98 mm/day (3.86 inches/day) on a 5-day application, 2-day resting cycle. The normalized rate was 2.76 inches/day. Consumptive use was 4 mm/day. Nitrogen application was 475 to 2600 kg/ha/yr (14,154 lb/ac/yr). Only three percent (3%) percolated. The conclusion was that 69% of the nitrogen was taken up in the biomass and 28% was denitrified. Soil nitrogen remained either unchanged or decreased. Crop production on a dry weight basis averaged 150 tons/ha/yr with short term rates up to 193 tons/ha/yr.

Broadbent and Reisenauer (1986) reviewed the fate of nitrogen and phosphorus from wastewater effluent application to irrigation: the uptake by crops, leaching, and denitrification in the case of nitrogen. With wastewater effluent applications, denitrification could occur as high as 40% of the applied amount. This is understandable. Sufficient organic matter would be present in wastewater effluents to cause anoxic conditions to occur somewhere in the pathways of infiltration and percolation to cause the reduction of nitrate nitrogen to the gaseous form of molecular nitrogen or nitrous oxide. Soil texture is important in the work described by Broadbent and Reisenauer. Leaching of nitrate nitrogen was described as being directly proportional to the drainage volumetric rate, especially so for the sandy loams that apparently were prevalent in the cases described by Broadbent and Reisenauer. Sandy loams are not part of the Lanai projects. Silty clays are more prevalent for the Lanai. In any case, the relationship proposed by Broadbent and Reisenauer is intuitive and is used here in comparing and contrasting estimates of the leaching potentials found by experience in this State.

Takahashi (1964, 1967, 1968, 1970) undertook extensive studies in the field and in lysimeters on the fate of fertilizer nitrogen using the radioisotope, N15. Stanford (1963) studied the nitrogen application rates and the sugar yields from cane crops. Maximum yield of sugar in terms of pounds per acre occurred with 400 lb/acre/crop. Higher application rates resulted in "luxury uptake" with more yield of fiber rather than sugar. Applying nitrogen at a lesser rate resulted in a decrease in sugar yield but not significantly. For example, an application rate of 200 lb/acre gave 95% yield. The yield per pound of nitrogen applied would be much higher at the lower application rate.

In the range of applied nitrogen in sugar cane cultivation, Takahashi's studies led to the following conclusions: 1) Ammonium and nitrate fertilizers are rapidly converted to organic forms by soil microflora, which are then relatively immobile; 2) Uptake by cane is preferentially the nitrate form; 3) Uptake by cane ranges from 25% to 35% of the applied nitrogen with the major portion remaining in the top three feet of the soil layer; 4) fertilizer nitrogen immobilized in the soil is about 80% to 90% of the applied amount; and 5) nitrates are leached from soil more readily than ammonium or organic forms and the rate and extent of leaching depends upon the soil mineralogy, the soil organic matter, intensity of rain and length of period since last application of fertilizer.

Leaching of nitrate nitrogen and its impact on groundwater quality was evaluated by Sunn Low Tom and Hara, Inc. (SLTH) for the Pearl Harbor region in 1971 The focus at that time was on the evaluation of the potential effects of sewage

effluent reclamation for sugar cane irrigation on the groundwater quality. The significance of the Pearl Harbor experience is the large quantities of fertilizer applied to the sugar cane fields overlying the basal aquifer over a period of decades and the appreciable magnitude of the agricultural return flows in the hydrologic budget. Given these conditions, attention to nitrate nitrogen build-up in the drinking water supply has been given over the decades, but it has never proved to be a problem.

The Pearl Harbor experience. Sugar cane cultivation in the Pearl Harbor basin was well underway by 1900. By 1912, the sugar plantations of southern Oahu were pumping 160 mgd from the basal aquifer. With construction of the Waiahole tunnel system and the utilization of spring flows, sugar cultivation in the Pearl Harbor region alone utilized about 200 mgd. As much as 25,000 to 30,000 acres were once under cultivation. In the late 1960's, cultivation decreased to 20,000 acres of land. Today, the acreage is approaching about one half that amount.

SLTH (1971) evaluated the potential for wastewater reclamation for sugar cane irrigation and analyzed the potential impact on groundwater. A mixing model was constructed and calibrated to the observed groundwater conditions for projecting the impact of replacing part of the irrigation water with reclaimed water from sewage effluent.

The segment of the drainage basin evaluated in the SLTH study was 10,000 acres overlying the basal groundwater which contributed to the 60 mgd spring flows. The quality of the spring flows was represented by sampling results from the Waiawa and Waiau springs. Nitrogen application, normalized over an average day, was 4140 pounds per day, which is about 300 lb/acre/2 year crop. All of the nitrogen is applied in the first year and none in the second "ripening" year. The applied irrigation rate was 10,000 gpd/acre in ridge and furrow configuration at frequencies of 14 to 16 days. The total return flow from irrigation and rainfall was estimated to be 60 mgd or 6000 gpd/acre (0.22 in/day). The corresponding application rate was 0.52 in/day including rainfall.

With a large agricultural return flow component, the pumping system was essentially operating as a regional groundwater recycling system. As such, the conclusion was that nitrogen leaching to groundwaters was 9% of the applied rate. If the system was operating on a once-through basis, leaching would have been 23%.

The net effect on the groundwater quality was found to be as follows:

Constituent	Predicted	Observed
Silica, mg/l	61.0	62.0
Nitrate-N, mg/l	1.6	1.4
Phosphate, mg/l	0.3	0.3

Leaching of phosphate amounted 1.4%. The overall effect of leaching of nitrate nitrogen was 9%, giving a resulting concentration in the groundwater of 1.4 mg/l as measured by the concentration in the Waiawa and Waiau springs. Compare those numbers with the drinking water standard of 10 mg/l.

Discussion of Reported Results.

The model constructed for Pearl Harbor (SLTH, 1971) showed excellent agreement with the chemical quality observed for the groundwater. The leaching potential was high for sugar cane cultivation compared to the findings of Handley and Ekern (1981) with Californiagrass. Nitrogen uptake by sugar cane ranges from 25 to 35% of the applied nitrogen while Handley and Ekern reported uptake by Californiagrass as high as 69%; only 3% percolated from the surface soil layer and the remainder (28%) volatilized by denitrification.

The objectives are different for the two scenarios. For sugar cane, it is sugar yields, not biomass production. For Californiagrass, it was biomass production or nitrogen uptake. The same can be said about sugar cane. Stanford (1963) reported on "luxury uptake" for sugar cane. Cultivation practices could be managed to induce greater uptake of nitrogen if that were to be the objective but at the expense of reduced sugar yields.

The work of Takahashi showed that soil microflora rapidly fixed nitrogen in the soil in the organic form in proportion of 80% to 90% of the applied amount. Therefore, the remainder could constitute the potential for leaching in soils with high drainage or high infiltration and percolation. Broadbent and Reisenauer suggested a direct proportional relationship. Note also that the fraction that could move in the percolate could also undergo losses from denitrification. This would be especially appreciable in situations with reclaimed water from sewage effluents because the soil-water environment would become especially conducive for this biochemistry.

A summary of the relevant parameters from the literature is given in Table 2. A wide range of values are illustrated for nitrogen application and irrigation rates. The Pearl Harbor experience show the highest percentage of leaching and it should be kept in mind that the experience represents different soil-water microcosms. There is definitely a finite limit on the maximum nitrogen leachable in irrigation

of crops (or turfgrass). The range in sugar cane cultivation has been estimated in the field and experiment that it is 80% to 90%. The same fundamental process here would apply to other environments. The differences would be in the plant uptake, soil medium, and the hydraulics of percolation.

The projection of the leaching rate of applied fertilizer nitrogen is based on the application rate. Irrigation of golf courses is done daily, usually in the night and sufficient to satisfy the turfgrass transpiration requirement for the following day or so. For this purpose the hydraulic regime would be unsaturated and as a consequence, the percolation rate out of the surface soil layer would be slower than a ponding type of application like the ridge and furrow application that the sugar plantations used to practice before. Now the more common and efficient method is the drip application.

Recent advances in the management of golf course irrigation include sensors in the soil to monitor the moisture content and on this basis turn on the sprinkler. With this method, irrigation would be far more efficient with less chance of losses through deep percolation of irrigation water. Management and technology of irrigation are getting more efficient over time and the result is less loss of water and fertilizer through deep percolation. In turn, the trend is for declining potential for coastal water quality impact.

The present analysis is based on the projected loss of 5% of applied nitrogen. This analysis serves to illustrate the magnitude of potential water quality impact. A sensitivity analysis is also made to show the consequence of variations in the estimates and to high light the factors that dictate water quality.

IMPACT ON COASTAL WATER QUALITY

Chang and Young (1977) and Dollar and Smith (1988) specifically investigated the coastal water quality impact of existing golf course maintenance and operation and found none. Even a seemingly severe situation with sugar cane cultivation in the Pearl Harbor Basin where 2 tons per day of fertilizer nitrogen have been applied over decades of time led to the finding that the affected groundwaters had concentrations of 1.4 mg/l compared to the acceptable limit of 10 mg/l. The attenuation of nitrate nitrogen has been researched by others and certain generalizations have evolved on the limits of their occurrence.

In our island environment, groundwater seepage invariable occurs to coastal waters following different pathways around different boundary conditions for different localities. For

TABLE 2. SUMMARY OF NITROGEN LEACHING EXPERIENCE AND PROJECTED VALUES FOR MAKELE GOLF COURSE.

PROJECT	CROP	N APPLIED lb/ac/yr	IRRIG. inch/day	% LEACH	METHOD OF IRRIGATION
PEARL HARBOR	SUGAR CANE	150	0.52	23*	Ridge and furrow, every two weeks, 10,000 acres
RECLAMATION	CALIFORNIAGRASS	1154	2.76	3	Lysimeter
KLIPPER COURSE	TURFGRASS	NA	0.06	1.8	Golf course sprinkler
PROJECTED VALUES					
MAKELE GOLF COURSE	TURFGRASS	548	0.34	5	Golf Course sprinkler, daily.

*Calculated for single pass.
9% observed with recycling.

Manele, the seepage is assumed to occur as a line source along the shoreline. Deviation from this idealized boundary condition will further minimize the water quality impact. In other words, the analysis here is intended to illustrate the worst case scenario at the groundwater-coastal water interface.

Coastal water processes.

A pronounced difference between groundwater and coastal water movement is the time scale of transport of substances. Coastal water currents have velocities about 10,000 times faster or more than groundwater movement. The equations of fluid motion are basically the same, but the parameters are different. Moreover, the coastal zone supports a viable ecology, and the biological response to the water column quality would be a concentration-time dependent phenomenon. Concentration in turn would be directly proportional to the mass emission rate.

The mass emission of fertilizer nitrogen is estimated for illustrative purposes to be 9.9 lb/day or 10 lb/day spread out along the 9000 foot coastal zone frontage. This would be about 0.001 lb/day/ft.

The coastal zone experiences turbulent flow with mixing from wave action and wind action. The parameter used to describe the mixing and dissipating character is the dispersion coefficient. Values have been compiled for different tidal rivers and estuaries, and these observations are used as estimates for one set of conditions where the tidal influence would be significant factor. The open coast regime, with rocky shoreline, with littoral transport would have a much higher coefficient than calm water conditions.

The dispersion coefficients for tidal rivers and estuaries range from 1 to 50 square miles/day principally in the longitudinal direction (Hydroscience, Inc. 1971) Dispersion coefficients obtained for open ocean regime in outfall disposal application range from 4 to 20 square kilometers per day (Koh, 1988). The common application is in the transverse axis.

The range of values expressed in common units in square miles per day is 1.5 to 7.7 compared to 1 to 50 for estuaries. For the consideration here a value of 1 square mile per day is used for the water quality impact, and this is considered to be a conservative estimate. The more likely value would be closer to 5 square miles per day, and this value is also evaluated.

Calculations.

Two analytical approaches are used in estimating the concentration of nitrogen in the coastal water from the projected mass emission rates.

Method 1. The dispersion coefficient can be considered to be the spreading rate of pollutant plume expressed in units of area per unit time. The depth under consideration is taken to be the tidal range, or approximately 2 feet. The volume dispersed or discharged from the zone of consideration and replaced by "new" water under the tidal influence would be the following:

$$1 \text{ sq.mi./day} \times 2 \text{ ft} = 55{,}800{,}000 \text{ cu.ft./day}$$

$$= 417 \text{ mgd}$$

The average concentration in the coastal water from the mass emission of nitrate nitrogen at steady state condition would be the following:

$$C = (10 \text{ lb/day})/417 \text{ mgd}/8.34 = 0.003 \text{ mg/l N}$$

This is expected to be the maximum average value. In all likelihood the value would be lower based on greater dispersion and inclusion of the advective along shore currents in the analysis which would increase the net transport out of the nearshore regime.

Method 2. A more precise method is to evaluate the equations of mass transport. For this case, the situation is described in mathematical terms as a line source diffusing into a semi-infinite plane. The solution on the equation is given by Crank (1964) and is shown in the Appendix. Advective flow is ignored in this equation to be conservative in the estimates. The solution is obtained numerically to illustrate the time variation of concentration as well as the average.

Three cases are evaluated. One with dispersion coefficient as one square mile per day; another as 5 square miles per day; and the last with 20% leaching of fertilizer nitrogen. The true value is expected to fall somewhere between the extreme values calculated.

With a dispersion coefficient of one square mile per day, the nitrogen concentration in the coastal regime would be 0.003 mg/l. With 5 square miles per day, the concentration would be 0.001 mg/l. An increase of 20% leaching of nitrogen, the concentration would be 0.005 mg/l.

Discussion. Methods 1 and 2 are consistent. At the lower dispersion coefficient, the results are equivalent at one significant digit. The range of incremental increase in nitrogen concentration is 0.001 to 0.005 mg/l. This is an inconsequential impact.

Conclusion.

The impact of fertilizer nitrogen would be insignificant. Management practices, irrigation efficiencies, choice of turfgrass, all provide safeguards against excessive leaching of nitrogen fertilizers. Groundwaters underlying the golf course are not intended for drinking water, and the seepage of nitrogen into the coastal waters is not a problem.

ASSESSMENT OF PESTICIDE USE

The assessment of environmental impact from pesticide usage and fertilizers for the proposed Koele Golf Course (Murdoch and Green, 1989) is generally applicable to Manele. There are differences in the climate and irrigation rates. Pesticide usage and principles of attenuation remain the same. Numerical values for the parameters would change but not by much.

The scope here is broader with the consideration of emissions to the coastal waters because of their proximity.

Rate of application. Typical rates of pesticides usage have been compiled by Dr. Richard Green, and data are included in Appendix B. Murdoch and Green (1989) observe that the rate of usage on golf courses is typically much lower than in pineapple cultivation. Despite high usage in pineapple, these chemicals have not been detected in groundwaters on Lanai. However, problems have occurred with DBCP in groundwater on Oahu. The associated attenuation factor for DBCP was compared by Murdoch and Green (1989) to those of the typical chemicals used in golf courses. DBCP has a factor of 4.6×10^{-1} compared to the most mobile of the golf course usage at 10^{-3} and the least, at 10^{-6}. The chemicals typically used for golf courses are several orders of magnitude less susceptible to leaching.

Transport factors. The leaching potential is evaluated here in terms of the order of magnitude of emissions past the soil layer, considering degradation of chemicals with time.

For this purpose, the retardation factor is evaluated as it is defined by the equations of groundwater flow. The equations are not evaluated here. They are used merely to define nomenclature and terminology. The mathematical representation is given in Appendix C.

Murdoch and Green (1989) included basic data for the evaluation of the retardation factors, and they are included in Appendix D. Selected chemical data are evaluated to illustrate the order of magnitude of potential emissions to groundwater which seeps into the coastal water regime.

Degradation. The chemicals undergo degradation at a rate indicated by the half-lives in the soil water medium. The rates are relatively fast compared to the time scale of transport. Percolation rate is anticipated to be slow in the unsaturated flow regime which would develop from sprinkler irrigation and is estimated to be equivalent to the water in excess of the specific retention of the soil and the plant uptake.

The rate constant is determined from the half-life data in terms of fraction per day and applied in the numerical analysis of the transport equation in Appendix E.

Analysis of emission rates. To illustrate the probable magnitudes of leaching of pesticides, the analysis was made using the retardation factor and degradation rate of chemicals. For this purpose, it is hypothesized that chemicals percolating below the soil layer of 50 centimeters will eventually reach groundwater. The substrata in the region changes from soil at the surface to weathered basalt in the deeper layers. The retardation factor would change but it is not necessary for this calculation.

Computations then were set up to see how much would leach beyond the 50 centimeter depth. The results are included in Appendix E. The results are revealing. The fraction passing the 50 cm depth is so infinitesimal that it is incalculable. In at least one case, the time to reach the specified depth is greater than 2000 years. By then the chemical would have degraded to its thermodynamically stable components.

Conclusion.

The chemicals listed as being typical for golf course use will be immobilized and will not have an impact on the groundwater and coastal water.

Estimates in the assumed parameters for percolation rate and soil media can be in error by several thousand percent and still not alter the conclusion.

Runoff from storm flows can carry pesticides to the coastal waters with the sediments. However, the impact would also be negligible. The waters are in the open coast regime where sediments would be dispersed. Experience with hydrocarbons and heavy metals transported by sediments relate to estuaries like Pearl Harbor and Kapalama canal.

E6

There are no known problems in the open coast regime. Moreover, the pesticides listed are degradable and are not expected to persist in the environment like DDT and other long-lived chemicals.

A note on the analysis. The numerical analysis on the leaching rate raises what appears to be an artifact of the analytical procedure used. The fraction computed is on the order of molecular counts. In reality the extrapolation is not valid to that extent, from the macroscopic to the infinitesimal. This raises the same philosophical issues that risk assessment extrapolation raises. It is more likely that the order of magnitude of leachate concentration could be on the order of parts per trillion or 10^{-12} as the limit. In the coastal zone with dispersion, the order of magnitude might be a two-fold dilution at least, or 10^{-14} as the resulting order of concentrations. Even with bioaccumulation, the result would be insignificant at this level.

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APPENDICES

APPENDIX A	Effect of Dispersion
APPENDIX B	Typical Pesticide Program for an 18-hole Golf Course in Hawaii
APPENDIX C	Equation of Flow
APPENDIX D	Properties of Pesticides Used on Turf in Hawaii
APPENDIX E	Calculation of Retardation Factors

APPENDIX A

CALCULATE EFFECT OF DISPERSION

CONVERSION FACTORS

	MI2/DAY	FT2/DAY	KM2/DAY	M2/DAY
D=	1	27878400	2.59	2591315
	2	55756800	5.18	5182629
	3	83635200	7.77	7773944
	4	111513600	10.37	10365259
	5	139392000	12.96	12956573
	6	167270400	15.55	15547888
	7	195148800	18.14	18139203
	8	223027200	20.73	20730518
	9	250905600	23.32	23321832
	10	278784000	25.91	25913147

	lb/ft/da	mg/day/m
M=	0.001111	1655

$$C = \int_0^\infty \frac{M}{4\pi Dt} e^{-(x^2+y^2)/4Dt}\, dy$$

$$= \frac{M}{(\pi Dt)^{1/2}} e^{-x^2/4Dt}$$

CONCENTRATION OF NO3-N, MG/L

T, DAYS / X, KM	1	2	3	4	5	6	7	8	9	10	SUM
0.1	0.000579	0.000410	0.000335	0.000290	0.000259	0.000237	0.000219	0.000205	0.000193	0.000183	0.002911
0.2	0.000578	0.000409	0.000334	0.000290	0.000259	0.000237	0.000219	0.000205	0.000193	0.000183	0.002908
0.3	0.000575	0.000408	0.000334	0.000289	0.000259	0.000236	0.000219	0.000205	0.000193	0.000183	0.002902
0.4	0.000571	0.000407	0.000333	0.000289	0.000259	0.000236	0.000219	0.000205	0.000193	0.000183	0.002895
0.5	0.000566	0.000405	0.000332	0.000288	0.000258	0.000236	0.000218	0.000204	0.000193	0.000183	0.002885
0.6	0.000560	0.000403	0.000331	0.000288	0.000258	0.000235	0.000218	0.000204	0.000193	0.000183	0.002873
0.7	0.000553	0.000401	0.000330	0.000287	0.000257	0.000235	0.000218	0.000204	0.000192	0.000183	0.002859
0.8	0.000545	0.000398	0.000328	0.000286	0.000256	0.000234	0.000217	0.000204	0.000192	0.000182	0.002842
0.9	0.000536	0.000394	0.000326	0.000284	0.000255	0.000234	0.000217	0.000203	0.000192	0.000182	0.002824
1.0	0.000527	0.000391	0.000324	0.000283	0.000254	0.000233	0.000216	0.000203	0.000191	0.000182	0.002804
1.1	0.000516	0.000387	0.000322	0.000282	0.000253	0.000232	0.000216	0.000202	0.000191	0.000181	0.002782
1.2	0.000505	0.000383	0.000320	0.000280	0.000252	0.000231	0.000215	0.000202	0.000190	0.000181	0.002759
1.3	0.000493	0.000378	0.000317	0.000278	0.000251	0.000230	0.000214	0.000201	0.000190	0.000180	0.002733
1.4	0.000480	0.000373	0.000314	0.000277	0.000250	0.000229	0.000213	0.000200	0.000189	0.000180	0.002707
1.5	0.000467	0.000368	0.000312	0.000275	0.000248	0.000228	0.000213	0.000200	0.000189	0.000179	0.002678

Ref: Crank, J., The Mathematics of Diffusion, Oxford University Press, 1964, pg 27

CALCULATE EFFECT OF DISPERSION

CONVERSION FACTORS

	MI2/DAY	FT2/DAY	KM2/DAY	M2/DAY
D=	5	139392000	12.96	12956573
	2	55756800	5.18	5182629
	3	83635200	7.77	7773944
	4	111513600	10.37	10365259
	6	167270400	15.55	15547888
	7	195148800	18.14	18139203
	8	223027200	20.73	20730518
	9	250905600	23.32	23321832
	10	278784000	25.91	25913147

	lb/ft/da	mg/day/m
M=	0.001111	1655

CONCENTRATION OF NO3-N, MG/L

T, DAYS / X, KM	1	2	3	4	5	6	7	8	9	10	SUM
0.1	0.000259	0.000183	0.000150	0.000130	0.000116	0.000106	0.000098	0.000092	0.000086	0.000082	0.001302
0.2	0.000259	0.000183	0.000150	0.000130	0.000116	0.000106	0.000098	0.000092	0.000086	0.000082	0.001302
0.3	0.000259	0.000183	0.000150	0.000130	0.000116	0.000106	0.000098	0.000092	0.000086	0.000082	0.001302
0.4	0.000259	0.000183	0.000150	0.000130	0.000116	0.000106	0.000098	0.000092	0.000086	0.000082	0.001301
0.5	0.000258	0.000183	0.000150	0.000130	0.000116	0.000106	0.000098	0.000092	0.000086	0.000082	0.001300
0.6	0.000258	0.000183	0.000149	0.000129	0.000116	0.000106	0.000098	0.000092	0.000086	0.000082	0.001299
0.7	0.000257	0.000183	0.000149	0.000129	0.000116	0.000106	0.000098	0.000092	0.000086	0.000082	0.001298
0.8	0.000256	0.000182	0.000149	0.000129	0.000116	0.000106	0.000098	0.000092	0.000086	0.000082	0.001296
0.9	0.000255	0.000182	0.000149	0.000129	0.000116	0.000106	0.000098	0.000092	0.000086	0.000082	0.001294
1.0	0.000254	0.000182	0.000149	0.000129	0.000116	0.000106	0.000098	0.000091	0.000086	0.000082	0.001293
1.1	0.000253	0.000181	0.000149	0.000129	0.000115	0.000105	0.000098	0.000091	0.000086	0.000082	0.001290
1.2	0.000252	0.000181	0.000148	0.000129	0.000115	0.000105	0.000098	0.000091	0.000086	0.000082	0.001288
1.3	0.000251	0.000180	0.000148	0.000129	0.000115	0.000105	0.000098	0.000091	0.000086	0.000082	0.001286
1.4	0.000250	0.000180	0.000148	0.000128	0.000115	0.000105	0.000098	0.000091	0.000086	0.000082	0.001283
1.5	0.000248	0.000179	0.000148	0.000128	0.000115	0.000105	0.000097	0.000091	0.000086	0.000082	0.001280

CALCULATE EFFECT OF DISPERSION

CONVERSION FACTORS

	M2/DAY	FT2/DAY	KM2/DAY	M2/DAY
D=	5	139392000	12.96	12954573
	2	55756800	5.18	5182629
	3	83635200	7.77	7773944
	4	111513600	10.37	10365259
	6	167270400	15.55	15547888
	7	195148800	18.14	18139203
	8	223027200	20.73	20730518
	9	250905600	23.32	23321832
	10	278784000	25.91	25913147

	lb/ft2/da	mg/day/m
N=		6618

CONCENTRATION OF NO3-N, MG/L

T, DAYS / X, KM	1	2	3	4	5	6	7	8	9	10	SUM
0.1	0.001037	0.000734	0.000599	0.000519	0.000464	0.000424	0.000392	0.000367	0.000346	0.000328	0.005209
0.2	0.001037	0.000733	0.000599	0.000519	0.000464	0.000424	0.000392	0.000367	0.000346	0.000328	0.005208
0.3	0.001036	0.000733	0.000599	0.000519	0.000464	0.000423	0.000392	0.000367	0.000346	0.000328	0.005206
0.4	0.001034	0.000733	0.000598	0.000518	0.000464	0.000423	0.000392	0.000367	0.000346	0.000328	0.005203
0.5	0.001033	0.000732	0.000598	0.000518	0.000464	0.000423	0.000392	0.000367	0.000346	0.000328	0.005200
0.6	0.001030	0.000731	0.000598	0.000518	0.000463	0.000423	0.000392	0.000367	0.000346	0.000328	0.005195
0.7	0.001028	0.000730	0.000597	0.000518	0.000463	0.000423	0.000392	0.000366	0.000345	0.000328	0.005190
0.8	0.001025	0.000729	0.000597	0.000517	0.000463	0.000423	0.000391	0.000366	0.000345	0.000328	0.005184
0.9	0.001021	0.000728	0.000596	0.000517	0.000463	0.000422	0.000391	0.000366	0.000345	0.000328	0.005177
1.0	0.001018	0.000727	0.000595	0.000516	0.000462	0.000422	0.000391	0.000366	0.000345	0.000327	0.005170
1.1	0.001014	0.000725	0.000594	0.000516	0.000462	0.000422	0.000391	0.000366	0.000345	0.000327	0.005162
1.2	0.001009	0.000724	0.000594	0.000515	0.000461	0.000422	0.000391	0.000366	0.000345	0.000327	0.005153
1.3	0.001004	0.000722	0.000593	0.000515	0.000461	0.000421	0.000390	0.000365	0.000345	0.000327	0.005143
1.4	0.000999	0.000720	0.000592	0.000514	0.000461	0.000421	0.000390	0.000365	0.000344	0.000327	0.005132
1.5	0.000993	0.000718	0.000590	0.000513	0.000460	0.000421	0.000390	0.000365	0.000344	0.000327	0.005121

E-13

APPENDIX B

RECEIVED DEC 4 1989

834 A 12th Avenue
Honolulu, HI 96816

Mr. Tom Leppert
President and C. E. O.
Oceanic Properties
650 Iwilei Road
Honolulu, HI 96817

Nov. 30, 1989

Dear Mr. Leppert:

At the public hearing on Lanai Tuesday evening, Nov. 28, you requested that we send you recommended fertilizer and pesticide practices for an 18-hole golf course at Koele. It should be understood that there is no single program of chemical use for all locations under all conditions. Each golf course superintendent will design and optimize practices for a given set of conditions, depending on climatic conditions, pest incidence, etc. However, we have provided typical fertilizer nitrogen and pesticide application practices for an 18-hole golf course in our report to M & E Pacific, Inc., entitled "Environmental Assessment of Fertilizer and Pesticide Use on the Proposed Koele Golf Course, Koele, Lanai", Sept. 25, 1989.

The following information is taken directly from the report; additional background and rationale for the recommendations are provided in the report.

1. Fertilizers

Fertilizers are applied to golf courses to supply those essential nutrients which are used in large amounts and which are deficient in most soils. In typical soils, the elements which are normally applied in a turfgrass fertilization program are nitrogen (N), phosphorus (P), and potassium (K). Fertilizers are normally applied to only the greens, tees, fairways, and part of the roughs of a golf course. Typical areas in these types of turfgrasses are estimated in the discussion below.

Turfgrasses use much more N than other elements. Based on turfgrass clipping composition, it has been shown that the turfgrasses grown in Hawaii use about twice as much N as K and about four times as much N as P.

The primary fertilizer elements of concern for contamination of ground and surface waters are nitrogen and phosphorus. Phosphorus is attached very tightly to iron and aluminum hydroxides which are plentiful in the soil of this location and moves little if any from the site of application. Phosphorus, therefore will not cause any problem with contamination of drainage water. Ammonium nitrogen (NH_4) likewise moves little in soils. Nitrogen applied in the ammonium form, however, is rapidly converted to the nitrate form (NO_3) which is not bound to the soil and moves readily with water. Because of high N uptake by turfgrasses, however, nitrogen will be used rapidly after application. Only under conditions where rainfall occurs soon after application of a soluble nitrogen source would there be loss by surface runoff or by leaching below the root zone. This nitrogen movement could be avoided by applying a slow-release nitrogen fertilizer.

Fertilizer use rates for the different golf course areas are shown in Table 1. Complete fertilizers (ones containing N, P, and K) are usually applied. Because nitrogen is applied in larger quantities and also because it is the only fertilizer element likely to cause contamination of ground or surface waters, only nitrogen application rates are given.

Table 1. Approximate fertilizer use rates for different areas of a typical 18-hole golf course in Hawaii.

Type of turf	Area (acres)	Fertilizer amount (lb. N/1000 sq. ft.)	Application frequency	Total annual application (tons N)
Greens	3	0.5	2 weeks	0.85
Tees	3	1.0	3 weeks	1.15
Fairways	50	1.5	8 weeks	10.00
Roughs	30	1.0	3 months	2.60
Total	86			14.60

2. Pesticides

There are a number of weed, insect and disease pests of turfgrasses in Hawaii making it impossible to maintain high-quality turf without using pesticides. They are normally applied only in response to outbreaks of pests. A typical pesticide program for golf courses in Hawaii is given in Table 2 below. There are several chemicals which may be substituted for certain ones in this suggested program. Properties of the chemicals listed in Table 2 (Hartley and Kidd, 1983), as well as those of other chemicals used in turf in Hawaii, are given in Appendix Table 1. These tables do not include a complete list of all chemicals labeled for use on turf in Hawaii. In practice, however, any given golf course will use no more than one-half dozen or so of these chemicals over a period of a few years. All pesticides used in golf course management must be approved by the U. S. Environmental Protection Agency (EPA) and

the Hawaii State Department of Agriculture. The safety of golfers, as well as possible environmental effects, are considered by EPA in granting registration of pesticides for use on golf courses.

Table 2. A typical pesticide program for an 18-hole golf course in Hawaii.

Turfgrass area	Area (acres)	Chemical	Frequency	Rate/application	Annual total
I. Herbicides					
A. Greens	3	MSMA	6 times/year	2 lb.. ai/acre	36 lb. ai
		bensulide	2 times/year	12 lb ai/acre	72 lb. ai
B. Tees	3	MSMA	6 times/year	2 lb. ai./acre	36 lb. ai
		Trimec®	3 times/year	1 pint/acre	9 pints
		bensulide	2 times/year	12 lb. ai./acre	72 lb. ai
C. Fairways	50	MSMA	6 times/year	2 lb. ai./acre	600 lb. ai
		Trimec®	3 times/year	1 pint/acre	19 gallons
		metribuzin	2 times/year	0.75 lb. ai./acre	75 lb. ai.
D. Perimeter areas	20	glyphosate	3 times/year	1.5 lb ai./acre	90 lb. ai.
II. Insecticides					
A. Greens	3	chlorpyrifos	As needed	1 lb. ai./acre	Approx. 18 lb. ai.
B. Tees	3	chlorpyrifos	As needed	1 lb. ai. acre	Approx. 18 lb. ai.
C. Fairways	Spot treatments	chlorpyrifos	As needed	1 lb. ai./acre	Approx. 50 lb. ai.
III. Fungicides					
A. Greens	3	metalaxyl	As needed	1.3 lb. ai./acre	Approx. 25 lb. ai.
		chlorothalonil	As needed	8 lb. ai./acre	Approx. 72 lb. ai.
B. Tees	3	metalaxyl	As needed	1.3 lb. ai./acre	Approx. 25 lb. ai.
		chlorothalonil	As needed	8 lb. ai./acre	Approx. 72 lb. ai.
C. Fairways	Spot treatments	chlorothalonil	As needed	8 lb. ai./acre	Approx. 250 lb.ai.

Sincerely,

R. E. Green Ph. D.

c.c. C. L. Murdoch
J. Kumagai

APPENDIX C

Basic Equation:

$$\frac{\partial C}{\partial t} + \frac{V}{R_f}\frac{\partial C}{\partial X} = \frac{D}{R_f}\frac{\partial^2 C}{\partial x^2} - KC$$

R_f = retardation factor

$$= \left(1 + \frac{\rho_b K_d}{\theta}\right)$$

ρ_b = soil bulk density, gm/ml

θ = moisture content, fraction

K_d = $K_{oc} \cdot f_{oc}$, ml/g

K_{oc} = partition coefficient with soil organic carbon

f_{oc} = fraction organic carbon

$$R_f = \frac{V}{V^*} = \frac{\text{velocity of uncontaminated water}}{\text{velocity of contaminant}}$$

Ref: Karickhoff, S.W., D.S. Brown, and T.A. Scott, Sorption of hydrophobic pollutants on natural sediments, Water Research, 13(3), pp. 241-248, 1979

APPENDIX D: PROPERTIES OF PESTICIDES USED ON TURF IN HAWAII*

Pesticide common name	Trade name(s)	Oral LD-50 (mg/kg body wt)**	Toxicity to fish and wildlife**	Soil sorption Index (Koc)***	Water solubility (mg/l)***	Half-life in soil (days)***	Leaching potential***
I. Herbicides							
MSMA	Weedhoe etc.	1,800	Low	10,000	1,000,000	100	Small
glyphosate	Roundup, Kleenup	150	Mod. to birds, none to fish	10,000	1,000,000	30	Small
metribuzin	Sencor	2,200	Moderate	41	1,220	30	Large
2,4-D	part of mixtures	370-700	High to fish	109	300,000	10	Medium
mecoprop	ditto	700-1,500	Low	3	640,000	21	Large
dicamba	ditto	1,000-2,000	Non toxic to fish	2	800,000	14	Large
oryzalin	Surflan	10,000	Mod. to birds, toxic to fish	2,700	2.5	60	Small
oxadiazon	Ronstar	8,000	Toxic to fish		0.7		
propyzamide	Kerb	5,620-8,350	Low	990	15	30	Small
prodiamine	Princep	>5,000	Low	138	3.5	75	Large
simazine	Dacthal	>5,000	Low	5,000	0.5	30	Small
chlorthal-dimethyl	Betasan, Betamec	>3,000	Low	10,000	25	60	Small
bensulide	ditto	770	Mod. to fish	100,000	1,000,000	3,600	Small
paraquat dichloride	Ortho Paraquat CL	150	Mod. to birds, none to fish	11,000	0.1	30	Small
benfluralin	Balan	10,000	Low to birds, high to fish				
II. Insecticides							
chlorpyrifos	Dursban	135-163	High	6,070	2	30	Small
bendiocarb	Ficam	40-156	High				
carbaryl	Sevin	400-850	Moderate	229	40	7	Small
trichlorfon	Dylox	450-630	Moderate	2	154,000	27	Large
III. Fungicides							
anilazine	Dyrene	>5,000	Low	3,000	10	1	Small
benomyl	Benlate	9,590	Low	2,100	2	100	Small
chlorothalonil	Daconil 2787	>10,000	Low to birds, mod. to fish	1,380	0.6	20	Small
iprodione	Chipco 26019 RP	3,500	Low	500	13	20	Small
mancozeb	Dithane M-45	>8,000	Low	1,000	0.5	35	Small
quintozone	PCNB, Terrachlor	12,000	Non-toxic	1,000	0.44	21	Small
thiram	Tersan	7,500	Low	383	30	20	Medium
triadimefon	Bayleton	568	Low	273	260	21	Medium
metalaxyl	Subdue	669	Non-toxic	16	7,100	7	Medium
thiophanate-methyl	Cleary 3336	7,500	Low	1,000	4	0	Small

*From Murdoch, C. and R. Green. 1989. Private Communication.
**From Hartley, Douglas and Hamish Kidd (eds.) 1983. The Agrochemicals Handbook. Unwin Bros., Ltd. Old Working, Surrey, England.
***From Vaughope, R.D. 1988. U.S.D.A. - ARS Interim Pesticide Properties Database, Version 1.0, unpublished.

OUTLINE FOR THE TESTIMONY FOR W. KENT ALKIRE,
DIRECTOR OF ENVIRONMENTAL SERVICES,
JACK NICKLAUS GOLF SERVICES

Mr. Alkire has extensive experience and is recognized as an expert agronomist. His analysis and testimony will focus on the impact the golf course will have on the surrounding environment. Specifically he will address:

1. Assess the applicability of alternative water sources for the irrigation of the golf course.

2. Describe the systems and specifications for the irrigation system.

   The system selected for Manale is computer drive to reduce demand and manage total water usage in the most efficient manner possible. Estimated total water demand at 800,000 gallons per day. Mr. Alkire will present data on this projected water demand.

3. Relate experience on other courses and the impact those courses have had on water quality and the preservation of the Bay.

   Testimony will focus on specific examples which are applicable to this situation. Findings and experiences over a number of years and the actions that will be taken in this situation to ensure no issues are raised will be included in the testimony.

4. Present scientific data on soil configuration.

   The company who has undertaken a computer model study to identify the most optimum soil configuration to preclude any potential environmental problems caused by pesticide leaching. Mr. Alkire will present the findings and implications of this and the importance of the results which indicate that there will be no impact.

5. Summarize the systems being established to monitor environmental quality on an on-going basis. This will include a pesticide program which is environmentally neutral.

PETITIONER'S EXHIBIT NO. 21

CALCULATION OF RETARDATION FACTORS.

R=(1+pKd/θ)

Assume:
- p= 1.2 g/cm3
- moisture= 0.35 fraction by volume
- foc= 0.015
- Ve= 0.05 cm/day*0.02 in/day
- effective porosity= 0.2 fraction by volume

COMMON NAME	TRADE NAME	Koc ml/g	Half life days	K day-1	Rf	Vf cm/day	Time to travel 50 cm days	Fraction remaining years
MSMA	Weedone, etc	10000	100	0.007	515	0.000493	101434	278	0
Glyphosate	Roundup, Kleenup	10000	30	0.023	515	0.000493	101434	278	0
Metribuzin	Sencor	41	30	0.023	3	0.081710	612	2	1.75796E-266
2,4-D	mixtures	109	10	0.069	7	0.038452	1300	4	0
mecoprop		3	21	0.033	1	0.220050	227	1	2.08416E-99
dicamba		2	14	0.050	1	0.230311	217	1	5.19513E-95
oryzalin	surflan	2700	60	0.012	140	0.001816	27531	75	0
oxyfluorazon	Ronstar								
propyzamide	Kerb	990	30	0.023	52	0.004893	10219	28	0
simazine	Princep	138	75	0.009	8	0.031369	1594	4	0
chlorthal-dimethyl	Dacthal	5000	30	0.023	258	0.000984	50816	139	0
benuslide	Betasan, Betamec	10000	60	0.012	515	0.000493	101434	278	0
paraquat dichloride	Ortho Paraquat	100000	3600	0.000	5144	0.000049	1012570	2774	0
benfluralin	Balan	11000	30	0.023	567	0.000448	111558	306	0
chlorpyrifos	Dursban	6070	30	0.023	313	0.000811	61648	169	0
bendiocarb	Ficam								
carbaryl	Sevin	229	7	0.099	13	0.019879	2515	7	0
trichlorfon	Dylox	2	27	0.026	1	0.230311	217	1	5.19513E-95
anilazine	Dyrene	3000	1	0.693	155	0.001636	30568	84	0
benomyl	Benlate	2100	100	0.007	109	0.002330	21457	59	0
chlorothalonil	Daconil 2787	1380	20	0.035	72	0.003329	14168	39	0
iprodione	Chipco 26019	500	20	0.035	27	0.009508	5259	14	0
mancozeb	Dithane M-45	1000	35	0.020	52	0.006845	10321	28	0
quintozine	PCNB, Terrachlor	1000	21	0.033	52	0.006845	10321	28	0
thiram	Tersan	383	20	0.035	21	0.012272	4074	11	0
triadimefon	Bayleton	273	21	0.033	15	0.016888	2961	8	0
metalaxyl	Subdue	16	7	0.099	2	0.139342	359	1	1.45236E-156
chlorbenzate-methyl	Cleary 3336	1000	0		52	0.006845	10321	28	0

OUTLINE FOR THE TESTIMONY FOR W. KENT ALKIRE,
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TRAFFIC IMPACT ASSESSMENT REPORT

FOR THE PROPOSED MANELE GOLF COURSE PROJECT

UPDATE

Manele, Lanai, Hawaii

Revised
August 1990

Prepared for:

The Lanai Company

Prepared by:

Pacific Planning & Engineering, Inc.
1144 Tenth Avenue, Suite 202
Honolulu, Hawaii 96816

PETITIONER'S EXHIBIT NO. 41

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Appendix B. Manual Traffic Count Data
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F-2

FOREWORD

The Traffic Impact Assessment Report for the Proposed Manele Golf Course Project was originally prepared in July 1988 by Pacific Planning & Engineering, Inc. Since then, more information on proposed land uses became available outdating the 1988 report. This updated version of the 1988 report includes all the known major land uses until 2003 and analysis on two additional intersections along Kaumalapau Highway (the intersections of Kaumalapau Highway with Fraser Avenue and Lanai Avenue). Using the revised land use information, the traffic forecasts without and with the project were updated as well as the intersection analysis performed on all study intersections.

INTRODUCTION

Pacific Planning & Engineering, Inc. (PPE) was engaged to undertake a study to assess future traffic impacts caused by the proposed Manele Golf Course development in Manele, Lanai. This Traffic Impact Report discusses the probable impact of future vehicular traffic generated by the proposed Golf Course, hotel, commercial areas, and residential areas of the Manele Resort Project in 2003. The impact of the Project is described by the analysis of the four intersections connecting Kaumalapau Highway with Lanai Airport Road, Manele Road, Fraser Avenue, and Lanai Avenue. The future traffic volumes at these intersections are compared with each intersection's ability to handle the future vehicular traffic.

Project Description

Castle & Cooke, Inc. is proposing to construct a resort development that would include an eighteen hole golf course, park areas, approximately 5 acres of commercial area, and 425 residential homes. Presently, a 250-room hotel is under construction in the area, and an additional 150 rooms are planned by 2003. Figure 1 shows the general project location.

The proposed development is to be located in Manele, Lanai. At present, the Manele Golf Course site is vacant open land consisting essentially of sloped land with sparse vegetation. The project site is bordered to the South by Hulopoe Bay and Manele Small Boat Harbor which is maintained by the State Department of Transportation.

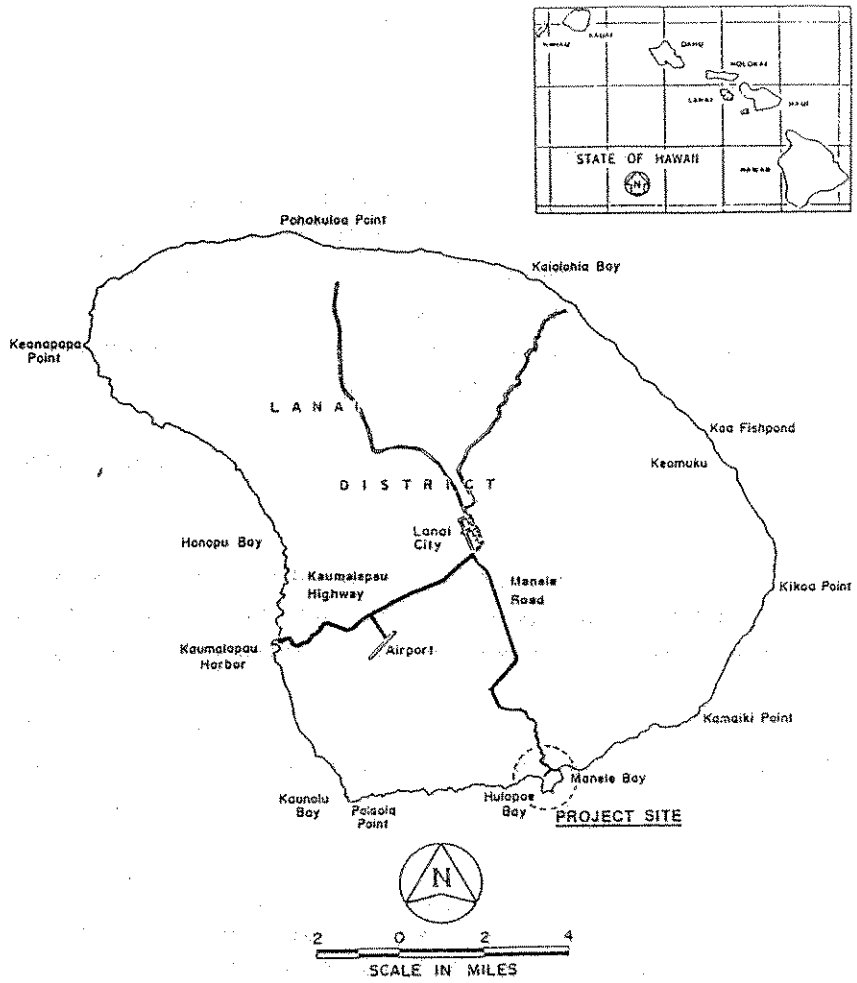

Figure 1. Project Location

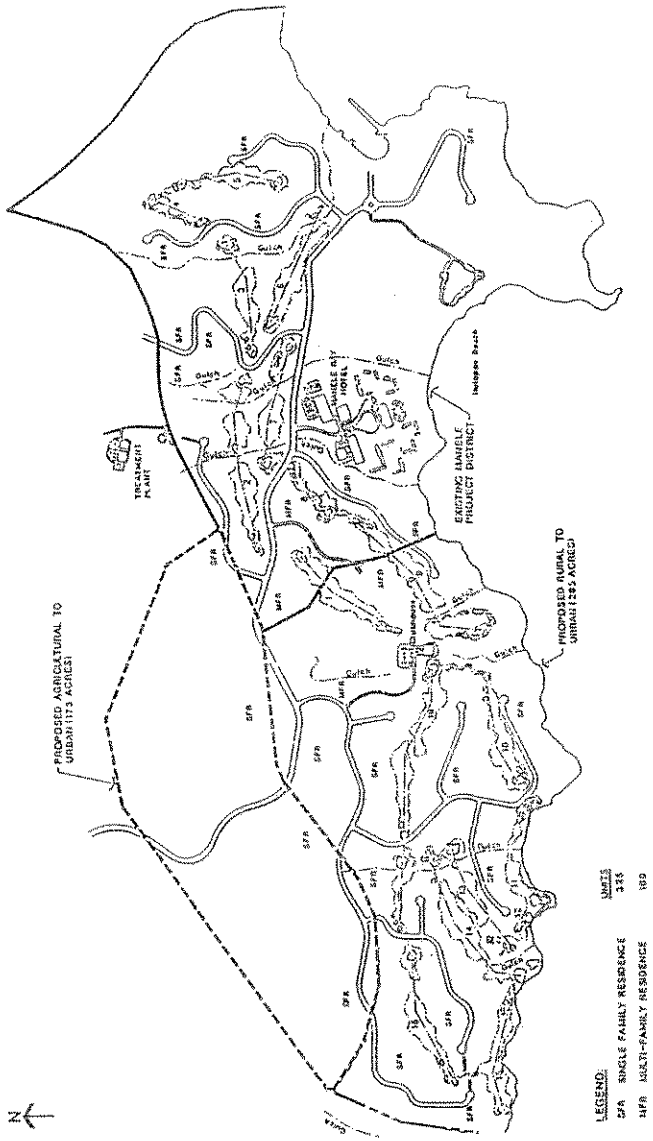

Figure 2. Manele Resort Conceptual Master Plan

Development of the Manele Resort area is projected to be completed in the year 2003. It would consist of the following developments and approximate areas:

1. Residential Units		87 acres
a. Single Family		325 units
b. Multi-family		100 units
2. 18 Hole Golf Course & Open Space Area		687 acres
3. Resort Hotel--Phase 1	250 Rooms	50 acres
Phase 2	150 Rooms	
4. Commercial		5.25 acres
5. Parks		66 acres

The single family dwelling units will consist of exclusive units of small single family house lots.

The Manele Resort is planned to have an access which would intersect Manele Road in a T-intersection mauka of the intersection of Manele Road with the access road to Manele Small Boat Harbor.

Study Purpose

The purpose of this Impact Report is to present the probable impacts of the forecasted vehicular traffic generated by the proposed development in the year 2003, when the project is expected to be completed and fully occupied. Within this time frame, other developments will be completed on Lanai. These developments, as foreseen by Castle & Cooke, are incorporated in the traffic estimation for the year 2003.

The analysis primarily focuses on the traffic impact at the four existing intersections of Kaumalapau Highway with Lanai Airport Road, Manele Road, Fraser Avenue and Lanai Avenue. These intersections provide vehicular access/egress from all major uses on Lanai. The study describes the impact on the Level of Service (LOS) at the intersections when the proposed development is completed in 2003.

This report assesses traffic impacts during the *afternoon peak hour* of 2 to 3 pm. The development will be served by Manele Road. Present traffic on Manele Road represents primarily agricultural and construction activities. The future traffic pattern of hourly volumes during a typical weekday is expected to result in the same general pattern of peaking during the morning and afternoon. Typically, residents and visitors alike will be active during the afternoon resulting in more trips and trip types than at any other time. Thus, the afternoon peak hour was selected. Figures 3-5 shows the traffic counts at each of the study intersections for 1988.

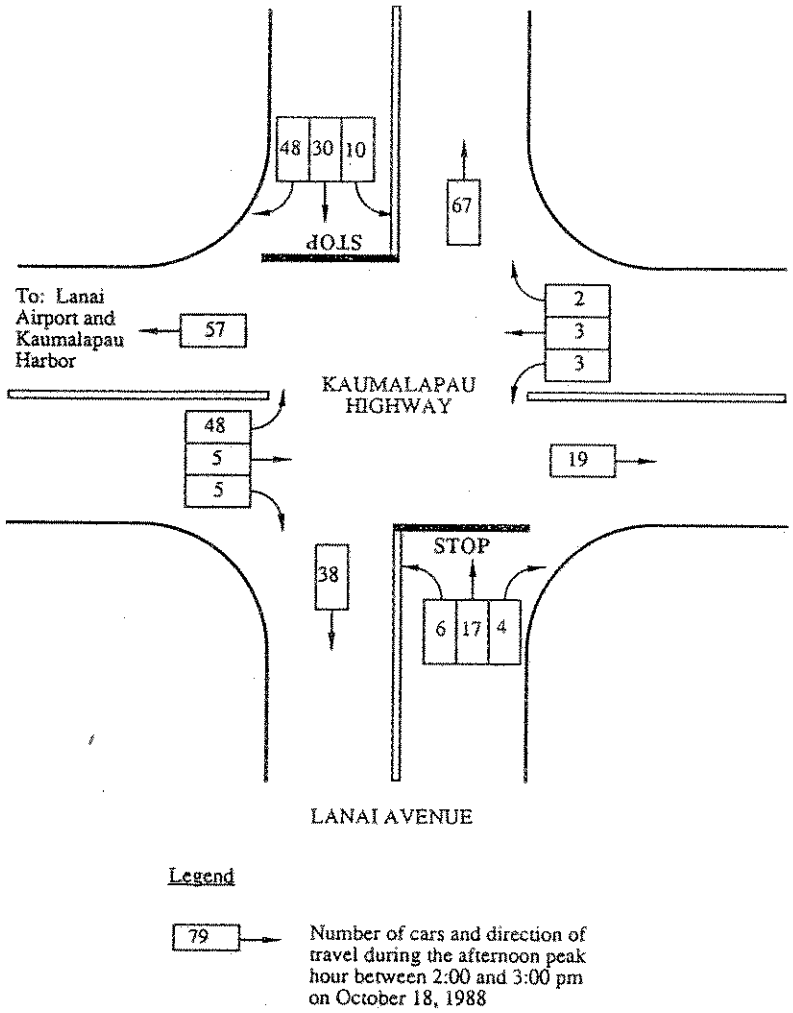

Figure 3. Traffic Counts--Lanai Avenue @ Kaumalapau Highway

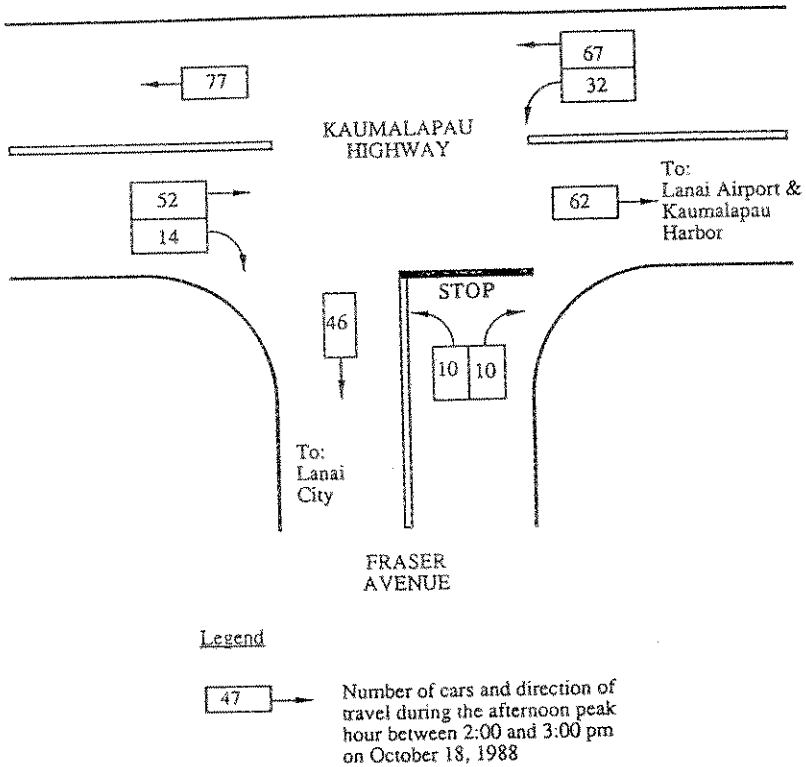

Figure 4. Traffic Counts--Fraser Avenue @ Kaumalapau Highway

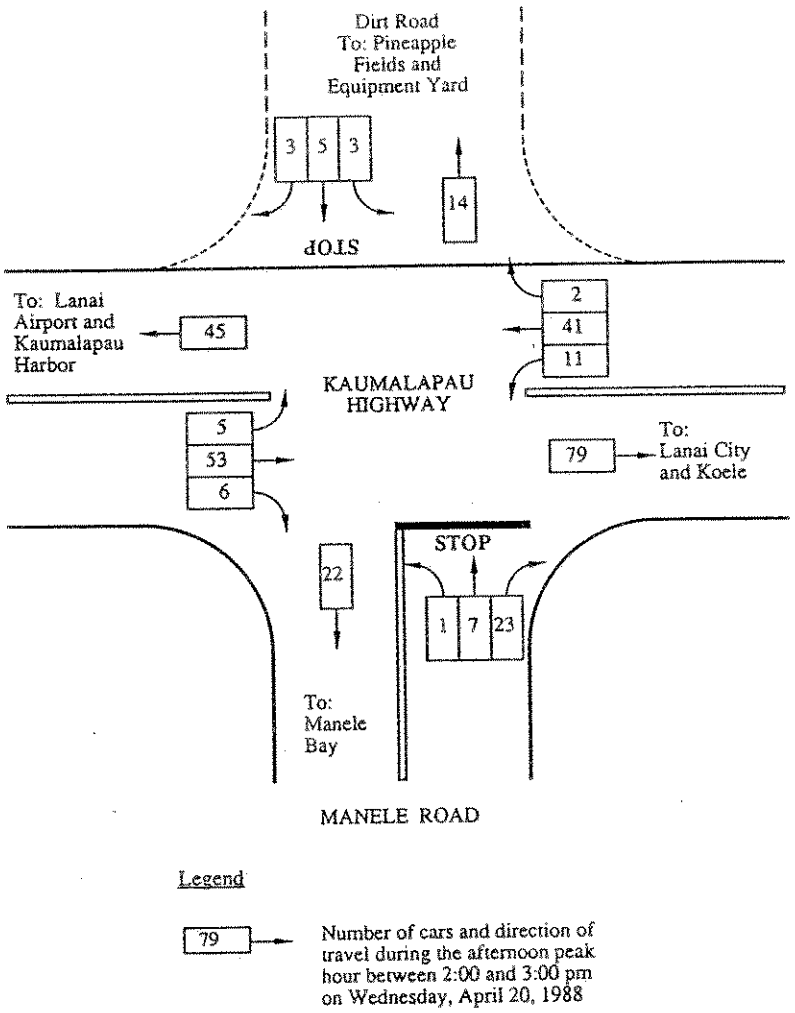

Figure 5. Traffic Counts--Manele Road @ Kaumalapau Highway

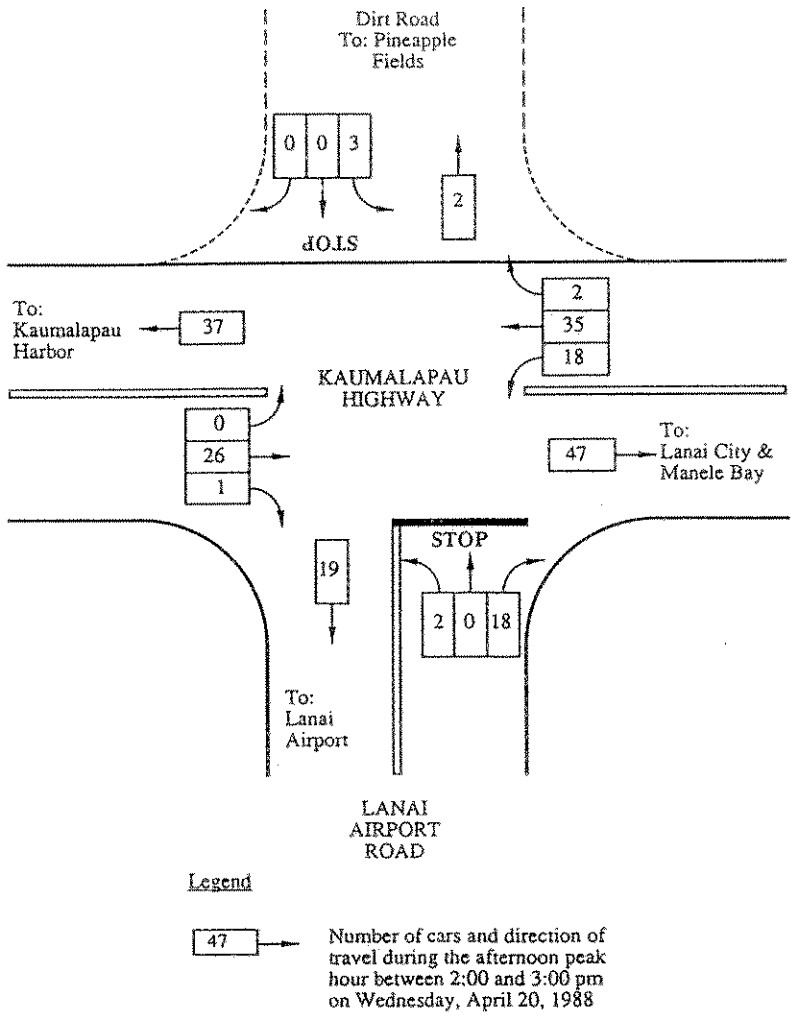

Figure 6. Traffic Counts--Lanai Airport Road @ Kaumalapau Highway

EXISTING CONDITIONS

Existing conditions are investigated and evaluated as part of the methodology. It is necessary to gain an understanding of the traffic flow and the roadway conditions as obtained through field study. Traffic volumes (number of vehicles by type and by time of day) are recorded by turning movement. Roadway geometrics, traffic control devices, and other environmental conditions are noted. These conditions affect traffic flow and are important in comparing the present with predicted traffic conditions.

Area Conditions and Roadway Network

The proposed project site is on barren land. The Project will be in a largely rural setting with very few urban-type uses planned for the future. Adjacent land areas are used to grow pineapples. No other major development is proposed in the adjacent area.

Lanai City lies to the North as the closest residential area. Lanai City is about 25 minutes by car or 7 miles from Manele Resort.

The vehicular access to the Manele Resort will be from Manele Road. The State maintained highway has two lanes within a 19 foot-wide pavement with 6-foot shoulders and a posted speed limit of 35 mph between Mileposts 6 and 10. From Milepost 10 to the end of Manele Road, the road is narrow and winding with pavement widths of 12-24 feet and shoulder

widths of 2 feet. There are no other major intersections along Manele Road between Kaumalapau Highway and Manele resort.

Traffic Conditions

Traffic counts along Manele Road and Kaumalapau Highway were obtained from the State Department of Transportation (DOT).

Additional turning movement counts were taken at the intersection of Manele Road with Kaumalapau Highway and Lanai Airport Road with Kaumalapau Highway by Pacific Planning & Engineering, Inc., on Wednesday, April 20, 1988, between 1:15 and 3:15 pm. Additional counts of the intersections of Kaumalapau Highway with Fraser Avenue and Lanai Avenue were taken on October 18, 1988, between 1:15 and 3:15 pm by Pacific Planning & Engineering, Inc.

The observed afternoon peak hour of the intersections occurred between 2 to 3 pm. Manual traffic count data for the intersections are shown in Appendix B. Observations were made for passenger cars, trucks, buses, bicycles, motorcycles and pedestrian volumes by turning movements and approaches. During the April 20th field counts, the weather was sunny and the pavement was dry and during the October 18th field counts, the weather was overcast and dry. The survey was conducted to establish a baseline condition to compare against estimated future traffic.

Capacity and Drivability--Manele Road

At present, there is no intersection that provides access to the Manele Resort site from Manele Road, therefore no intersection analysis is possible. In addition, the configuration of the future realigned Manele Road will be to provide direct and uncontrolled access to and from the Resort.

The roadway capacity of Manele Road was analyzed in accordance with the Highway Capacity Manual[1] for two-lane rural highways and the result of the analysis indicates:

1. Manele Road between Milepost 6 and 10 with an average pavement width of 19 feet, and 6-feet shoulders, has a two-way peak hour capacity of approximately 790 vehicles per hour.
2. Manele Road between Milepost 10 and 13 (end of mr) with pavement widths varying between 12 feet (along tangent sections) and 24 feet (at curves) and 2 feet shoulders, has a two-way peak hour capacity of approximately 540 vehicles per hour.

Field survey of present Manele Road conditions indicate:

1. Manele Road between Milepost 6 and 6.59 was resurfaced in 1987 and remains in very good condition.
2. Between Milepost 6.59 and 10, the bituminous surface is badly deteriorated and needs resurfacing to improve the ride condition.
3. Between Milepost 10 and 13, the roadway narrows to 12 feet for two-way traffic, forcing drivers to pull-over to permit opposing traffic to

[1] Highway Capacity Manual Special Report 209 1985 edition

pass. Although the roadway surface was treated with 2 applications of bituminous material between 1982 and 1983, the surface is showing signs of stress and is beginning to deteriorate at numerous locations. Because of its narrow pavement width and the winding roadway with occasional moderately steep grades, driving comfort is relatively low along this segment of Manele Road.

FUTURE CONDITIONS

Research of planned developments on the island of Lanai was conducted to determine future traffic conditions. These future conditions determine future traffic and are used in determining year 2003 traffic projections.

In order to accurately estimate the future traffic on Lanai, all known major developments on the island must be accounted for. Table 1 below lists the presently known developments that are accounted for in this report.

Table 1. Future Land Uses for Lanai

Land Use	Number	Unit
Commercial/Business	4417	sq. ft
Single Family Residential (Lalakoa III)	144	units
Multi-Family Residential (Queens Multi-Family)	132	units
Multi-Family Residential	132	units
Single Family Residential	502	units
Resort Hotel (Koele Lodge)	252	rooms
Multi-Family Residential (Waialua Multi-Family)	80	units
Single Family Residential (Lower Waialua Annex)	120	units
Low Rise Apartment (Lanai City Apartments)	24	units
Light Industrial (3 Buildings)	10.6	acres

TRAFFIC IMPACT ANALYSIS

The Study's main goal is to arrive at some conclusions on how well traffic would be moving at the study intersections along Kaumalapau Highway. The conclusions must be based on some objective and empirical measures, studied through recognized procedures and planning experience.

Future traffic forecasts without and with the project were estimated for the year 2003. Traffic generated by major future developments were used to forecast traffic without the project. The additional traffic volumes from ambient growth and the proposed project were added to the present traffic counts to arrive at the 2003 forecast volumes.

The established methods of trip generation, distribution and assignment were used to forecast future traffic.

Future Roadway Changes

There are no major roadway improvements within the Region being contemplated at this time by the State Highways Division for the period up to the year 2003. Planned projects would not significantly change corridor capacity.

Projected Year 2003 Traffic

An effort was made to develop a travel forecast method based on the traditional gravity model. A literature and data search was conducted to obtain information and forecasts from various sources such as State agencies, Maui County agencies, and state planning reports. Because of the dominant agricultural nature of Lanai's present activities changing to a more varied economic base, it was necessary to first develop a trip table based on known developments and estimate the percentage distribution throughout the roadway network.

Future vehicle forecast methods used are described in Appendix C. It also discusses the future traffic estimated for Manele Resort.

Table 2 below presents the results of the traffic forecasts. *For an average weekday*, the results indicate that the project will cause additional traffic at all of the study intersections. The intersection of Kaumalapau Highway with Manele Road will have the most impact of the study intersections. The largest increase of vehicles movements will occur from vehicles turning right onto Kaumalapau Highway going toward Lanai City and from vehicles turning left onto Manele Road. On specific days, it is likely that the volumes will be greater than that shown but not in any significant number. The reader is referred to Appendix C for details regarding vehicular trip generation and distribution.

Table 2. Afternoon Peak Hour Volumes

Turning Movement	1988	2003 Without GC	2003 With GC
Kaumalapau Highway & Lanai Airport Road			
Kaumalapau Highway--Eastbound (To Lanai City)			
Left	0	0	0
Through	26	65	70
Right	1	2	2
Kaumalapau Highway--Westbound (To Kaumalapau Harbor)			
Left	18	45	60
Through	35	88	98
Right	2	6	6
Lanai Airport Road--Northbound			
Left	2	5	5
Through	0	0	0
Right	18	51	68
Dirt Road--Southbound			
Left	3	7	7
Through	0	0	0
Right	0	0	0
Kaumalapau Highway & Manele Road			
Kaumalapau Highway--Eastbound (To Lanai City)			
Left	5	8	8
Through	53	168	168
Right	6	10	32
Kaumalapau Highway--Westbound (To Kaumalapau Harbor)			
Left	11	77	122
Through	41	138	138
Right	2	5	5
Manele Road--Northbound			
Left	1	3	28
Through	7	17	17
Right	23	103	177
Dirt Road--Southbound			
Left	3	7	7
Through	5	12	12
Right	3	7	7

Table 2. Afternoon Peak Hour Volumes Continued

Turning Movement	1988	2003 Without GC	2003 With GC
Kaumalapau Highway & Fraser Avenue			
Kaumalapau Highway--Eastbound			
Left	32	84	117
Through	67	195	236
Kaumalapau Highway--Westbound (To Kaumalapau Harbor)			
Through	52	136	158
Right	14	41	41
Fraser Avenue			
Left	10	24	24
Right	10	84	107
Kaumalapau Highway & Lanai Avenue			
Kaumalapau Highway--Eastbound			
Left	48	179	220
Through	5	5	5
Right	5	6	6
Kaumalapau Highway--Westbound (To Kaumalapau Harbor)			
Left	3	3	3
Through	3	3	3
Right	2	3	3
Lanai Avenue--Southbound			
Left	10	11	11
Through	30	38	38
Right	48	156	178
Lanai Avenue--Northbound (To Koele)			
Left	6	9	9
Through	17	26	26
Right	4	4	4

Level-of-Service

The study intersections were analyzed to determine the Level-of-Service (LOS), using the field data from the manual traffic counts, the forecasts of the future traffic demands, and analysis techniques for unsignalized intersections from the Highway Capacity Manual (HCM). The Level-of-Service for the traffic movements in an intersection is divided into six categories ranging from little or no delay (A) to extreme traffic delays (F). Appendix A provides the definitions for each LOS category.

Traffic Impact of the Proposed Manele Golf Course Project

A comparison of 2003 Level-of-Service results at the study intersections without and with the Manele Golf Course project is given in Table 3 below. The Level-of-Service (LOS) categories for each turning movement are presented for the years 1988 and 2003 without and with the project.

The results of the LOS analysis show that all intersections in 1988 operate at LOS A, little or no traffic delays. In 2003 without the project, the level-of-service remains at A for all the study intersections. With the proposed project in 2003, most of the study intersections will continue to operate at LOS A for all movements. There is one intersection whose level-of-service declines, that is the intersection of Kaumalapau Highway with Manele Road. At this intersection, the dirt road to the pineapple fields experience a decrease of level-of-service from LOS A (little or no traffic delays) to LOS B (short traffic delays). With the few vehicles (26 vehicles exiting in the peak hour) expected to travel on the dirt road so there is not

expected to be a noticeable decrease in level-of-service for this movement. This intersection is anticipated to continue to operate without difficulty during the afternoon peak hour with the proposed development.

Table 3. Level-of-Service

Turning Movement[2]	1988	2003 Without GC	2003 With GC
Kaumalapau Highway & Lanai Airport Road			
Kaumalapau Highway--Eastbound	A	A	A
Kaumalapau Highway--Westbound	A	A	A
Lanai Airport Road--Northbound	A	A	A
Dirt Road--Southbound	A	A	A
Kaumalapau Highway & Manele Road			
Kaumalapau Highway--Eastbound	A	A	A
Kaumalapau Highway--Westbound	A	A	A
Manele Road	A	A	A
Dirt Road	A	A	B
Kaumalapau Highway & Fraser Avenue			
Kaumalapau Highway--Eastbound	A	A	A
Fraser Avenue	A	A	A
Kaumalapau Highway & Lanai Avenue			
Kaumalapau Highway--Eastbound	A	A	A
Kaumalapau Highway--Westbound	A	A	A
Lanai Avenue--Southbound	A	A	A
Lanai Avenue--Northbound	A	A	A

[2]Refers to all movements: Left Turns (LT), Through movements (TH), and Right Turns (RT) whenever applicable.

CONCLUSIONS AND RECOMMENDATIONS

The proposed Manele Golf Course development, including residential homes and the resort development, when completed in the year 2003, will *not* significantly impact traffic flow on the study intersections.

The traffic forecasted for Manele Road will increase two-way peak hour traffic from the present 53 vehicles per hour to 388 vehicles per hour in the year 2003. The forecasted total traffic is below the present reduced capacity of Manele Road (540 vehicles per hour) during the afternoon peak hour.

The Level-of-Service (LOS) analysis at the critical intersection of Kaumalapau Highway and Manele Road indicates almost no change in the LOS for all shared lanes, even with the on-going and proposed developments at Lanai City and Manele Resort. Only one movement will change LOS from no delays, LOS A, to little delays, LOS B. However, we recommend Manele Road be realigned or portions of the existing road be widened and resurfaced to current standards.

APPENDIX A

Definition of Level-of-Service

Unsignalized Intersections, and Two-Lane Highways

APPENDIX A

DEFINITION OF LEVEL-OF-SERVICE

For unsignalized intersections, the traffic most impacted will be the minor or cross-street with the stop or yield control. The major roadway will have the right-of-way. The level-of-service is the amount of delay expected for the average vehicle desiring to cross or enter the major road. The following gives a general description of the measure.

The concept of levels of service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. A level of service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Six levels of service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with level-of-service A representing the best operating conditions and level-of-service F the worst.

Level-of-Service definitions--In general, the various levels of service are defined as follows for uninterrupted flow facilities:

Level-of-service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely

high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

Level-of-service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

Level-of-service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

Level-of-service D represents high-density, but stable, flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

Level-of-service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuver. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

Level-of-service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go wave, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of the vehicles or pedestrians discharged from the queue may be quite good. Nevertheless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and level-of-service F is an appropriate designation for such points.

These definitions are general and conceptual in nature, and they apply primarily to uninterrupted flow. Levels of service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them.

TWO-LANE HIGHWAYS

The highest quality of traffic service occurs when motorists are able to drive at their desire speed. Without strict enforcement, this highest quality, representative of of *level-of-service A*, would result in average speeds approaching 60 mph on two-lane highways. ...almost no platoons of three or more vehicles are observed. Drivers would be delayed no more than 30 percent of the time by slow-moving vehicles.

Level-of-service B characterizes the region of traffic flow wherein speeds of 55 mph or slightly higher are expected on level terrain. Drivers are delayed up to 45 percent of the time on the average.

Level-of-service C results in noticeable increases in platoon formation, platoon size, and frequency of passing impediment. Average speed still exceeds 52 mph on level terrain... While traffic flow is stable, it is becoming susceptible to congestion due to turning traffic and slow-moving vehicles.

Level-of-service D traffic approaches unstable traffic flow. ...passing becomes extremely difficult. Mean platoon sizes of 5 to 10 vehicles are common, although speeds of 50 mph can be maintained under ideal conditions. Maximum service flow rates of 1,800 passenger cars per hour, total in both directions, can be maintained under ideal conditions. This is the highest flow rate that can be maintained for any length of time over an extended section of level terrain without a high probability of breakdown.

Level-of-service E is defined as traffic flow conditions having a percent time delay of greater than 75 percent. Passing is virtually impossible under these conditions, and platooning becomes intense when slower vehicles or other interruptions are encountered. The highest attainable volume under E is the capacity of the highway. Under ideal conditions, capacity is 2800 pcph, total in both directions. This value decreases as the directional split of traffic changes from a 50/50 split to 0/100.

When traffic demand exceeds capacity, *Level-of-service F* is heavily congested flow. Volumes are lower than capacity, and speeds are below capacity speed.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

APPENDIX B

MANUAL TRAFFIC COUNT DATA

Location: Kaumalapau Highway @ Lanai Avenue
Date: October 18, 1988

	Kaumalapau Highway						Lanai Avenue					
	Eastbound			Westbound			Northbound			Southbound		
Time (pm)	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
1:45-2:00	0	2	0	0	0	0	1	0	10	8	2	1
2:00-2:15	2	7	2	0	0	0	0	1	14	17	7	1
2:15-2:30	0	3	2	2	1	1	2	0	12	15	6	6
2:30-2:45	1	3	2	0	1	2	0	3	11	10	6	1
2:45-3:00	1	4	0	0	1	0	3	1	11	6	11	2
Peak Hour (2:00-3:00)	5	5	48	2	3	3	4	17	6	48	30	10

Location: Kaumalapau Highway @ Fraser Avenue
Date: October 18, 1988

	Kaumalapau Highway				Fraser Avenue	
	Eastbound		Westbound		Southbound	
Time (pm)	LT	TH	RT	TH	RT	LT
1:45-2:00	6	11	0	13	1	2
2:00-2:15	11	15	3	13	0	1
2:15-2:30	7	16	6	18	6	1
2:30-2:45	8	15	4	13	1	4
2:45-3:00	6	21	1	8	3	4
Peak Hour (2:00-3:00)	32	67	14	52	10	10

Location: Kaumalapau Hwy @ Manele Road
Date: April 20, 1988

	Kaumalapau Highway						Manele Road					
	Eastbound			Westbound			Northbound			Southbound		
Time (pm)	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
1:45-2:00	0	14	1	1	13	2	2	2	0	0	0	1
2:00-2:15	0	12	2	0	19	2	4	0	1	0	2	1
2:15-2:30	2	12	1	1	7	4	4	2	0	2	1	0
2:30-2:45	3	13	1	0	10	4	6	3	0	0	1	0
2:45-3:00	1	15	0	1	5	1	9	2	0	1	1	0
Peak Hour												
(2:00-3:00)	6	53	5	2	41	11	23	7	1	3	5	3

Location: Kaumalapau Hwy @ Lanai Airport Road:
Date: April 20, 1988

	Kaumalapau Highway						Lanai Airport Road					
	Eastbound			Westbound			Northbound			Southbound		
Time (pm)	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
1:30-1:45	1	4	0	1	8	3	2	0	2	0	0	0
1:45-2:00	0	8	0	0	13	6	6	0	0	0	0	1
2:00-2:15	0	6	0	1	3	3	5	0	0	0	0	0
2:15-2:30	0	8	0	0	11	6	5	0	0	0	0	2
2:30-2:45	0	7	0	0	4	1	3	0	0	0	0	2
2:45-3:00	2	12	0	0	7	3	4	0	0	0	0	0
3:00-3:15	0	3	0	0	4	0	5	0	0	0	0	0
Peak Hour												
1:30-2:30 pm	1	26	0	2	35	18	18	0	2	0	0	3

Notes:
At Lanai Airport: there were a total of 63 cars and 42 trucks counted during the Wednesday pm peak hour. Of the 42 trucks, 18 were construction -related trucks hauling materials from Kaumalapau Harbor to job sites, and debris from job sites to public land fill. No buses, bicycles, motorcycles, or pedestrians were observed at the intersection during the afternoon peak hour....

Appendix C

Forecasting Future Traffic for Lanai

This appendix describes the general method used to estimate future traffic for Lanai in the year 2003, when the proposed Golf Course and Resort will be completed. The three step method consists of trip generation, distribution and assignment.

Up to the present, Lanai's primary economic activities have been agricultural, with a rural life style for the residents. Traffic patterns and vehicle use reflect the present agricultural and construction activities. As Lanai's activities become more diversified, with visitor business and related commercial activities, traffic patterns will reflect a more urban type of vehicle use. Lanai's traffic generation will not be similar to that found on urban Oahu.

Several factors contribute to this conclusion. First, the majority of visitors at Manele will be transported by vans. Rental car growth at the airport will not be as significant as on other islands. Manele Resort employees also will be transported in company vans to and from Lanai City. Lanai does not have the number and variety of attractions outside of the Resort area as does Oahu, reducing the vehicle trip generation and trips outside of the Resort area.

Other important observations and assumptions include:

1. Much of the commercial activities were in existence when the resident population was higher. New establishments would be a

likely replacement of existing activities given the relatively low number of tourists.

2. Standard rates of vehicle generation would generally be too great for Lanai uses, given the general low level of population, autos, commercial, and urban recreational uses.

Trip Generation

Trip generation was estimated for the year 2003 without and with the project. Future traffic was generated for other proposed developments. Table 1 in the chapter entitled "Future Conditions" lists the known major developments on the island of Lanai. Vehicle trips entering and exiting the land uses were generated depending upon the type and the amount of the land use. These estimates were made based upon average trip rates for peak hour traffic provided in the Trip Generation Report (Fourth Edition) 1987, by the Institute of Transportation Engineers (ITE).

ITE's trip generation rates are based upon empirical data gathered in various locations. The trip generation for the ambient developments were obtained from the ITE's trip generation rates for single family detached housing, apartments, and light industrial land uses. Caution is exercised when applying such average rates. Due to the rural nature of Lanai, it will not have the number and variety of attractions as does a metropolitan area, such as Honolulu. The rates for the ambient developments are given in Table C-1.

The trip generation rates for Manele Resort were also obtained from the ITE's Trip Generation Report and is shown in Tables C-2 and C-3. These

vehicle trips for 2003 would be in addition to those existing today. Trips were generated using the trip generation rates for recreational homes for the 425 residential units. For the hotel, trips were generated using the rates for resort hotel. The trips for the golf course was generated using the rates for golf courses. The daily and afternoon peak hour rates are given along with the related number of external trips for each zone.

The trips for the commercial areas for the resort were generated a different way. The rates in the ITE Trip Generation report were developed using large shopping center data which produced rates that were too high to use for Lanai. Since the commercial uses are mainly resort related, the only vehicle trips that would be produced outside of the resort area would be guests from Koele Lodge who wish to shop at Manele. Assuming a worst case condition of 100% double occupancy at Koele Lodge, there would be about 500 potential shoppers staying at Koele Lodge. Since not everyone would shop at Manele everyday, we assumed 1/3 of the 500 people would shop at Manele in a typical day, making 168 visitors throughout the day. Of the 168 visitors, we assumed 10% would enter and leave during the afternoon peak hour, making 17 vehicles enter and exit Manele Road during the peak hour at a 50/50 split.

Table C-1. Trip Generation Rates and Generated Trips--Ambient Growth For Afternoon Peak Hour

Land Use	Units	ITE Rate		No. of Trips	
		Enter	Exit	Enter	Exit
Commercial/Business	4417 s.f.	2.4/1000	2.4/1000	11	11
Single Family DU	144 units	0.63	0.37	91	53
Multi-Family DU	132 units	0.37	0.19	49	25
Multi-Family DU	132 units	0.37	0.19	49	25
Single Family DU	502 units	0.63	0.37	316	186
Resort Hotel	252 rooms	0.31	0.26	78	66
Multi-Family DU	80 units	0.37	0.19	30	15
Single Family DU	120 units	0.63	0.37	76	44
Low Rise Apartment	24 units	0.41	0.22	10	5
Light Industrial	10.6 acres	2.96	5.87	29	62

Table C-2. Trip Generation Data and Vehicle Trips for Project

Land Use	ITE Rates[1] Daily		Adjusted Daily		PM Peak Hour	
	Enter	Exit	Enter	Exit	Enter	Exit
Resort Hotel	9.20	9.20	5.52	5.52	0.31	0.26
Resort Homes	1.60	1.60	1.60	1.60	0.11	0.15
Golf Course	4.17	4.17	2.09	2.09	0.03	0.36

[1]Average rates, "Trip Generation," Institute of Transportation Engineers, 1987.

Table C-3. Vehicle Trips--Manele Resort

Land Use	Daily		PM Peak Hour	
	Enter	Exit	Enter	Exit
Resort Hotel				
150 rooms	828	828	47	39
250 rooms	1380	1380	78	65
Resort Homes				
425 units	680	680	47	64
Golf Course				
164 acres	343	343	5	59
Commercial			9	8

Future ambient vehicle trips for Lanai Airport and Kaumalapau Harbor were based on State Department of Transportation (DOT) master plan

Future ambient vehicle trips for Lanai Airport and Kaumalapau Harbor were based on State Department of Transportation (DOT) master plan information. Currently in draft, the Statewide Airport System Plan provides forecast passenger and aircraft operations until the year 2005. Based on these values, a rate of increase of 175 % was estimated and applied to the present traffic volumes representing new vehicle trips.

Based on the master plan for the harbor, an increase of roughly 3.5 acres or about 67% of the existing area was estimated and applied to the existing vehicle trips. Since there is no indication from other planning sources of major growth in economic activities which would imply greater values, the 67% growth was applied to existing vehicle trips.

Trip Distribution

Trip distribution assigns trips to their expected origins and destinations. The distribution was based on travel time and trip purpose between zones. Existing trip purposes will change substantially, as different and greater development occurs. With the limited number of land uses, trip purposes and travel routes on Lanai, the situation is not as complex as for urban areas where many identical land uses compete for the distribution of the vehicle trips.

A straight-forward estimation of the trips between major areas was made by distributing the projected trips among the major destinations on Lanai. The major areas that would attract trips include Lanai City, Manele Bay, Lanai Airport and Kaumalapau Harbor. The percentages were based on the amount of land uses in each area and the relation of the land uses with each area being considered. For example, the trips from Manele Bay to Kaumalapau Harbor was estimated to be much smaller than

the trips bound to Lanai City because not only does Lanai City have a greater variety of land uses than the harbor, Lanai City's land uses hold a greater attraction to those who would frequent Manele Bay.

For the project generated trips, each land use was distributed differently. For the resort hotel, since there are not many attractions outside of the resort area for tourists, 40% of the trips were assumed to stay within the resort. It was assumed that 30% of the residential trips would stay within the resort area also. Since the guests from Manele Hotel and Koele Lodge are the most likely to use the golf course, 50% of the trips were assumed to enter/exit the resort area.

Traffic Assignment

Traffic assignment is the designation of the trips between all zones to the road network. Presently, the road network for Lanai is simple with no alternative routes between zones and none anticipated in the year 2003. All trips between the zones were manually assigned to the road network. Figure C-1 shows the present afternoon peak hour volumes, Figure C-2 shows the projected afternoon peak hour volumes for the year 2003 without the project, and Figure C-3 shows the projected afternoon peak hour volumes with the project for the year 2003.

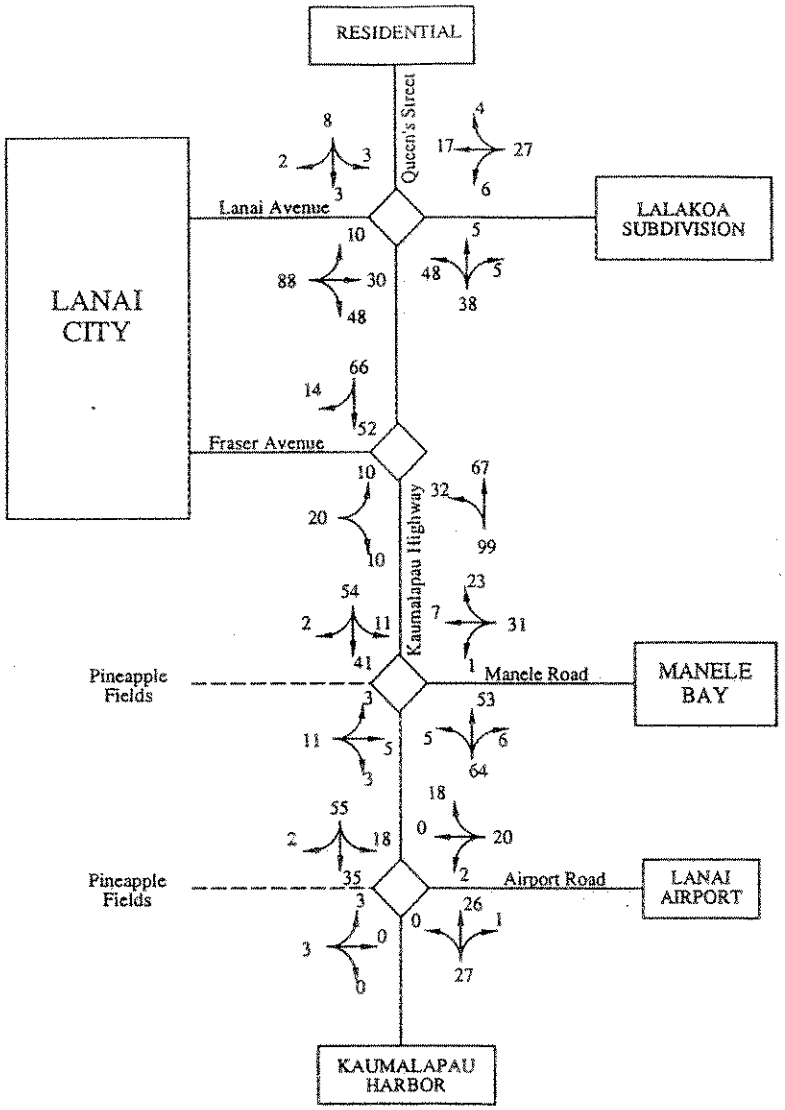

Figure C-1. 1988 Afternoon Peak Hour Traffic

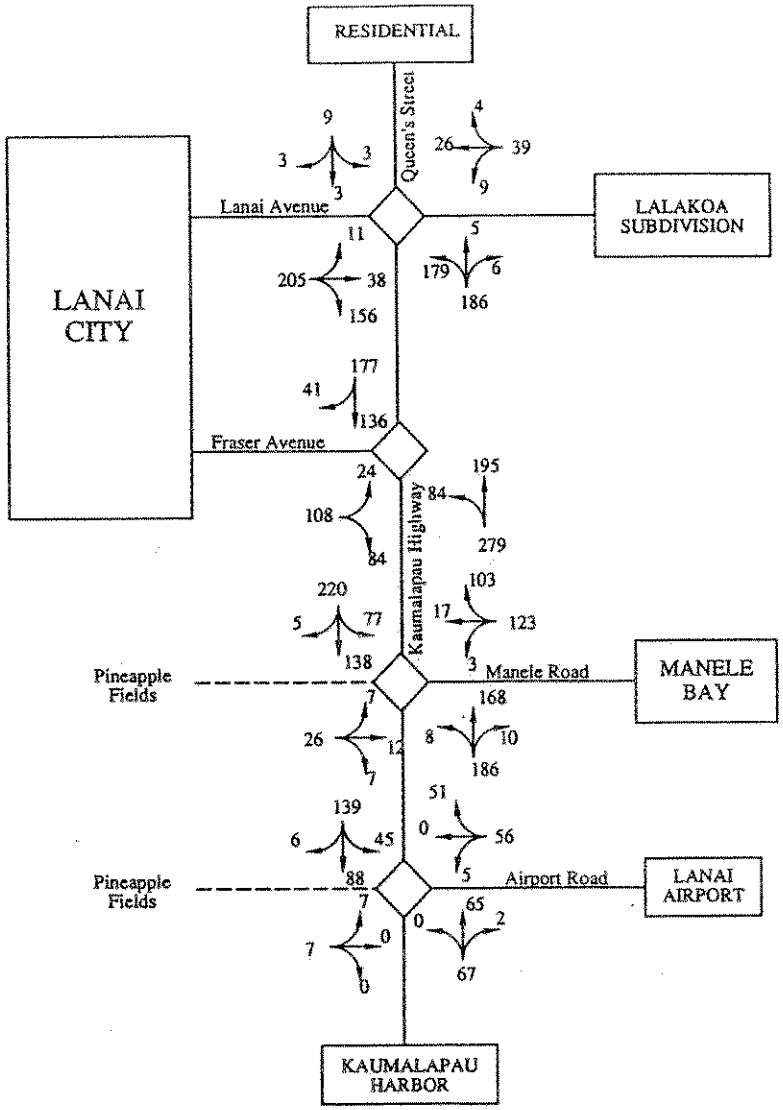

Figure C-2. 2003 Afternoon Peak Hour Traffic Without Project

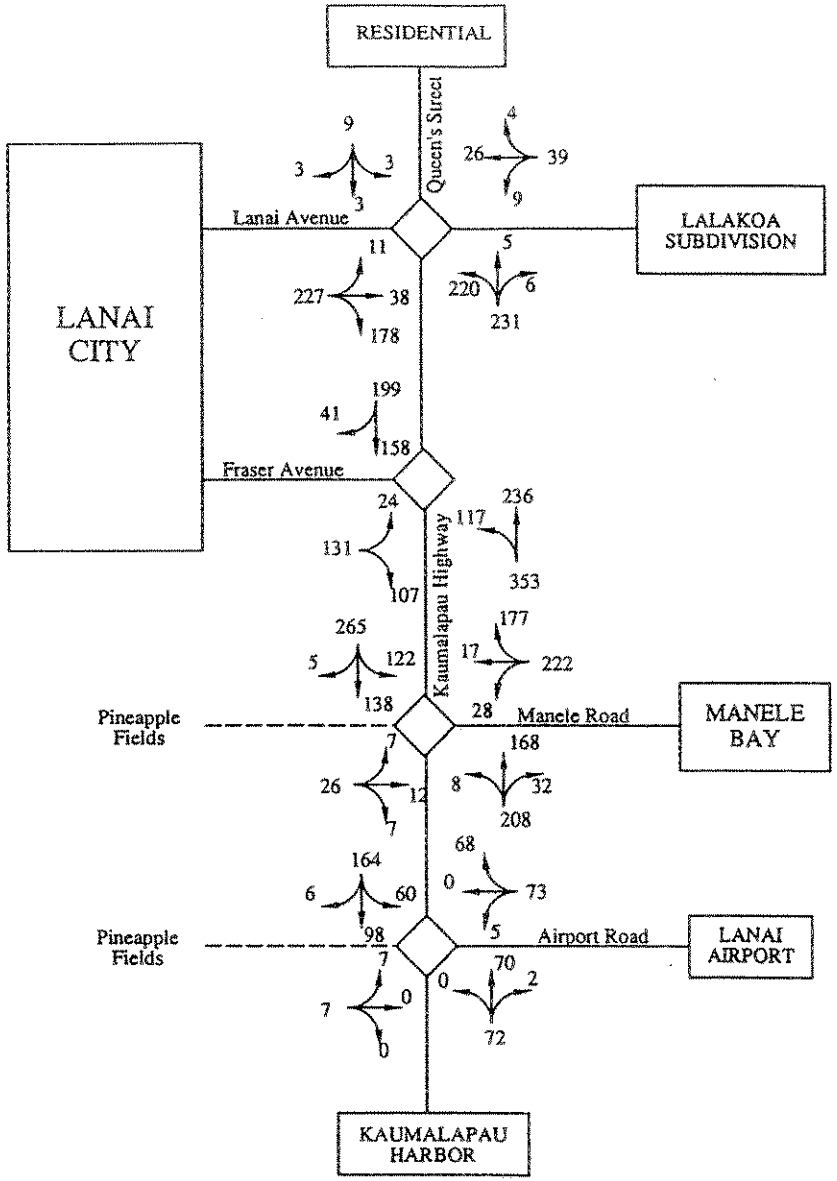

Figure C-3. 2003 Afternoon Peak Hour Traffic
With Project

G: AIR QUALITY STUDY

AIR QUALITY STUDY

FOR THE PROPOSED

MANELE GOLF COURSE PROJECT

MANELE, LANAI, HAWAII

Prepared for:

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September 1990

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3 Estimated Worst-Case 8-Hour Carbon Monoxide Concentrations Along Roadways Leading to the Proposed Manele Golf Course Project

4 Estimated Indirect Air Pollutant Emissions from Manele Golf Course Project Electrical Demand

5 Estimated Potential Air Pollutant Emissions from Incineration of Solid Wastes from Proposed Manele Golf Course Project

1.0 INTRODUCTION AND PROJECT DESCRIPTION

Castle & Cooke, Inc. proposes to construct a resort development at Manele, Lanai which will include an eighteen hole golf course, about 5 acres of commercial area and 425 residential units. A 250-room hotel is presently under construction in the area and an additional 150 rooms are planned by 2003. Figure 1 shows the general project location and Figure 2 shows the Conceptual Master Plan. The project site consists of unused, sloping land covered with sparse vegetation. The site is bordered on the south by Hulopoe Bay and Beach Park and the Manele Small Boat Harbor. Proposed land use within the Manele Resort area is as follows: 687 acres for golf course and open space use; 87 acres for 325 single-family dwelling units and 100 multi-family units; 66 acres for parks; 50 acres for the resort hotel; and a little over 5 acres for commercial use. Full development of the Manele Resort area is expected to be completed by 2003. Roadway access will be via a T-intersection off Manele Road slightly before the intersection of Manele Road with the current road to the Manele Small Boat Harbor.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short-term and long-term direct and indirect air quality impacts that could result from the construction and use of the proposed development as planned. Measures to mitigate potential impacts are suggested where possible.

2.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal

Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, AAQS have been established for six air pollutants. These regulated air pollutants include: particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. National AAQS are stated in terms of primary and secondary standards. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow one exceedance per year.

State of Hawaii AAQS are in some cases considerably more stringent than comparable national AAQS. In particular, the State of Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

Under the provisions of the Federal Clean Air Act [1], the U.S. Environmental Protection Agency (EPA) is required to periodically review and re-evaluate national AAQS in light of research findings more recent than those which were available at the time the standards were originally set. Occasionally new standards are created as well. Most recently, the national standard for particulate matter has been revised to include specific limits for particulates 10 microns or less in diameter (PM-10) [2]. The State of Hawaii has not explicitly addressed the question of whether to set limits for this category of air pollutant, but national AAQS prevail where states have not set their own more stringent levels.

Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make them essentially the same as national limits. It has been proposed in various forums that the state also relax its carbon monoxide standards to the national levels, but at present there are no indications that such a change is being considered.

3.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout the state most of the year, significant differences in these parameters may occur from one location to another. Most differences in regional and

local climates within the state are caused by the mountainous topography. While no specific climatological record exists for the Manele area of Lanai, it is possible to infer some climatological values by comparison to other stations on Lanai and similar locales elsewhere in the Hawaiian islands.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. The Manele area, however, is sheltered from the trade winds by high mountains on the nearby islands of Molokai and Maui. Due to this wind shadow effect, winds at Manele are predominantly light and variable. Local winds such as land/sea breezes and/or upslope/downslope winds tend to dominate the wind pattern for the area. During the daytime, winds typically move onshore because of seabreeze and/or upslope effects. At night, winds generally are land breezes and/or drainage winds which move downslope and out to sea. At Manele this diurnal wind pattern could include calm or nearly calm conditions on the order of 25 percent of the time.

G4

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's

sheltered location and low-level elevation should result in a relatively moderate temperature profile compared to other windward locations near sea level. At Lanai City, located near 1600 ft above sea level, average daily minimum and maximum temperatures are 62°F and 76°F, respectively. The extreme minimum temperature on record at this location is 48°F, and the extreme maximum is 87°F. Temperatures at the lower elevation of the project site are likely to range about 5 or 6 degrees higher than those at Lanai City.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. For air pollution modeling turbulence is usually measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 the least. Thus, air pollution dissipates best during stability class 1 conditions and worst when stability class 6 prevails. In the Manele area, stability class 5 or 6 could occur during clear, calm nighttime or early morning hours when temperature inversions form either due to radiational cooling or to downslope winds that push warmer air aloft. Stability classes 1 through 4 should prevail during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the

trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas may also experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Although there is no mixing height data for Lanai, mixing heights elsewhere in the state typically are above 3000 feet (1000 meters). Mixing heights in the Manele area probably tend to be somewhat lower due to the fact that light winds often prevail and also because sea breeze conditions often develop during the daytime.

Rainfall can have a beneficial effect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it may also "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. Manele is located near sea level on the southeast coast of Lanai in the rain shadow of the West Maui mountains, which are only a short distance upwind when the usual trade winds are blowing. Lanai City, located approximately 1600 feet above sea level near the center of the island and on the windward side of the forested central mountains, receives about 40 inches of rain per year, but Manele can expect only about 10 to 20 inches. The area is thus extremely dry on a year round basis. Most of the rainfall which does occur at Manele comes in conjunction with winter storms, with only a little occurring during summer afternoons and evenings as a result of the onshore and upslope movement of moisture-laden marine air.

4.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from natural, agricultural, industrial and vehicular sources. Natural sources of air pollution emissions which may affect the project area but cannot be quantified very accurately include the ocean (sea spray), plants (aero-allergens), wind-blown dust, and volcanoes. Of these natural sources of air pollution, volcanoes are the most significant. Volcanic emissions periodically reach Lanai from the Island of Hawaii. There have been several episodes of statewide volcanic haze since the latest eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from the Hawaiian volcanoes consist primarily of sulfur dioxide. After entering the atmosphere, these sulfur dioxide emissions are carried away by the wind and either washed out as acid rain or gradually transformed into particulate sulfates. Although emissions from Kilauea are vented more than 125 miles southeast of the project site, periodic southeasterly winds in conjunction with a lower than normal temperature inversion level can spread these emissions throughout the island chain. The American Lung Association is currently studying the character and concentrations of volcanic air pollution on the island of Hawaii, but to date no results of the study are available.

Pineapple cultivation is the primary land use activity on "the Pineapple Isle" and fugitive dust emissions from field operations are the major source of airborne contaminants on a daily basis. Less frequently (about once every three or four years) a field is burned to rid it of the remains of its past crop so that the field can be made ready for replanting. Under adverse dispersion conditions this activity can result in significantly elevated levels of airborne particulates and carbon monoxide.

At present the only industrial "smoke stack" air pollution source on Lanai is the small Maui Electric Company power plant. This plant provides on the order of 10 million kilowatt-hours of electricity annually to less than 1000 customers. On nearby Maui, by comparison, annual electric demand is about 50 times higher. Present emissions of industrial pollutants on Lanai are thus estimated to be insignificant.

Aside from a few paved streets within Lanai City, Kaumalapau Highway and Manele Road constitute the only significant paved roadways on the southern half of the island. Some contamination from the exhausts of motor vehicles traversing these and other unpaved roadways occurs, but there are presently too few vehicles on Lanai to result in significant concentrations of exhaust pollutants even near the major intersections of these roadways. The significant network of unpaved roadways related to agricultural operations and the extremely narrow width of much of Manele Road leads to a large degree of airborne dust generation as vehicles approaching each other on the narrower sections of Manele Road are forced to operate with one set of wheels on the dusty shoulder of the road. Likewise vehicles entering paved roadway sections from unpaved access roads track a fair amount of dirt onto the pavement. Other vehicles traveling over this dirt pulverize and suspend it, thus creating some fugitive dust even from paved roadways.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state. Unfortunately no such data exists for the island of Lanai. The only existing monitoring data in the vicinity of the project site consist of sulfur dioxide and particulate measurements that were made about 23 miles to the east at Kihei, Maui. Long term

measurements of 24-hour average sulfur dioxide concentration at this location have been consistently low with daily mean values ranging from less than 5 to 13 $\mu g/m^3$. No exceedances of the state/national 24-hour AAQS for sulfur dioxide were recorded. In 1985 24-hour particulate concentrations at Kihei ranged from 16 to 190 $\mu g/m^3$ with four violations of the state AAQS then in effect. By 1986 the number of violations had decreased to only one, and in 1987 the monitor was changed to record only PM-10 (particulate matter under 10 microns in diameter) with annual ranges of 11 to 107 $\mu g/m^3$. This level is within the allowable federal standard and the state of Hawaii has no comparable limit. Kihei has an agricultural/resort environment similar to that currently existing on Lanai, and particulate and sulfur dioxide readings there are probably fairly representative of those that occur in the Manele area.

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems; concentrations of these contaminants generally have not been found to exceed AAQS elsewhere in the state. Carbon monoxide air pollution, on the other hand, typically is a microscale problem caused by congested motor vehicular traffic. In traffic congested areas such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Present concentrations of carbon monoxide in the project area are estimated later in this study based on mathematical modeling of motor vehicle emissions.

5.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions which could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there could also be short-term impacts from exhaust emissions emanating from slow-moving construction equipment traveling to and from the project site and from a temporary increase in local traffic caused by commuting construction workers.

Fugitive dust emissions may arise from grading and dirt-moving activities associated with site preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately because it varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [3] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Because of the arid nature of the project site, uncontrolled fugitive dust emissions from the proposed project would probably be somewhat higher than this level. In any case, State of Hawaii Air Pollution Control Regulations [4] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by establishment of a frequent watering program to keep bare-dirt surfaces in work areas from becoming significant dust generators. In some cases, limiting the area that can be disturbed at any given time may be necessary. Control regulations also require that open-bodied trucks be covered at all times when in motion if they are transporting materials likely to give rise to airborne dust. Paving of parking areas and/or establishment of landscaping as early in the construction process as possible can also lower the potential for fugitive dust emissions.

On-site mobile and stationary construction equipment will also emit some air pollutants in the form of engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Indirectly, slow-moving construction vehicles on roadways leading to and from the project site could obstruct the normal flow of traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy construction equipment during periods of low traffic volume. Likewise, the schedules of commuting construction workers can be adjusted to avoid peak hours in the project vicinity. Thus, most potential short-term air quality impacts from project construction can be mitigated.

6.0 LONG-TERM IMPACTS OF PROJECT

6.1 Roadway Traffic

By serving as an attraction for increased motor vehicle traffic on nearby roadways, the proposed project is considered to be an indirect air pollution source. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides, and those burning leaded gasoline contribute lead to the atmosphere. The use of leaded gasoline in new automobiles is now prohibited. As older vehicles continue to disappear from the numbers of those currently operating on the state's roadways, lead emissions are approaching zero. Nationally, so few vehicles now require leaded gasoline that the EPA is proposing a total ban on leaded gasoline to take effect immediately. Even without such a ban, reported quarterly averages of lead in air samples collected in urban Honolulu have been near zero since early 1986. Thus, lead in the atmosphere is not considered to be a problem anywhere in the state.

Federal air pollution control regulations also call for increased efficiency in removing carbon monoxide and nitrogen oxides from the exhausts of new motor vehicles. By the year 2003 carbon monoxide emissions on a per vehicle basis are expected to be more than 40 percent less on the average than the amounts now emitted due to the replacement of older vehicles with newer models. Further reductions in vehicular emissions have recently been proposed by the President for areas of the country which do not currently meet AAQS, mainly through the use of alternative fuels.

To evaluate the potential long-term indirect air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem, whereas nitrogen oxides air pollution most often is a regional issue. This is reflected in the fact that the AAQS for carbon monoxide are specified on a short-term basis (1-hour and 8-hour averaging times) while the AAQS for nitrogen dioxide is set on an annual basis.

For this project, three scenarios were selected for the carbon monoxide modeling study: year 1990 with present conditions, year 2003 without the project, and year 2003 assuming the project is built and complete. To begin the modeling study, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic cycling: decelerating, stopping, queuing and accelerating. For this study, the four key intersections of Kaumalapau Highway with Lanai and Fraser Avenues and Manele and Airport Roads were selected for air quality analysis. The traffic impact assessment report for the project [5] describes the present and future conditions and configurations of these intersections in detail.

The main objectives of the modeling study were to estimate both current and projected levels of maximum 1-hour average carbon monoxide concentrations which could then be directly compared to

the national and state AAQS. Although worst-case emission and meteorological dispersion conditions typically occur during the morning hours at many locations, the traffic impact assessment report indicates that traffic volumes are and will be higher during the afternoon peak period. Thus, for this case, afternoon meteorological conditions were assumed to prevail during the peak traffic hour, and worst-case concentrations were computed for that time of day.

The EPA computer model MOBILE4 [6] was used to calculate vehicular carbon monoxide emissions for each of the years studied. One of the key inputs to MOBILE4 is vehicle mix. Based on recent vehicle registration figures, the present and projected vehicle mix in the project area is estimated to be 91.9% light-duty gasoline-powered vehicles, 4.2% light-duty gasoline-powered trucks and vans, 0.5% heavy-duty gasoline-powered vehicles, 1% diesel-powered trucks and buses, and 1% motorcycles.

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Other key inputs to the MOBILE4 emission model are the cold/hot start fractions. Motor vehicles operating in a cold- or hot-start mode emit excess air pollution. Typically, motor vehicles reach stabilized operating temperatures after about 4 miles of driving. For Lanai traffic it was assumed that about 25 percent of all vehicles would be operating in the cold-start mode and that about five percent would be operating in the hot-start mode. These operational mode values were estimated based on a report from the California Department of Transportation [7] and taking into consideration the likely origins of traffic operating through the intersections studied. MOBILE4 idle emissions (which pertain to stabilized engines) were adjusted to account for excess cold/hot-start emissions per a recent U.S. EPA memorandum [8].

An ambient temperature of 68 degrees F was used for afternoon peak-hour emission computations. This is a conservative assumption since afternoon ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE4 are inversely proportional to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE4, these data were then input to the latest version of the computer model CALINE4 [9]. CALINE4 was developed by the California Transportation Department to simulate vehicular movement and atmospheric dispersion of vehicular emissions. It is designed to predict 1-hour average pollutant concentrations along roadways based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data were obtained from the traffic study for the project. Traffic volumes for the future scenario include project traffic as well as traffic from other growth that is expected to occur in the area by the year 2003. Traffic queuing estimates were made based on the project traffic study, Transportation Research Board procedures [10], U.S. EPA guidelines [11], and traffic observations at the subject intersections.

Model roadways were set up to reflect actual roadway geometry, physical dimensions and operating characteristics. Model receptor sites were located approximately 3 meters from the edge of the roadways near the intersections studied. All receptor heights were placed at 1.5 meters above ground to simulate levels within the normal human breathing zone. There are no sidewalks in the vicinity of any of these intersections, and it is unlikely that

anyone would remain at any of these locations for a one hour period. Housing is located in the general vicinity of the Lanai, Fraser, and Manele intersections, but it is situated much further back than 3 meters from the edge of the roadway.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 4 was assumed. This is the most conservative stability category that can be used for estimating pollutant dispersion during the afternoon. A surface roughness length of 100 cm was assumed with a mixing height of 800 meters above sea level. Worst-case wind conditions were defined as a wind speed of 1 meter per second (2 miles per hour) from whichever wind direction resulted in the highest predicted concentration.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be minimal. Hence, background contributions of carbon monoxide from sources or distant roadways not directly considered in the analysis were accounted for by adding a background concentration of 0.1 ppm to all predicted concentrations for both the 1990 and 2003 scenarios.

Table 2 summarizes the final results of the modeling study in terms of the estimated worst-case 1-hour ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for three scenarios: year 1990 with existing traffic, year 2003 without project traffic and year 2003 with project traffic. The locations of these estimated

worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As shown in the table, the estimated present worst-case 1-hour carbon monoxide concentration in the project area, 2.9 mg/m^3, occurs near the intersection of Lanai Avenue with Kaumalapau Highway. By the year 2003, the offsetting effects of increased traffic but lower emission levels per vehicle yield no net change in this level. The small increase in traffic at this intersection associated with the proposed project will result in only a small increase in peak-hour, worst-case carbon monoxide levels to about 3.1 mg/m3.

More substantial traffic volume increases are expected at the other three intersections studied with the result that future levels of carbon monoxide are predicted to be substantially higher than present levels (by as much as three times near the Manele Road intersection), but future levels of carbon monoxide at these locations are still not expected to go higher than present levels at the Lanai Avenue intersection. The reason current worst-case concentrations at the Lanai intersection are significantly higher than present values at the other intersections is that current traffic levels at that intersection are higher and the intersection is a full four-way intersection with stops on three legs while the others are essentially T-intersections with stops on only one leg.

All estimated worst-case 1-hour carbon monoxide levels are within the national AAQS of 40 mg/m^3 and the State of Hawaii 1-hour AAQS of 10 mg/m^3 for all scenarios studied.

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological dispersion conditions are more variable (and hence more favorable) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One recent study based on modeling [12] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [11] recommend using a value of 0.6 to 0.7 unless a locally derived persistence factor is available. Recent monitoring data for Honolulu reported by the Department of Health [14] suggests that this factor may range between about 0.35 and 0.55 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 is probably most appropriate for this application.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 3. Once again these values are well within acceptable national and State of Hawaii AAQS for all scenarios studied.

The results of this study reflect several assumptions that must be made concerning traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is not very likely, and it may occur only once a year or less. With wind

speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above.

6.2 Golf Course Pesticide Usage

Once the project is completed and the golf course is in use, it will be necessary to regularly apply various chemical pesticides to maintain grass quality. Herbicides are applied to fairways and roughs, and insecticides and fungicides are used on greens and tees. Herbicide products typically used to treat fairways and roughs include: MSMA, glyphosate, metribuzin and pendimethalin. Greens and tees may be treated with Sevin to control insects and Dithane M-45, Kocide 101 and/or Subdue to control fungi. The frequency of application for herbicide treatments is typically 2 to 4 times per year for each of the herbicide products mentioned above. Greens and tees are typically treated monthly with Sevin for insect control and semimonthly with one or more of the chemicals listed above for fungi control.

AAQS have not been established for any of the pesticides presently in use, although occupational safety and health standards have been established for some of the chemical ingredients. Most pesticide products carry warning or caution labels on their containers. The primary purpose of these labels is to provide occupational safety and health guidance regarding proper handling and application. The chief risk of using these chemicals is to the applicator rather than to individuals at possible receptor sites downwind, since these individuals should encounter airborne concentrations of these chemical substances only in greatly diluted form if at all. There are, however, certain precautions that must be followed by pesticide applicators in order to prevent significant downwind

drift when spraying. Primary among these are the use of a coarse rather than a fine spray and application under low wind speed conditions when the wind direction will not contribute to drift towards the clubhouse area or to nearby residences. If proper safety precautions are followed, the potential for serious air quality degradation from chemical spraying for golf course maintenance can be minimized.

6.3 Electrical Demand

The proposed project will also cause indirect emissions from power generating facilities as a consequence of electrical power usage. Average annual electrical demand by the project when it is fully developed is not expected to exceed two million kilowatt-hours. While this number is not in itself very large (power requirements for operating the irrigation system for pineapple cultivation at its maximum extent on the island were more than twice as much), it will constitute an increase on the order of 20 percent over current electrical demands. This power demand will be met by increased fuel usage by the diesel-powered generating facility located on the project site. Table 4 shows estimates of the increased air pollution emissions that will result from the incremental power demand that will be created by the proposed project.

6.4 Solid Waste Disposal

Solid waste generation by the proposed development when fully completed is expected to amount to about 400 tons per year, or less than one refuse truckload (six ton capacity) per twice weekly pickup. Once this trash has been picked up it will be hauled away to a landfill or incinerator at a site substantially removed from the project. If all refuse is landfilled (as is currently the

case), the only air pollution emissions associated with solid waste disposal will be exhaust and fugitive dust from trucks and heavy equipment used to place the refuse in the landfill. Present long term plans call for creation of new landfill space to meet increased solid waste disposal needs and there are no plans to incinerate any of this waste. If, at some point in the future incineration should come to be the chosen method of disposal, however, disposal of solid waste from the project would result in increased emissions of particulate, carbon monoxide and other contaminants from the incinerator stack. Table 5 shows estimated annual air pollutant emissions for 400 tons of residential trash burned at a typical municipal refuse incinerator equipped with settling chamber and water spray but no other pollution control devices.

7.0 SUMMARY OF IMPACTS AND MITIGATIVE CONSIDERATIONS

7.1 Impacts Summary

The major short-term air quality impact will be the potential emission of significant quantities of fugitive dust during project construction. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month. During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers traveling to and from the project site.

The primary long-term air pollution impact from the project will arise from the increased motor vehicle traffic associated with the project. Potential increased levels of carbon monoxide concentra-

tions along roadways leading to and from the proposed development are usually the main concern. For this project, mathematical modeling of current and projected peak hour vehicular traffic in conjunction with worst case meteorological conditions yields projected values of carbon monoxide that are well within allowable national and state of Hawaii ambient air quality standards with or without the additional traffic expected to be generated by the project. In the worst case, increased traffic loading of the Kaumalapau Highway/Manele Road intersection by project-related traffic will increase expected carbon monoxide levels there by about 1 mg/m3. This amount is barely significant in light of the fact that a background value of that order is usually added to modeled values for a typical intersection on urban Oahu.

Pesticides will be used to maintain golf course grasses. If applied during low wind conditions using proper application techniques, contamination of nearby, downwind areas by airborne drift is not expected be a problem.

Increased air pollutant emissions because of project-related increases in demand for electricity and potential incineration of solid waste will be very small.

7.2 Mitigative Considerations

Strict compliance with State of Hawaii Air Pollution Control Regulations regarding establishment of a regular dust-watering program and covering of dirt-hauling trucks will be required to effectively mitigate fugitive dust emissions from construction activities. Twice daily watering is estimated to reduce dust emissions by up to 50 percent. Paving of parking areas and

establishment of landscaping early in the construction schedule will also help to control dust. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

Long-term projections of carbon monoxide emissions from vehicular traffic associated with the completed development are based in part on the traffic impact study. Air quality modeling of these emissions show that the project will have relatively minimal impact. Thus, no specific mitigative measures appear to be necessary with regard to vehicular tail pipe emissions. It is highly recommended, however, that Manele Road be widened to the point where approaching vehicles do not have to drive with one set of wheels off the roadway in order to help mitigate the fugitive dust problem that will be associated with increased vehicular use of this roadway. Extending the pavement for about a car length off the road for those permanent unpaved roadways that adjoin Manele Road will also help to cut down on the amount of dirt tracked onto the roadway from these sources.

Compliance with existing safety guidelines for the spraying of chemicals for golf course maintenance should mitigate potential air quality impacts from this activity.

The relatively small increases in air pollutant emissions because of increased demand for electrical power and potential incineration of solid wastes likewise require no special mitigative measures, but it is worth noting that project electrical demand could be reduced somewhat by utilizing solar energy design features to the maximum extent possible. This might include installing solar water

heaters or heat pumps, designing homes and other facilities so that window positions maximize indoor light without unduly increasing indoor heat, and using landscaping where feasible to provide afternoon shade to cut down on the use of air conditioning. Use of wind power generating units, ocean thermal energy conversion and/or other alternative energy sources instead of burning fuel at the generating plant could also lessen the potential air pollution impact of project development.

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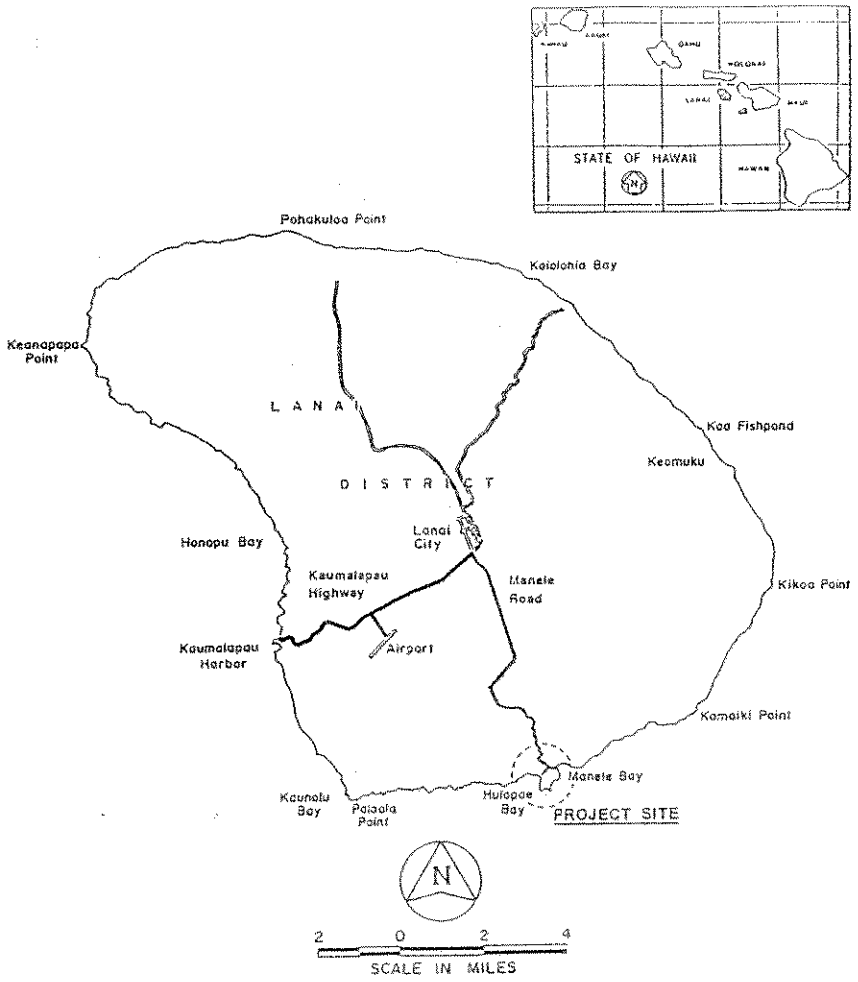

Figure 1. Project Location

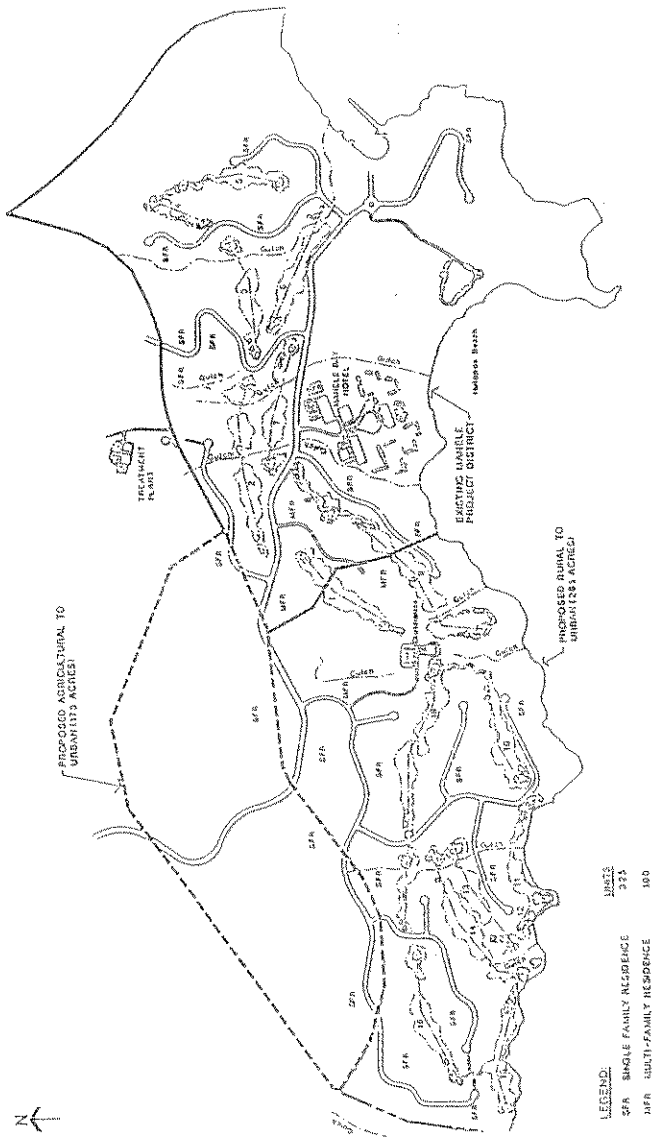

Figure 2. Manele Resort Conceptual Master Plan

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration: National Primary	National Secondary	State of Hawaii
Suspended Particulate Matter	ug/m^3	Annual	-	-	60[a]
		24 Hours	-	-	150[b]
Particulate Matter[c]	ug/m^3	Annual	50	50	-
		24 Hours	150[b]	150[b]	-
Sulfur Dioxide	ug/m^3	Annual	80	-	80
		24 Hours	365[b]	-	365[b]
		3 Hours	-	1300[b]	1300[b]
Nitrogen Dioxide	ug/m^3	Annual	100	100	70
Carbon Monoxide	mg/m^3	8 Hours	10[b]	-	5[b]
		1 Hour	40[b]	-	10[b]
Ozone	ug/m^3	1 Hour	235[b]	235[b]	100[b]
Lead	ug/m^3	Calendar Quarter	1.5	1.5	1.5

[a] Geometric mean

[b] Not to be exceeded more than once per year

[c] Particles less than or equal to 10 microns aerodynamic diameter

Table 2

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS LEADING TO THE PROPOSED MANELE GOLF COURSE PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario 1990/ Present	2003/ Without Project	2003/ With Project
Kaumalapau Highway with:			
Lanai Avenue	2.9	2.9	3.1
Fraser Avenue	0.7	1.4	1.6
Manele Road	0.8	1.5	2.6
Airport Road	0.8	1.0	1.4

Hawaii State AAQS: 10
National AAQS: 40

Table 3

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS LEADING TO THE PROPOSED MANELE GOLF COURSE PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario 1990/ Present	2003/ Without Project	2003/ With Project
Kaumalapau Highway with:			
Lanai Avenue	1.5	1.5	1.6
Fraser Avenue	0.4	0.7	0.8
Manele Road	0.4	0.8	1.3
Airport Road	0.4	0.5	0.7

Hawaii State AAQS: 5
National AAQS: 10

Table 4

ESTIMATED INDIRECT AIR POLLUTANT EMISSIONS FROM MANELE GOLF COURSE PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	0.4
Sulfur Dioxide	5.0
Carbon Monoxide	1.1
Volatile Organics	0.4
Nitrogen Oxides	4.8

[a]Based on U.S. EPA emission factors for utility gas turbines [3]. Assumes net electrical demand of two million kilowatt-hours per year and low sulfur oil used to generate power.

Table 5

ESTIMATED POTENTIAL AIR POLLUTANT EMISSIONS FROM INCINERATION OF SOLID WASTE FROM THE PROPOSED MANELE GOLF COURSE PROJECT[a]

Air Pollutant	Emission Rate (tons/year)
Particulates	2.8
Sulfur Oxides	0.5
Carbon Monoxide	7.0
Organics	0.3
Nitrogen Oxides	0.3

[a]Based on 400 tons/year of solid waste and U.S. EPA emission factors for an incinerator equipped with settling chamber and water spray [3].

NOTE: Present long term plans call for landfill burial versus incineration of solid wastes from this project in which case emissions would consist mostly of fugitive dust from landfill operation.

H. NOISE STUDY

NOISE STUDY
FOR
THE MANELE GOLF COURSE PROJECT
LANAI, HAWAII

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CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed Manele Golf Course project in Lanai, Hawaii were evaluated for their potential impacts on noise sensitive residents and hotel guests in the project environs. The Manele Golf Course project represents a change from the original planned development of the Manele Bay Hotel resort. The future traffic noise levels along the primary access roadways to the project were calculated for the Year 2003 for conditions with the proposed golf course and residental units completed as well as for conditions under the original plans for the project district.

Along Manele Road, traffic noise levels are expected to increase by 3.6 Ldn, primarily due to project traffic. Along Kaumalapau Highway, traffic noise levels are expected to increase by approximately 1.6 Ldn, with non-project traffic being the primary contributor to the future increases. The greatest increases in future traffic noise levels are expected to occur within Lanai City, but project traffic contributions to these increases are predicted to be less than 1 Ldn, which is not significant. Traffic noise impacts resulting from the proposed project are expected to be minimal due to adequate setback distances of existing noise sensitive properties from Manele Road and Kaumalapau Highway, and due to the relatively small setback distances required from the project's circulation roadways.

Adverse impacts from aircraft noise on existing and future noise sensitive properties are not anticipated because the proposed project site is sufficiently distant from Lanai Airport.

Unavoidable, but temporary, noise impacts will occur during the construction of the proposed project, particularly during the site preparation phase when blasting operations will be necessary. Because construction activities are predicted to be audible within the project and at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during

periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts. The use of monitoring during blasting operations, proper scheduling and disclosure of detonation periods, and minimization of air blast levels to 110 dBL at noise sensitive properties are recommended mitigation measures for blasting operations.

CHAPTER II. PURPOSE

The objective of this study was to describe the existing and future noise environment in the environs of the proposed Manele Golf Course and Residential Development project in Manele on the island of Lanai. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways expected to service the project traffic. A specific objective was to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Assessments of possible future impacts from aircraft noise at the project, and from short term construction noise in the project's environs were also included as noise study objectives. Recommendations for minimizing identified noise impacts were also to be provided as required.

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CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the Ldn descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the Ldn descriptor. A more complete list of noise descriptors is provided in **APPENDIX B** to this report.

TABLE 1, derived from **Reference 1**, presents current federal noise standards and acceptability criteria for residential land uses. Land use compatibility guidelines for various levels of environmental noise as measured by the Ldn descriptor system are shown in **FIGURE 1**. As a general rule, noise levels of 55 Ldn or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, Ldn levels generally range from 55 to 65 Ldn, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 Ldn, and as high as 75 Ldn when the roadway is a high speed freeway. In the Manele area, noise associated with roadway traffic are typically less than 55 Ldn due to the rural character of the area, large separation distances, and due to noise shielding effects from intervening terrain features between the project site and the main highways.

For the purposes of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 Ldn or lower is considered acceptable. This standard is applied nationally (**Reference 2**), including Hawaii. Because of our open-living conditions, the predominant use of nat-

TABLE 1

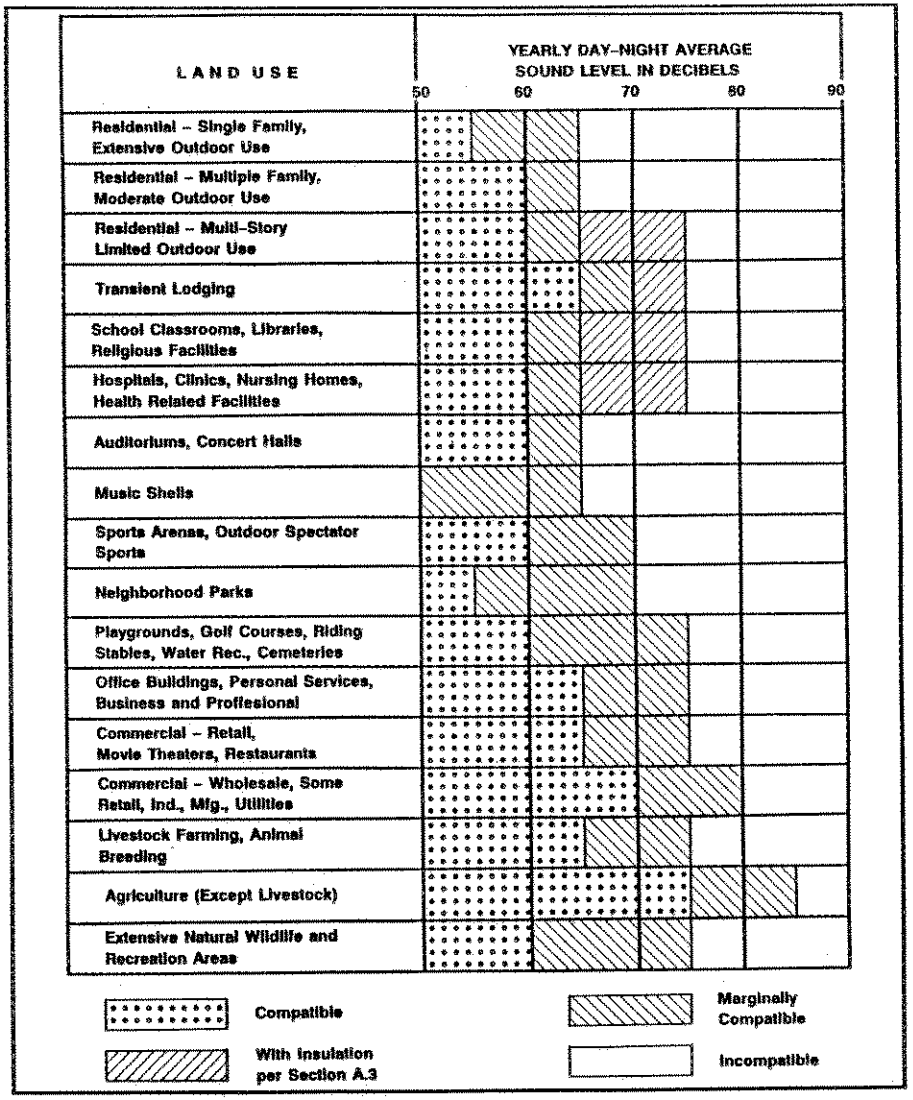
EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL[1] STANDARD
Minimal Exposure	Not Exceeding 55 L_{dn}	Not Exceeding 55 L_{eq}	Unconditionally Acceptable
Moderate Exposure	Above 55 L_{dn} But Not Above 65 L_{dn}	Above 55 L_{eq} But Not Above 65 L_{eq}	Acceptable[2]
Significant Exposure	Above 65 L_{dn} But Not Above 75 L_{dn}	Above 65 L_{eq} But Not Above 75 L_{eq}	Normally Unacceptable
Severe Exposure	Above 75 L_{dn}	Above 75 L_{eq}	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the L_{eq} instead of the L_{dn} descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 L_{eq}.

H-5



LAND USE COMPATIBILITY
WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL
AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED
(Source: American National Standards Institute S3.23-1980)

FIGURE 1

urally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 Ldn does not eliminate all risks of noise impacts. Because of these factors, and as recommended in **Reference 3**, a lower level of 55 Ldn is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 Ldn, government agencies such as FHA/HUD and VA have selected 65 Ldn as a more appropriate regulatory standard.

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 Ldn are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 Ldn.

There are no construction noise or vibration standards on the island of Lanai. On the island of Oahu, the State Department of Health (DOH) regulates noise from construction activities, through the issuance of permits for allowing excessive noise during limited time periods. State DOH noise regulations are expressed in maximum allowable property line noise limits rather than Ldn (see **Reference 4**). Although they are not directly comparable to noise criteria expressed in Ldn, State DOH noise limits for residential, commercial, and industrial lands equate to approximately 55, 60, and 76 Ldn, respectively.

It should be noted that the noise compatibility guidelines and relationships to the Ldn noise descriptor may not be applicable to impulsive noise sources. The use of penalty factors (such as adding 10 dB to measured sound levels or the use of C-Weighting filters) have been proposed. However, the relationships between levels of impulsive noise sources and land use compatibility have not been as firmly established as have the relationships for non-impulsive sources. The State DOH limits for impulsive sounds which exceed 120 impulses in any 20 minute period are 10 dB above

the limits for non-impulsive sounds. If impulsive sounds do not exceed 120 impulses in any 20 minute time period, there are no regulatory limits on their sound levels under the State DOH regulations.

For aircraft noise, the State Department of Transportation, Airports Division, has recommended that 60 Ldn be used as the common level for determining land use compatibility in respect to noise sensitive uses near its airports. In addition, for those noise sensitive land uses which are exposed to aircraft noise greater than 55 Ldn, the division recommends that disclosure of the aircraft noise levels be provided prior to any real property transactions. **Reference 5** requires that such disclosure be provided prior to real property transactions concerning properties located within Air Installation Compatibility Use Zones (AICUZ) or located within airport noise maps developed under Federal Aviation Regulation Part 150 - Airport Noise Compatibility Planning (14 CFR Part 150).

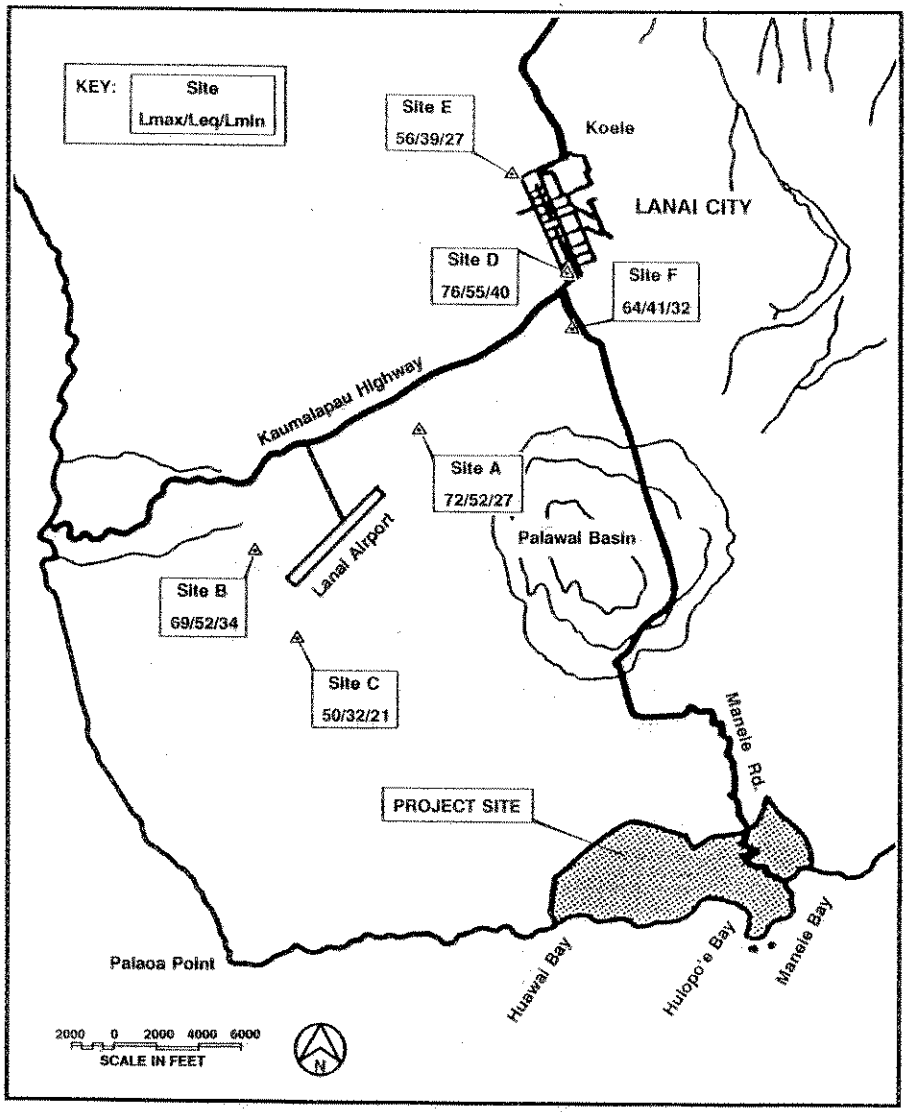
CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing background ambient noise levels were measured at six locations on Lanai. The locations of the measurement sites are shown in **FIGURE 2**. Noise measurements were performed during the latter part of CY 1988. The results of the background noise measurements at the measurement sites are also shown in **FIGURE 2**. In the figure, Lmax, Leq, and Lmin correspond to the maximum, average, and minimum sound levels recorded at each site.

Traffic noise calculations for the existing conditions (CY 1988) as well as noise predictions for the Year 2003 following project build-out were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (**Reference 6**). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and soft ground propagation loss factor. Existing and future traffic volumes were obtained from the traffic study for the project (**Reference 7**). For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were equal to the 24-hour Ldn along each roadway segment.

Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors without the benefit of shielding effects. Traffic noise levels were calculated for future conditions with the previously approved Manele Bay Hotel project completed, as well as for future conditions with the proposed golf course and additional residential units completed as proposed in the current application for Community Plan/Project District Amendment. The forecasted changes in traffic noise levels over existing levels were calculated for both scenarios, and noise impact risks evaluated. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation of possible traffic noise impacts was made.

Measurements and computer model predictions of aircraft noise



LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 2

levels were performed to determine typical noise levels to be expected from aircraft operations at Lanai Airport, and from aircraft transiting over the project site. These measurements and predictions were used to assess potential aircraft noise impacts at noise sensitive properties of the project.

Calculations of average exterior and interior noise levels from construction activities were performed for typical naturally ventilated and air conditioned dwellings. Predicted noise levels were compared with existing background ambient noise levels, and the potential for noise impacts were assessed. Potential noise and vibration impacts from blasting operations were also discussed, and mitigation measures recommended.

CHAPTER V. EXISTING NOISE ENVIRONMENT

The existing background ambient noise levels at the project site as well as in the island's population center of Lanai City are in the "Minimal Exposure, Unconditionally Acceptable" category. Background ambient noise levels in the inland portions of the project site are controlled by the natural sounds of wind, foliage, and birds, as well as by intermittent aircraft flybys. Existing background ambient noise levels at the project site are estimated to be less than 45 Ldn. Minimum instantaneous noise levels are in the order of 30 to 35 dB. In areas which are barren and without foliage, minimum background ambient noise levels are in the order of 20 to 30 dB. Near the shoreline, the ocean and surf control the level of background ambient noise, which is normally greater than 50 Ldn.

The locations and results of the November 1988 background ambient noise measurements are summarized in **FIGURE 2**. These measurements were obtained in conjunction with the recently completed FAR Part 150 Noise Compatibility Program study for Lanai Airport (**References 8 and 9**). The maximum (Lmax), average (Leq), and minimum (Lmin) noise levels obtained at the six measurement sites are indicated in **FIGURE 2**. Measured aircraft noise levels resulting from aircraft operating at Lanai Airport and from transiting aircraft generally ranged from 60 to 76 dB (Lmax) at the six monitoring sites.

Because the project site is removed from the island's highways and from the airport, background ambient noise levels at the project site should be very low. Noise levels associated with flybys of propeller aircraft range from 55 to 65 dB (Lmax) over the project site. Single event noise levels from jet aircraft departures at the project site are less than 60 dB. Existing total aircraft noise levels over the project site are less than 30 Ldn, and are considered to be compatible with the proposed golf course and residential uses.

Based on the FAR Part 150 Noise Compatibility Study results and CY 1988 noise contours which were developed for Lanai Airport, the location of the existing 55 Ldn contour is estimated to be approximately 3.6 miles northwest of the project site (see **Figure 4-1 of Reference 8**). The location of the existing 60 Ldn contour is located beyond 3.6 miles northwest of the project site. Based on the large distances of these existing aircraft noise contours from the project site, it was concluded that special aircraft noise mitigation measures are not required, and existing aircraft noise levels do not place special development constraints on the project site.

Results of calculations of existing (CY 1988) traffic noise levels during the PM peak hour period are shown in **TABLE 2**. The results of the calculations apply at 50 FT distance from the centerlines of the various roadway sections shown in the table. Calculated setback distances from these roadways to the existing 55, 60, and 65 Ldn contours are shown in **TABLE 3**. The traffic noise levels shown in the tables only apply when unobstructed line-of-sight conditions exist to the roadways. These conditions would generally occur at short (50 to 100 FT) distances to a roadway, within any flat, open space along the roadway, and at distant, but elevated locations above the roadway. The existing traffic noise levels shown in the tables should be reduced by 3 to 5 dB (or Ldn) if partial shielding (line-of-sight obstruction) exists between the roadway and the receptor location. If the receptor is located behind an obstruction (berm or hill), the noise levels in the tables and figures should be reduced by 5 to 10 dB.

TABLE 2

COMPARISONS OF CY 1988 AND CY 2003 TRAFFIC NOISE LEVELS
ALONG ACCESS ROADS TO PROJECT SITE
(PM PEAK HOUR AND 50 FT FROM ROADWAY CENTERLINES)

LOCATION	SPEED (MPH)	VPH	***** HOURLY LEQ IN dB **** AUTO	MT	HT	ALL VEH
EXISTING (CY 1988) PM PEAK HR. TRAFFIC:						
Manele Road @ Lanai City	45	53	50.6	51.6	60.9	61.8
Kaumalapau Hwy. @ Manele Rd.	50	109	55.5	56.3	65.2	66.1
Lanai Avenue	25	155	46.5	47.6	49.3	52.7
Fraser Avenue	25	66	42.8	43.9	45.6	49.0
Lalakoa Subdivision Road	25	65	42.7	43.8	45.6	49.0
CY 2003 PM PEAK HR. TRAFFIC WITH THE PROJECT:						
Manele Road @ Lanai City	45	388	60.1	60.2	61.4	65.4
Kaumalapau Hwy. @ Manele Rd.	50	381	61.7	61.7	64.6	67.7
Lanai Avenue	25	476	51.4	52.5	54.2	57.6
Fraser Avenue	25	289	49.2	50.3	52.0	55.4
Lalakoa Subdivision Road	25	86	43.9	45.0	46.8	50.2

Notes:

The following assumed traffic mixes of autos, medium trucks, and heavy trucks were used for existing and future conditions:

(a) Existing Traffic on Manele Road and Kaumalapau Highway at Manele Road: 73% autos; 7% medium trucks; and 20% heavy trucks and buses.

(b) Future Traffic on Manele Road: 90% autos; 7% medium trucks; and 3% heavy trucks and buses.

(c) Future Traffic on Kaumalapau Highway at Manele Road: 88% autos; 7% medium trucks; and 5% heavy trucks and buses.

(d) Existing and Future Traffic within Lanai City: 91% autos; 7% medium trucks; and 2% heavy trucks and buses.

TABLE 3

EXISTING AND CY 2003 DISTANCES TO 55, 60, AND 65 Ldn CONTOURS

STREET SECTION	55 Ldn SETBACK (FT) EXISTING	CY 2003	60 Ldn SETBACK (FT) EXISTING	CY 2003	65 Ldn SETBACK(FT) EXISTING	CY 2003
Manele Road @ Lanai City	141	246	66	114	30	53
Kaumalapau Hwy. @ Manele Rd.	275	350	128	162	59	75
Lanai Avenue	35	75	16	35	8	16
Fraser Avenue	20	54	9	25	4	12
Lalakoa Subdivision Road	20	24	9	11	4	5

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 3 for traffic volume, speed, and mix assumptions.
(3) Ldn assumed to be equal to PM peak Hour Leq on all roadways.
(4) Setback distances are for unobstructed line-of-sight conditions.
(5) Soft ground conditions assumed along all roadways.

Predictions of future traffic noise levels were made using the traffic volume assignments of **Reference 7** for CY 2003 with and without the proposed Manele Golf Course project. The future condition without the proposed project is expected to result in traffic volumes which are greater than those associated with the previously approved Manele Bay Hotel and resort developments. The future projections of project plus non-project traffic on the roadways which would service the project are shown in **TABLE 2** for the PM peak hour of traffic. As indicated in **TABLE 2**, by CY 2003, traffic volumes throughout Lanai are expected to increase significantly due to planned resort and housing developments. Traffic noise levels are also expected to increase significantly from the existing low levels. The greatest increases in traffic noise of 4.9 to 6.4 Ldn are expected to occur along Lanai and Fraser Avenues, but these large increases are primarily associated with non-project traffic. The smallest increase in traffic noise of 1.2 Ldn is expected at the entrance to the Lalakoa Subdivision. Traffic noise levels are expected to increase by approximately 1.6 Ldn along Kaumalapau Highway, and by 3.6 Ldn along Manele Road.

TABLE 3 summarizes the predicted setback distances to the 55, 60, and 65 Ldn traffic noise contour lines along the roadways servicing the project and attributable to both project plus non-project traffic by CY 2003. The setback distances in **TABLE 3** do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in **TABLE 3**, relatively large setback distances to the 55 Ldn contour of 246 to 350 FT from the centerlines of the high speed sections of Kaumalapau Highway and Manele Road are predicted in CY 2003. At the project's entrance and circulation roadways, the setback distances to the 55 Ldn contours should be less and in the order of 50 to 100 FT due to the lower average speeds and lower traffic

volumes along these roadways. For these reasons, traffic noise levels within the project site are expected to be very low and in the "Minimal Exposure, Unconditionally Acceptable" noise exposure category.

The relationship of the CY 2000 Lanai Airport noise contours to the project site is shown in **Figure 5-7 of Reference 9.** The 60 and 55 Ldn aircraft noise contours should continue to remain beyond 3 miles northwest of the project site. Future aircraft noise levels over the project site were calculated using the Federal Aviation Administration Integrated Noise Model, Version 3.9. By CY 2005, with the existing runway extended to 7,000 FT, aircraft noise levels over the project site are predicted to remain below 30 Ldn. Aircraft single event levels are also expected to be similar to existing levels of 55 to 65 dB (Lmax). CY 2005 aircraft noise levels over the project site are expected to remain compatible with the proposed golf course and residential uses.

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CHAPTER VII. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Traffic Noise. By CY 2003, traffic volumes throughout the island are expected to increase significantly from existing volumes. It is also expected that the number of heavy trucks associated with current construction and agricultural activities will diminish as the island's resort facilities mature. The largest increases in traffic noise attributable to project traffic are expected to occur along Manele Road (see **TABLE 4**). Traffic noise levels along this roadway are expected to increase by 1.2 Ldn and 2.4 Ldn as a result of non-project and project traffic, respectively. Fortunately, noise sensitive developments are not located in close proximity to the high speed sections of Manele Road, and adverse traffic noise impacts from the proposed project are not expected to occur along Manele Road.

Large increases in traffic noise levels are predicted to occur within Lanai City, but the greater portion of these large increases are expected to be attributable to non-project traffic (see **TABLE 4**). Project contributions to the noise level increases within Lanai City are less than 1 Ldn, which is not considered to be significant.

Along the project's circulation roadways, traffic noise levels are expected to be less than 55 Ldn at 50, 70, and 110 FT setback distances from the centerlines of the roadways whose PM peak hour traffic volumes are approximately 100, 200, and 400 vehicles per hour, respectively. If berms or sound attenuation walls are located between the roadways and the noise sensitive properties, the setback distances to the 55 Ldn contours should be significantly less than those listed above. Because the project's development plan allows for these setback distances to the proposed residences, adverse noise impacts on future residents from project traffic are not expected. In addition, these new circulation roadways are located in excess of 100 FT from the Manele Bay Ho-

TABLE 4

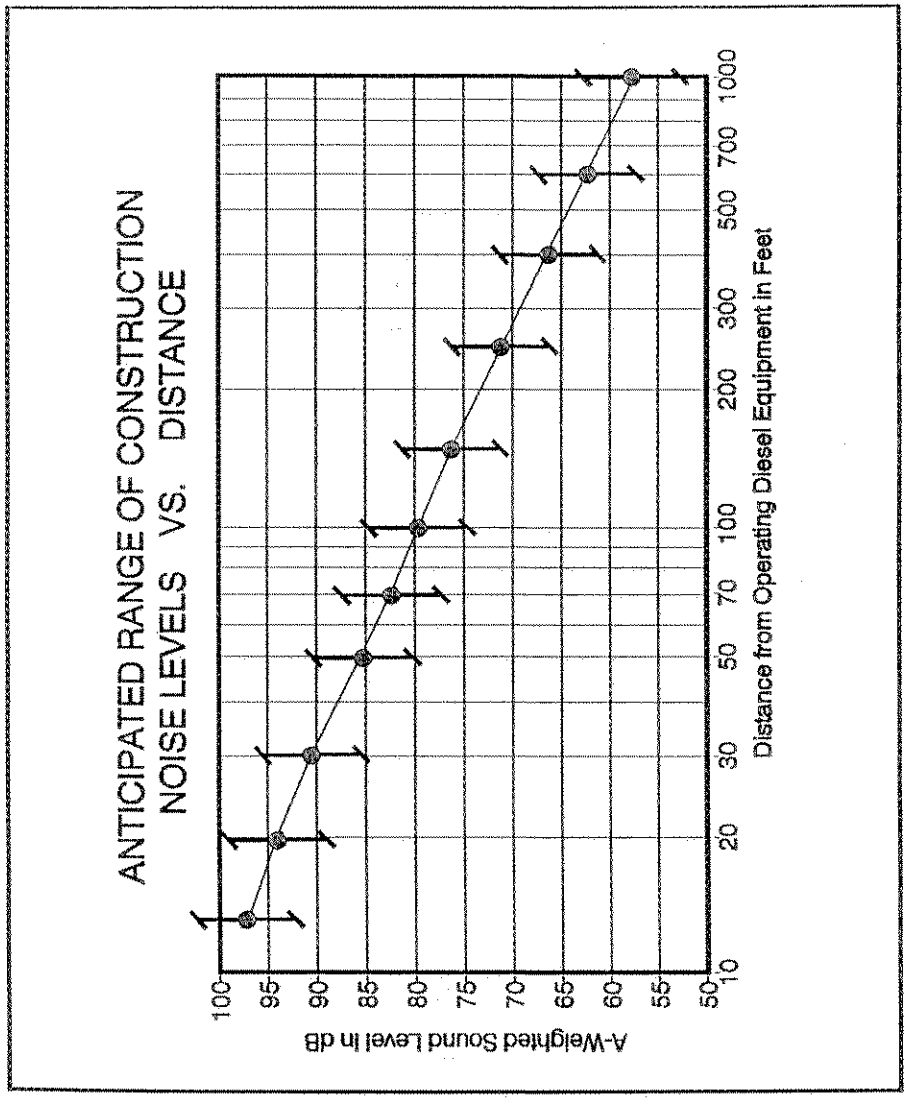
CALCULATIONS OF PROJECT AND NON-PROJECT
TRAFFIC NOISE CONTRIBUTIONS (CY 2003)

STREET SECTION	NOISE LEVEL INCREASES (Ldn) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Manele Road @ Lanai City	1.2	2.4
Kaumalapau Hwy. @ Manele Rd.	1.0	0.6
Lanai Avenue	4.3	0.6
Fraser Avenue	5.5	0.9
Lalakoa Subdivision Road	1.2	0.0

tel, and adverse traffic noise impacts at the hotel from the proposed project are not expected.

Aircraft Noise. The proposed project should not cause adverse aircraft noise impacts on the golf course or on project residences. Additionally, the location of the project site should not impact the future airport expansion potential at Lanai Airport. Because of the very low ambient noise levels on Lanai, aircraft noise events during flybys as well as during jet aircraft departures from the airport will probably be audible at the project site. However, the total aircraft noise levels at the project site should be well below current aircraft noise exposure criteria and standards, and should remain in the "Minimal Exposure, Unconditionally Acceptable" exposure criteria through CY 2005. Based on existing and forecasted aircraft noise levels over the project site, special aircraft noise attenuation measures are not considered mandatory within the project site. The implementation of the airport noise disclosure provisions of Act 208 is not required because the existing and forecasted 55 Ldn noise contours do not enter into the project area.

General Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of exterior noise from construction activity (excluding pile driving activity) are shown in **FIGURE 3**. The impulsive noise levels of impact pile drivers are approximately 15 dB higher than the levels shown in **FIGURE 3**, while the intermittent noise levels of vibratory pile drivers are at the upper end of the noise level ranges depicted in the figure. Typi-



CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 3

cal levels of construction noise inside naturally ventilated and air conditioned structures are approximately 10 and 20 dB less, respectively, than the levels shown in **FIGURE 3**. The noise sensitive areas which are predicted to experience the highest noise levels during construction activities on the project site are within the Manele Bay Hotel complex, which is presently under construction. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site and in the Manele Bay area.

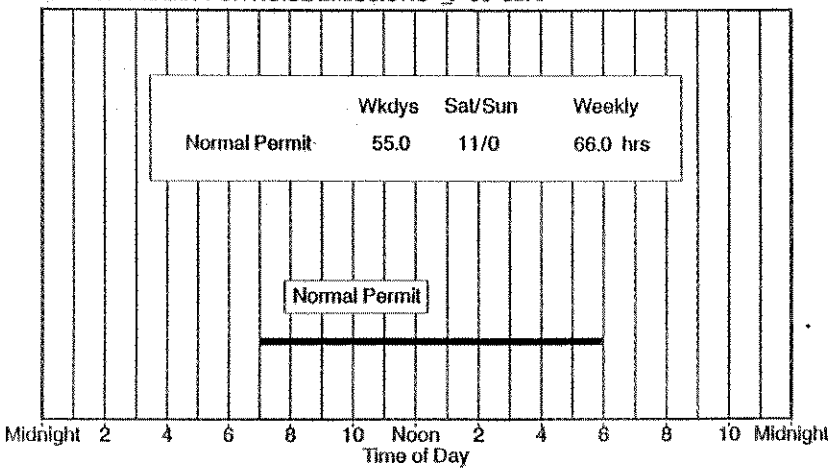
Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (pile driving, grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Oahu (**Reference 4**), is another noise mitigation measure which can be applied to this project. **TABLE 5** depicts the allowed hours of construction for normal construction noise (levels which do not exceed 95 dB at the project's property line) and for construction noise which exceeds 95 dB at the project's property line. Noisy construction activities are not allowed on holidays under the DOH permit procedures.

Noise and Vibration from Blasting. Blasting will be used to fragment rock, coral, or lava during the excavation and site preparation phase of the construction project. Blast induced ground and air vibrations have the potential to startle or annoy surrounding residents and guests, and to also cause damage to struc-

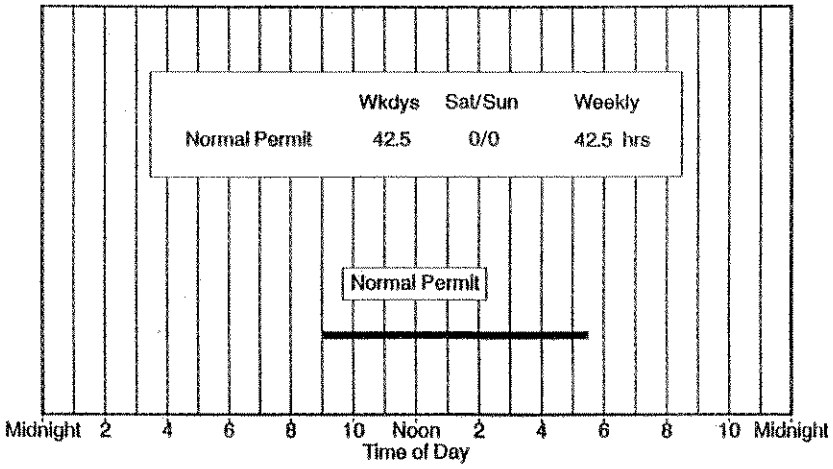
TABLE 5

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

a. DOH PERMIT FOR NOISE EMISSIONS $\leq$ 95 dBA.



b. DOH PERMIT FOR IMPACT PILE DRIVING ACTIVITIES.



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tures.

The air blasts associated with blasting are concussion type, low frequency vibrations, which are of relatively short duration (or impulsive) and generally described in terms of peak overpressure in psi, or in dBL. The dominant sources of the air blast are the Air Pressure Pulse, which is caused by the large displacement of the ground surface near the charge, and the Stemming Release Pulse, which is caused by gas pressure ejecting the stemming (fill) material from the hole bored for the explosive charge. When exposed to high peak overpressure levels exceeding 141 dBL, large plate glass windows may break. At peak overpressure levels of 171 dBL, most windows can be expected to break. For these reasons, air blast levels during blasting are generally limited to levels below the 141 dBL level in order to minimize risks of damage to structures.

The low frequency characteristic (usually referred to as bass sounds) of air blast noise tends to induce vibrations in structures (and subsequent complaint reactions) due to the low resonant frequency (10 to 25 Hz) of buildings. High frequency sounds of amplitudes equal to blast noise generally do not induce vibrations and cause physical damage to structures. Although the human ear has an opposite characteristic (i.e., the ear is less sensitive to low frequency sounds), structures which vibrate can produce secondary audible effects such as rattling sounds (of fixtures, doors, etc.), and effects which are sensitive to touch (or feelable). Sound levels at which these secondary effects occur vary with the weight (and probably stiffness) of the structure. In general, the inception point of sound induced vibration is difficult to establish, but may occur at levels as low as 80 dBL. These levels are significantly below the peak levels of 120 to 136 dBL which have been associated with low risk of damage to structures.

Ground vibrations, or seismic waves, are also generated during blasting operations, and are generally described in terms of

peak particle velocity in inches/second. Most of the seismic energy remains trapped in the ground, but some energy is released as an overpressure pulse into the air (or Rock Pressure Pulse). In general, the ground vibrations as well as the airborne Rock Pressure Pulse are expected to be less intrusive than the Air Pressure and Stemming Release Pulses. As an example, tunneling work along Dole Street on Oahu for a sewer project generated some initial air blast complaints from nearby residents during blasting of the surface entrance to the tunnel. However, once the entrance to the tunnel was formed and blasting was confined to tunneling underground, complaints stopped. Maximum ground vibration levels during the tunneling work was limited to 2 inches/second, but blasting was conducted during all hours of the day and night (approximately 5 blasts per day). A total of 6 delays were typically used, with fixed delays of approximately 200 milliseconds, and with a maximum charge weight per delay of approximately 8.6 pounds.

Predictions of peak overpressure or ground vibration levels vs. scaled distance from the blast are not precise, with initial uncertainties for a given location in the order of 20 to 30 dBL. For this reason, it is standard practice to employ seismograph monitoring of air and ground vibrations during blasting operations with a 3-axis geophone (for ground vibrations) and a microphone (for air vibrations). The construction specifications for blasting operations generally require seismograph monitoring at the structure(s) closest to the bore holes. Based on the monitoring data, explosive charge sizes (or weights) are adjusted in order to limit peak overpressures of the air blasts to levels below the threshold of possible damage to structures. Based on standard practices, it is expected that, without special mitigation measures, maximum vibration levels at structures closest to the bore holes will be approximately 136 dBL for the air blasts and 2 inches/second for the seismic vibrations.

Since complaints resulting from air blast noise levels may

occur at levels considerably below those necessary to cause damage to structures (120 to 136 dBL), additional mitigation measures will probably be required to minimize risks of antagonizing nearby residents and hotel guests. These recommended mitigation measures are described as follows:

- Monitor air blast and ground vibration levels simultaneously at the closest noise sensitive residence(s) or structure(s).

- For initial blasts, prior to establishment of a data base of air blast levels vs. scaled distance, use a maximum charge weight (in equivalent pounds of TNT) per delay of less than (D/70)**2 pounds (or distance divided by 70, and quantity squared), where D is the distance in feet between the charge and the nearest noise sensitive residence or structure.

- If practical, reduce maximum air blast levels to less than 110 dBL at the nearest noise sensitive residences in response to air blast complaints. Possible methods of accomplishing this are: reducing charge sizes; increasing delay intervals; increasing hole depth; orienting bore holes to direct the Stemming Release Pulse away from noise sensitive properties; trucking in high quality stemming material to minimize stemming blowouts; and filling (sandbagging) over the area to be blasted and the detonating chord.

- Schedule actual blasting during the warm periods of the day to minimize the possibility of thermal ducting and focusing of air blast noise at large distances from the blast. If possible, schedule blasting during fixed time periods which are publicized and made known to area residents and hotel guests.

- Restrict blasting operations which exceed 95 dBL at resi-

dences or guest suites to the hours of 9:00 AM to 5:30 PM of the same day, and to weekdays (excluding holidays). For other noise sources associated with excavation operations, follow State Department of Health permit procedures and requirements for construction activities on Oahu.

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(3) "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety;" Environmental Protection Agency (EPA 550/9-74-004); March 1974.

(4) "Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu;" Hawaii State Department of Health; November 6, 1981.

(5) Act 208, Session Laws of Hawaii 1987; Fourteenth Legislature, State of Hawaii; June 7, 1987.

(6) Barry, T. and J. Reagan, "FHWA Highway Traffic Noise Prediction Model;" FHWA-RD-77-108, Federal Highway Administration; Washington, D.C.; December 1978.

(7) "Traffic Impact Assessment Report for the Proposed Manele Golf Course Project;" Pacific Planning & Engineering, Inc.; August 1990.

(8) "FAR Part 150 Airport Noise Compatibility Program, Volume I - Noise Exposure Map Report, Lanai Airport;" Hawaii State Department of Transportation, Airports Division; August 1989.

(9) "FAR Part 150 Airport Noise Compatibility Program, Volume II - Noise Compatibility Program Report, Lanai Airport;" Hawaii State Department of Transportation, Airports Division; December 1989.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(Y)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78, NOISE REGULATION REPORTER.

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1. Sound (Pressure)[3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level[4] Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average value over (non-time domain) set of observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level exceeded x% of the total set of (non-time domain) observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

I. WATER RESOURCES DEVELOPMENT PLAN FOR LANAI

WATER RESOURCES DEVELOPMENT PLAN
FOR THE ISLAND OF LANAI
LANAI, HAWAII

Prepared for:

Lanai Company, Inc.
Honolulu, Hawaii

Prepared by:

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March 1989

PETITIONER'S EXHIBIT NO. 14

I-1

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EXECUTIVE SUMMARY

Recent review efforts between the two hydrologists most familiar with the water resources of Lanai have led to a general consensus in terms of the hydrologic budget, the ultimate sustainable yield from high level ground water resources, and the initial phases of future water resources development on Lanai. This body of knowledge was distilled down to three average daily values: 1) the recharge to the high level aquifer is thought to be about 9.0 million gallons per day (mgd); 2) the ultimate sustainable yield from this aquifer is 6.0 mgd; and 3) the exploitable resource under good development practices is 4.8 mgd, of which the present system extracts 3.0 mgd, leaving a remainder of 1.8 mgd available for future high level water resources development.

Projections for water demand made during the plan preparation are based on plantation requirements (received from the plantation manager), existing domestic usage, and Maui County consumption factors (for new and future development). At the end of the 1991 planning horizon selected for this review, the usage is forecast as follows:

Domestic	1.36 mgd
Plantation	2.40 mgd
Landscape irrigation	2.08 mgd
Total	**5.84 mgd**

To meet this demand, we recommend initially two more high level wells with the estimated total yield of 0.8 mgd (see Figure 1, page 8). In addition, alternate sources are to supply 1.4 mgd, of which 0.4 mgd could be available from reclaimed sewage. A third high level well may be needed depending upon yields of the first two wells, and future demands. In comparison to the estimated 1991 total demand, projected supply capacity is 6.4 mgd, of which 5.0 mgd will be from the high level aquifer.

The principal alternate source is low level fresh or brackish water. This water, because it has leaked from the high level aquifer on its path to the sea, is unaccounted in the above estimates of sustainable yield. An exploratory well has been recommended as part of this program to evaluate the water table location and water quality condition of this alternate source.

We recommend that the initial phase of implementing this water resources plan consist of developing three new wells. Two wells should be located to tap into the high level aquifer and be completed as soon as possible for full scale production. A third exploratory well is recommended to develop the low level water resource.

After the initial phase and assessment of the drilling results, a complete system evaluation should be made to consider long-range lowering/replacement of existing pumps, additional low level well development, and system-wide improvements to main transmission capability.

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INTRODUCTION

The hydrogeology of the island of Lanai has been studied by various investigators: Stearns (1940), Bartz (1972), Bowles (1974), Anderson and Kelly (1985), and Mink (1983). Recent work has been performed by Keith Anderson and John Mink, the principal hydrologists in contemporary studies and evaluation of the water resources available on Lanai.

Both hydrologists worked independently on recent projects until this year, when they collaborated in a review and evaluation of the water resources of Lanai to develop recommendations for development of the water resources on the island. The summarization of water supply and demand projections used during the review is shown in **Appendix 1.**

This joint effort is significant. The wealth of experience and expertise represented by both hydrologists are brought to bear on the formulation of the resource development plan in a collaborative effort to meet the projected needs of the future. The technical and professional basis underlying the water resource development plan is the most competent and relevant to the experience on Lanai. The summarization from the hydrologists is shown in **Appendix 2.**

The contribution made to the deliberations by M&E Pacific, Inc., is the demand assessment for the projected

water consumption and the engineering factors to be incorporated in the development and scheduling of construction of new sources of water.

SCOPE AND PURPOSE

The relevant hydrology was reviewed by Anderson and Mink based on most recent data and experience to ascertain the completeness of the data base. From this common data base, both hydrologists analyzed the sustainable yield of the existing well and shaft system and of the overall high level resource that the current system draws from. The conclusion drawn from both hydrologists, each following differing methodologies, agrees remarkably well considering the degree of precision of the data base itself. Based on the projected needs, the recommendation for the water resource development plan is formulated to meet the future demand.

The projection for pineapple irrigation was provided by James Parker, manager of Dole Company, Hawaii operations. The demand figures for the urban development were projected by M&E Pacific, Inc., following unit consumption rates specified by County codes. Landscape irrigation needs were projected by assuming typical values for pan evaporation rates applicable to this area and drawing from experience of other landscaped areas.

Altogether, expertise was brought to bear on developing a consensus on the estimates of the available supply for the projected demand for the future of Lanai. The formulation

of the water resource development plan included recommendations on where, when, and how, new sources of water should be developed.

SUSTAINABLE YIELD OF THE HIGH LEVEL SOURCE

The recharge rate. Both hydrologists agree on the amount of recharge to the high level aquifer. Rainfall and fog drip are accounted for in their analyses. Anderson uses a lower estimate than Mink for fog drip, but considering the accuracy of measurements of rainfall and evapotranspiration, the estimates of recharge are essentially equivalent:

Mink	9.3 mgd	(per 1983 report)
Anderson	8.9 mgd	(per Appendix 2)

Considering the precision of estimates, a recharge rate of 9 mgd has been adopted for planning purposes.

Both hydrologists have developed this total in terms of two high level zones that attempt to account for variation in precipitation and evapotranspiration with elevation. Their breakdowns are discussed in their recent memorandums shown in Appendix 2.

Sustainable yield. The amount of water that can be extracted safely over time is a fraction of the recharge rate, never equal to or greater than the recharge rate. The terms "safe yield" and "sustainable yield" are often used interchangeably, but the latter term is preferred.

An important point to keep in mind is that both hydrologists estimate sustainable yield relative to the

status of the water supply system. For example, given the present setting of the pumps in the high level aquifer, both consultants (see Appendix 2) estimate the present sustainable yield at 3 mgd. If the condition of the system were to change, for example, the pumps lowered in the wells, the sustainable yield for that system configuration would change, but will never exceed the ultimate sustainable yield.

John Mink analyzes the sustainable yield based on the dynamics of the system with the aid of a mathematical model which has been demonstrated to work by experience with the Pearl Harbor and other aquifer systems. Keith Anderson bases his estimates on experience with the management of annual pumpage with respect to precipitation trends and economic factors.

The sustainable yield estimates agree well with experience and with hydrologic principles. Estimates of the ultimate sustainable yield by both hydrologists are as follows:

Mink	6.0 mgd	(per Appendix 2)
Anderson	6.2 mgd	(per Appendix 2)

The ultimate sustainable yield of the high level aquifer adopted for planning purposes is 6 million gallons per day (mgd).

The present system as it is configured can be counted on to provide 3.0 mgd (agreed upon by both hydrologists) on a sustained basis expressed as an average daily flow. This

represents about 50 percent of the current estimates of the ultimate sustainable yield from the high level aquifer.

Interconnected aquifer. The high level aquifer is envisioned to be an interconnected, compartmentalized media connected by fractures which permit hydraulic continuity within the dike complex. Over decades of time all sources of withdrawal will stabilize, provided the rate of withdrawal is not significantly changed before equilibrium levels occur between compartments. Due to varying irrigation demands and equipment operation, this is, practically speaking, difficult to achieve. Differences in the water levels will be noted in the transition periods which may take several years or decades.

There are two significant implications of this conclusion:

1) The use of a single value to represent the entire high level aquifer safe yield is warranted from a long-term planning point of view, and
2) The addition of new wells in the high level aquifer increases the flexibility in controlling short term water levels, but does not change the ultimate sustainable yield and will not prevent the water table from declining to its equilibrium level.

To what extent the withdrawal from new wells will contribute to the lowering of water level is an important

consideration to setting new pump intake levels and resetting existing pump intake levels. This would need some follow-up investigation by one or both hydrologists. But both hydrologists agree that it is prudent to establish a threshold limit for withdrawal in terms of sustainable yield. We propose that this limit be set at 80 percent of the estimated sustainable yield or 4.8 mgd from the high level aquifer.

The increase in sustainable yield that can be expected must always leave a margin of error for such uncertainties as natural leakage from the aquifer, the vagaries of drought occurrences, and the imperfect nature of the hydraulic connectivity of the individual dike compartments which constitute the high level aquifer zone.

Alternate sources. Alternate sources are considered here to mean water resources outside the high level aquifer, in particular, low level fresh and brackish waters believed to underlie the Palawai Basin and beyond. Alternate sources also include reclaimable sewage effluent suitable for landscape irrigation.

The alternate sources are a significant part of the overall water resources development plan, especially in anticipation of the fact that close to 80 percent of the demand for future water is estimated to be for irrigation. Domestic consumption is approximately 20 percent of the demand. This demand component requires the highest quality

water in any allocation scheme. By comparison, landscape irrigation can utilize brackish waters and reclaimed sewage effluent. The intermediary use is in pineapple irrigation. The water quality requirements for pineapple cultivation are also stringent. These are the considerations given to the future plan for alternate water resource development. Alternate sources will expand the availability of resources for Lanai's future.

The magnitude of the quantity of alternate sources, in particular, low level water has not been given much consideration by the hydrologists because the primary thrust has been to develop high level water. However, Anderson and Mink believe it to be a significant resource. One approximation of the minimum upper limit is the difference between the sustained recharge rate and the ultimate sustainable yield, namely 3 mgd. Some of this water will leak toward the coast. We know from geophysical surveys and early water development on Lanai that there is a hydraulic gradient toward the ocean.

We propose that an initial effort be made as part of the development program to drill an exploratory well in the southwestern sector of the Palawai Basin. This location is outside the range of influence of the wells in the high level aquifer. At worst, this well would be brackish. At best, it would be potable, but perhaps of low yield, considering estimates of the hydrogeology of the area.

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PROJECTED DEMAND AND SUPPLY

The water demand and supply projected for the future is summarized in **Figure 1.** Included in Appendix 1 is a breakdown of the anticipated water sources to be developed in tandem with the hotel and residential construction.

Projected individual yields for future wells are based upon judgement concerning the hydrogeology of the site and relevant experience from similar wells. The average of the yields of Wells 1 through 5 is 0.5 mgd. We believe 0.4 mgd is more prudent for well sites 8 and 9 given their location, the yield of Well 1, and pump test results from Well 7. At an average rate of 0.4 mgd, the well would pump at approximately 275 gallons per minute (gpm) on a 24-hour basis. A sustained period of operation of Wells 6 through 9 will be required before individual yields can be confirmed. Estimates of individual well yields from alternate sources are too speculative at this time. The significance of this point is that the exact number of wells needed to reach the threshold limit of ultimate sustainable yield is also a variable in the planning of water resource development.

Existing sources and consumption. The current supply to Lanai City other than pineapple irrigation is 0.38 mgd. Dole Plantation uses water up to 2.4 mgd and will continue at this rate into the future. The total average demand is 2.78 mgd. The sustainable yield from the existing sources at the present configuration is 3.0 mgd. The existing

sources are the Maunalei shaft and tunnels, and Wells 1 to 5, and Shaft 3. These are located in **Figure 2**. Two additional wells have been drilled and will soon be hooked up into the water distribution network. These are Wells 6 and 7. The supply will increase to 3.8 mgd, which is sufficient to support the designated projects for 1989, as shown in Figure 1.

Future Sources and Consumption.

According to our plan, Wells 8 and 9 should be brought on line early in 1990. We estimate 4 months to drill and complete two wells; another 6 to 8 months to design and order the pumps, motors, controls and electrical substation equipment, and construct the transmission connection. The total supply with these wells is projected to be 4.6 mgd. Well 9 should be brought on line before the Koele Golf Course is placed in operation. In comparison to supply, the total projected demand on the high level aquifer is 4.16 mgd at that time (1990).

Another rationale for moving ahead with these wells, in particular Well 8, is the prospect that both Wells 1 and 2 will be down for major overhaul in the future (see Appendix 2, memo from J.H. Parker). During this overhaul Well 8 could furnish irrigation water and/or reduce the load on Well 4. Replacement of the first leg of the irrigation system could be programmed for that time frame (see Figure 2, replacement lines).

The plan to support the demand for landscape irrigation water is the exploration for and development of the brackish water sources, starting with wells in the southwestern sector of Palawai Basin. The desired quantities average 1.0 mgd, which would be equivalent to the anticipated demand of a golf course in Manele. The first step in this development is the exploratory Well 10. The total number of wells from this source could be estimated after the exploratory well tests were complete.

Reclamation of sewage effluent for landscape irrigation from the Lanai City's oxidation ponds and the Manele treatment plant can provide landscape irrigation water ultimately in quantities up to 0.4 mgd.

Figure 3 summarizes the projected water resource plan elements and preliminary planning, drilling permit application, design, and construction time tables needed to schedule the completion of the initial phase plan consisting of two production wells and a pilot exploratory well ahead of anticipated demands. The time for completion of wells to supply Manele Golf Course irrigation is also estimated. The total cost for the project would depend upon the yield of the new wells, the requirement for separate transmission supply to Manele Project District from the public health viewpoint, and the requirement for a separate transmission line for the Manele Golf Course irrigation water. The

latter depends upon the quality of water yielded from Well 10. At the time of this plan preparation, cost estimates were being prepared for the three new wells.

Figure 3 also shows the time to complete the source permit application, design and construction of transmission lines from new sources to points of demand. The critical time element for these plan elements is the scheduling of electrical substations for submersible well pumps. Diesel drive is an option, but the depths of these wells may limit the drive shaft capability.

The overall system transmission capability will need evaluation when the production capacity of Wells 6 to 9 and low level wells can be estimated. It would be prudent at that time to evaluate the requirements for resetting the existing pumps in light of future water table declines that are predicted concurrently with additional water withdrawal from the high level aquifer.

By 1991, one additional well in the high level aquifer may be needed. This will bring the total high level supply to 5.0 mgd. In comparison the demand supplied from the high level source is projected to be 4.44 mgd. In relation to the ultimate sustainable yield of the high level aquifer, the demand is 74 percent or approximately 50 percent of the estimated recharge rate of 9.0 mgd.

WATER RESOURCES DEVELOPMENT PLAN

In summary, the approach represents a prudent plan to develop all available resources commensurate with the

quality of use without over-committing the high level resources. Monitoring of the aquifer performance over time will provide more precise estimates for the supply and demand equation where adjustments can be made in the management of the water resources.

The total capacity of planned sources is given below:

High level water	5.00 mgd*
Reclaimed effluent	0.40
Alternate sources	1.00
Total	**6.40 mgd**

*Projected usage = 4.44 mgd.

The total usage of water by categories is as follows:

Domestic consumption	1.36 mgd
Pineapple irrigation	2.4
Landscape irrigation	2.08
Total	**5.84 mgd**

The projected installed capacity of the sources is 6.4 mgd. This will come from the future construction of three more wells at 0.4 mgd each in the high level aquifer. Wells 6 and 7 are already drilled and ready for hookup. Wells 8 and 9 must be constructed soon. The alternate sources anticipated amount to 1.4 mgd, of which 0.4 mgd is available from reclaimed sewage.

The total usage will vary. Experience will demonstrate the pattern of consumption. Irrigation water will depend on the rainfall pattern for the year. Domestic consumption is

projected according to the requirements of the County of Maui codes. For single family residences, the requirement is 600 gallons per day per unit (gpd/unit). For apartments, it is 560 gpd/unit. By comparison, the actual usage in the present Lanai community is about 276 gpd/unit, which is far below the allowance being provided.

Consumption patterns are expected to change in the future, but not beyond the levels being provided for in planning. It could well be that the pattern of usage would be less than projections. For this reason, the third well in the high level aquifer can be constructed later.

The alternate source can be a pilot well until it is demonstrated that a production well here would be worth the effort. Exploration should begin concurrently with construction of Wells 8 and 9.

It should be noted that the domestic consumption is 1.36 mgd out of the total projected at 5.84 mgd. Domestic consumption is but 23 percent of the total. The remainder (4.48 mgd) is for plantation use, golf course irrigation, and ornamental irrigation. Pineapple irrigation requires high quality water. Therefore, of the remainder, 2.08 mgd total non-domestic demand can utilize alternate sources. This provides considerable flexibility in the allocation scheme for irrigation water. In contrast, domestic and pineapple consumption do not have that flexibility.

CONCLUSION

The ultimate sustainable yield of the high level source is estimated at 6.0 mgd. The estimate is derived from two competent hydrologists, each with a wealth of experience and expertise. The projected demand from this source is 4.44 mgd, or 74 percent of the sustainable yield.

Construction of Wells 8 and 9 must begin now to provide additional water totaling 0.8 mgd, and plans for exploratory drilling in the southwestern sector of the Palawai Basin for an alternate water source must proceed concurrently. One mgd is desirable from this alternate source. In the future, another high level well will be necessary if the consumption pattern occurs as projected.

The projections of supply and demand for water show that the water resources on Lanai are adequate to meet future needs of domestic (urban) consumption, pineapple cultivation, and landscape development.

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APPENDIX 1

DETAILED WATER DEMAND AND RESOURCE DEVELOPMENT

Lanai Projected Water Demand and Resource Development

Time Line		Demand MGD	Cumulative Demand	Water Transmission Capability (MGD)	Source Wells/Other	New Well(s) Schedule
1988	Lanai City Dole Plantation	0.38 2.40	2.78	3.00	Maunalei Wells 1-5 Shaft 3	Wells #6 & 7 Complete
1989	Koele Hotel Lalakoa III Hulopoe Beach Park (Phase I) Lanai Industrial (Central Support) Community Gardens Assumes 27.5 ac. @ 4,000 gpd/ac. Lanai City Apartments	0.15 0.09 0.07 0.03 0.11 0.02 (0.47)	3.25	3.80	Wells #6 & 7 On Line (0.4 mgd each)	• Locate "Alternate Water Resources (1.5 mgd Drill Test Well(s) • Start Well #8 • Start "Alternate Water Development • Start System to Utilize Treated Effluent
1990	Koele Golf Course Lower Waialua (122 units @ 600 gpd) Queen's Multi-Family (128 units) Manele Bay Hotel Manele Golf Course Other Landscape Clubhouse, Roadways Beach Park Phases II - IV Commercial Area (Downtown Redevelopment) Koele (SFR) assumes 35 units	0.40 0.07 0.07 0.20 1.0 0.5 0.05 0.02 (2.31)	(4.16 High level) (0.40 Effluent) (1.00 Alternative Source) 5.56	4.20 4.60 5.60	Well #8 - On Line (0.4 mgd) Treated Effluent System On Line (0.4 mgd) Alternate Water Resource On Line (1.0 mgd)	• Complete Develop Well #9 Develop Well (High level) subject to review of operating conditions of wells and demand
1991	Manele Residential (133 units) Koele Residential (200 units)	0.08 0.20 (0.28)	5.84	6.00 6.40	Well #9 - On Line (0.4 mgd) High level Well On Line (0.4 mgd)	
			4.44 High level .40 Effluent 1.00 Alternative	5.00 .40 1.00		

January 17-18, 1989

APPENDIX 2

MEMORANDA

RECEIVED
JAN 24 1989
Lanai Company, Inc.

Memo to Bob Oda, Vice President, Lanai Land Co.
From John F. Mink
Re Status and Sustainable Yield of the High Level Aquifers
January 23, 1989

The sustainable yield of the Lanai High Level Aquifers for the current configuration of the wells is approximately 3 mgd. Adding wells 6 and 7 does not change sustainable yield but allows more flexibility in controlling groundwater levels. The water levels are not yet at equilibrium with respect to continuous withdrawal of 3 mgd. It may take a few years before they stabilize.

The sustainable yield can be increased to 5 mgd by lowering the pumps in each well to 20 feet above well bottom. At total draft of greater than 3 mgd the water tables will continue to decline, but the rates are slow enough to allow time to lower the pumps.

Ultimately a sustainable yield of about 6 mgd is possible if wells are deepened to sea level and pumps set 20 feet above the bottom of each well. It may be less costly to drill new wells rather than deepen all of the old ones.

Total demand on the High Level Aquifers is expected to be 4.44 mgd in 1991, 0.56 mgd less than sustainable yield for the wells with pumps lowered to 20 feet above existing depths. Although the transient period of water level decay takes years before new equilibrium is reached, a plan should be formulated to eventually lower the pumps.

The new wells, numbers 6 and 7, will add 0.8 mgd to the system over the short term but will not prevent the water table from declining to its equilibrium head. Similarly, proposed wells 9 and 10 will contribute to the decline.

Exploratory well 10 has been located to test for the outer limit of high level water and to ascertain whether acceptable brackish is available if the site is outside the high level boundary.

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JMM James M Montgomery
Consulting Engineers Inc

January 25, 1989

Mr. Robert Oda
Vice President & General Manager
Lanai Company, Inc.
P. O. Box 2780
Honolulu, Hawaii 96803

Subject: Lanai Water Supplies

Dear Mr. Oda:

This letter report will summarize our conclusions and recommendations, stated in our January 17-18 meetings in your office, concerning the potential for additional development of water supplies on Lanai.

As you know, our study and evaluation of groundwater on Lanai goes back to 1957, with primary emphasis on the continuing evaluation of the capability of the existing water supply installations. From time to time we have made recommendations for the management of annual pumpage with respect to precipitation trends and economic factors.

Additional information gained from the drilling and testing of Wells 6 and 7, and from such studies as Ekern's investigation of fog-drip, allows for an updated estimate of additional water-supply that could be developed to accommodate the projected increased need for water on the island.

Our early estimate of recharge from rainfall was 0.41 mgd per square mile over a limited area. We believe this rate can be increased by 20 percent and the area increased to 14 square miles for a total of 6.89 mgd over the principal recharge area. We estimate that an additional 10 square miles receives recharge at a rate of 0.20 mgd per square mile from either direct precipitation or the infiltration of runoff from adjacent higher areas. Total estimated average recharge would then be:

Primary area 14 sq. mi. -	6.89 mgd
Secondary area 10 sq. mi. -	2.00 mgd
Total	8.89 mgd

We would estimate the sustainable yield from the high-level aquifers to be about 70 percent of recharge, or 6.22 mgd.

The experience with water use in recent years indicates that the present supply system (Maunalei side, Shaft 3, and Wells 1-5) can be managed to furnish an average

of 3.0 mgd. Additional water from Wells 6 and 7, completed and tested but not yet on-line, is estimated at 0.8 mgd for a total of 3.8 mgd.

An additional 0.8 mgd, for a total of 4.6 mgd, could probably be developed by drilling and equipping two—or possible three—new wells on the plantation side of the island.

With the additional development now taking place, and considering future planned development, it is recommended that the drilling of at least two new water-supply wells be started as soon as possible.

Several additional points should be kept in mind as plans and developments continue:

- A comprehensive program of monitoring pumpage, water levels, and precipitation must be continued.
- Some additional future costs should be anticipated for modifications or replacements at existing source facilities.
- Additional features related to the water-supply system will be required (distribution, storage, and power supply and transmission).

We would be glad to discuss any of these matters in more detail if you wish. Please let me know if you have any questions.

Sincerely,

Keith E. Anderson

Keith E. Anderson

/ln

cc: J.H. Parker
J. Kumagai

File: 2549.0010

Dole Packaged Foods Company
Lanai Plantation • Lanai, Hawaii 96763

Date: January 11, 1989

To: R. C. Oda

From: J. H. Parker

Subject: Lanai Plantation Water Distribution System

Per Mr. Murdock's request, the following summarizes the care, cost and condition of the water pumping and distribution system.

Wells:

1988 Cost	Maintenance:	$ 68,845
	Operation	$594,667

Well 1

This well is in the Palawai Basin and one of two diesel powered water sources. The pump was rebuilt and the drive line shaft replaced in 1987. The diesel engine was replaced in 1986, due for a routine major overhaul soon.

Well 2, Shaft 3

This complex above Kapohaku Gulch has been the Plantation's major source of irrigation water, but deliveries have declined due to the continuing drought. The Well has an electric powered line shaft pump that may require replacement in the near future. Capacity has been reduced, but water availability has also declined, and productivity has not been adversely affected.

Well 3

Above Kapano Gulch, east of Lanai City. Pump upgraded and replaced in 1979. Can deliver into either the 2 MM Gallon domestic tank or the Plantation irrigation system. No major problems.

Well 4

Above Field 5455, Puu Aalii, interconnects with Well 2/Shaft 3 to the 1 MM Gallon reservoir and the irrigation distribution system. Pump replaced and upgraded in mid 1980's. This well is most outstanding resource on the Island, carrying about 20% of the present withdrawal load. No major problems.

Well 5

Above Field 5451, Waiakeakua, has a direct feeder into the First Leg of the distribution system. Pump replaced and upgraded in the mid 1980's. This source has felt the impact of the extended dry period and produces well, but must be carefully managed. Due to the direct interconnect and elevation of the pump discharge, running this unit at critical times gives the Plantation's irrigation system a decided pressure and flow boost in the south slope fields.

Maunalei System

In the Maunalei Gulch, east of Lanai City, this system provides domestic water to Lanai City and excess can be diverted to irrigation through the Well 3 interconnect. Shaft 2 has a 500 Gallon Per Minute, electric line shaft pump at the shaft bottom. The pump could be lowered and capacity increased if greater flow required. There is probably some increased total water available, but significant investment in recovering more may not be warranted until the present pump fails. The booster was replaced and upgraded in 1987. The tunnels continue to contribute, but flows have been inhibited by the drought. Work is required on the tunnel lines, replacement is inevitable, but not justified until a normal rainfall and water recovery pattern return.

Distribution System:

1988 Cost	Maintenance:	$ 46,284
System	Depreciation:	$ 74,743

Major areas of concern:

First Leg, from Well 1 to Koala. A main feeder to the south slope irrigation and Manele Bay Projects, this exposed pipe is subject to frequent failures. Requests to Lanai Company, for approximately $75,000 for replacement of this section, have received no approval. Repairs to this section will contaminate the lines, causing continued Department of Health involvement and public relations problems - which will escalate as the hotel complex develops.

Well 5 feeder enters the system at this section of First Leg. Failures continue in Field 5409 and upgrading of this rather short section should be included with the above.

Extension to Field 5517, in west slope of Palawai Basin. This underground section has frequent breaks, may be caused by some faulty pipes in original 1964 installation. A unique situation, confined to a small area.

Overall condition. The complex, in years past, had a cathodic protection system. These installations fell out of favor with hydrologists and hydraulic engineers and the Plantation system was not maintained. The question of possible external corrosion has been raised again, and the Plantation has hired a consulting firm to make an evaluation of our system. We hope to receive firm direction regarding the possible need to reinstitute the cathodic protection system, or feel confident that it is not needed.

The internal corrosion was inhibited by addition of lime at each pumping station. We were required to stop this practice when the Manele withdrawal for the small boat harbor was declared potable. The above mentioned study should also answer the question of internal corrosion.

Well 7 has a direct feed into the irrigation system in the north end of the Plantation. This is in place and ready to go.

Well 6 was assumed to be tied into the Maunalei feeder, but Dr. Kumagai suggested a separate feeder to the Koele Lodge interconnect. A requested estimate for this by M&E Pacific appears to be out-of-line, with $55,000 engineering fees and an estimated cost in excess of $600,000 for the 3,200 ft. of piping required.

J. H. Parker

cc: R L Hawthorne
E T Oyama

I-15

5. SOCIOECONOMICS ANALYSIS

APPENDIX J

SOCIOECONOMIC ANALYSIS

The assessment of potential social and fiscal impacts, conducted by Community Resources, Inc. involved both research and analytical tasks. The following tables include existing demographic data; population, labor force, employment, housing, and government spending trends; and family characteristics data. In addition, some tables summarize the quantitative analyses performed as projected estimates of social and economic indicators such as population, employment, housing needs, and revenues on Lanai. These projections were made for two scenarios: 1) "Without Project" or Lanai developments excluding the Manele Golf Course and Golf Residential Project and 2) " With Project" or Lanai developments including the proposed project. The assumptions used to calculate these projections and the interpretation of the data are provided in Chapter IV, Section 5 of this Environmental Impact Statement. Subsequent tables list resident attitudes (i.e., results of personal interviews), population trends and ethnic shifts, and contributions planned by Castle & Cooke, Inc. for the Lanai community.

TABLE J-1

TOTAL POPULATION AND DEMOGRAPHIC BREAKDOWNS, 1980

	Lanai Island 1980	Maui County 1980	State of Hawaii 1980
Total Population	**2,119**	**70,847**	**964,691**
Ethnicity			
Filipino	51.3%	18.9%	13.7%
Japanese	17.8%	22.1%	24.9%
Caucasian	11.3%	33.6%	34.4%
Hawaiian	9.2%	17.3%	12.3%
Other (includ. Chinese	10.4%	8.0%	14.8%
Place of Birth*			
Hawaii	53.5%	64.9%	57.8%
Other US**	10.6%	21.7%	28.0%
Foreign	35.8%	13.4%	14.2%
Residence 5 Yrs. Before* (people aged 5 or more)			
Same house	73.4%	52.0%	49.3%
Same county	6.6%	22.7%	25.2%
Other county	1.0%	8.9%	2.8%
Other state	9.1%	12.7%	16.9%
Other country	9.9%	3.7%	5.9%

NOTES: * Figures based on 15% sample; hence numbers represent estimates.
** Includes persons born in U.S. territories, or born abroad or at sea to U.S. parents.

SOURCES: U.S. Bureau of the Census, 1981a, 1981b.

TABLE J-2a

MANELE BAY AVERAGE DAILY ON-SITE POPULATION

	1991	1996	2001	2006
WITHOUT PROJECT APPROVAL				
Hotel Visitors	95	238	238	238
Multi-Family Residences:				
Full Time Residents	0	4	8	8
Part Time Residents	0	8	17	16
Visitors	0	11	21	20
Single-Family Residences:				
Full Time Residents	0	35	90	142
Part Time Residents	0	17	45	70
Visitors	0	22	57	90
COMBINED TOTALS:				
Full Time Residents	0	39	98	150
Part Time Residents	0	25	62	86
Hotel and Res. Visitors	95	271	316	348
TOTAL DE FACTO POPULATION	**95**	**335**	**476**	**584**
WITH PROJECT APPROVAL				
Hotel Visitors	238	380	608	608
Multi-Family Residences:				
Full Time Residents	0	11	21	21
Part Time Residents	0	12	23	23
Visitors	0	18	36	35
Single-Family Residences:				
Full Time Residents	0	58	183	178
Part Time Residents	0	30	94	92
Visitors	0	10	31	30
COMBINED TOTALS:				
Full Time Residents	0	69	204	199
Part Time Residents	0	42	117	115
Hotel and Res. Visitors	238	408	675	673
TOTAL DE FACTO POPULATION	**238**	**519**	**996**	**987**
DIFFERENCES BETWEEN WITH AND WITHOUT PROJECT				
Hotel Visitors	143	142	370	370
Multi-Family Residences:				
Full Time Residents	0	7	13	13
Part Time Residents	0	4	6	7
Visitors	0	7	15	15
Single-Family Residences:				
Full Time Residents	0	23	93	36
Part Time Residents	0	13	49	22
Visitors	0	-12	-26	-60
COMBINED TOTALS:				
Full Time Residents	0	30	106	49
Part Time Residents	0	17	55	29
Hotel and Res. Visitors	143	137	359	325
TOTAL DE FACTO POPULATION	**143**	**184**	**520**	**403**

TABLE J-2b

KOELE LODGE AVERAGE DAILY ON-SITE POPULATION

	1991	1996	2001	2006
WITHOUT PROJECT APPROVAL				
Hotel Visitors	68	106	106	106
Multi-Family Residences:				
Full Time Residents	0	25	24	23
Part Time Residents	0	20	19	18
Visitors	0	18	18	17
Single-Family Residences:				
Full Time Residents	0	101	276	268
Part Time Residents	0	32	86	83
Visitors	0	12	33	32
COMBINED TOTALS:				
Full Time Residents	0	126	300	291
Part Time Residents	0	52	105	101
Hotel and Res. Visitors	68	136	157	155
TOTAL DE FACTO POPULATION	**68**	**314**	**562**	**547**
WITH PROJECT APPROVAL				
Hotel Visitors	93	135	333	333
Multi-Family Residences:				
Full Time Residents	0	25	24	23
Part Time Residents	0	20	19	18
Visitors	0	18	18	17
Single-Family Residences:				
Full Time Residents	0	101	276	268
Part Time Residents	0	32	86	83
Visitors	0	12	33	32
COMBINED TOTALS:				
Full Time Residents	0	126	300	291
Part Time Residents	0	52	105	101
Hotel and Res. Visitors	93	165	384	382
TOTAL DE FACTO POPULATION	**93**	**343**	**789**	**774**
DIFFERENCES BETWEEN WITH AND WITHOUT PROJECT				
Hotel Visitors	25	29	227	227
Multi-Family Residences:				
Full Time Residents	0	0	0	0
Part Time Residents	0	0	0	0
Visitors	0	0	0	0
Single-Family Residences:				
Full Time Residents	0	0	0	0
Part Time Residents	0	0	0	0
Visitors	0	0	0	0
COMBINED TOTALS:				
Full Time Residents	0	0	0	0
Part Time Residents	0	0	0	0
Hotel and Res. Visitors	25	29	227	227
TOTAL DE FACTO POPULATION	**25**	**29**	**227**	**227**

TABLE J-3

LABOR FORCE SIZE AND CHARACTERISTICS LANAI ISLAND, MAUI COUNTY, AND STATE OF HAWAII, 1980

	Lanai Island 1980	Maui County 1980	State of Hawaii 1980
POTENTIAL LABOR FORCE (Aged 16+)	1,505	52,598	723,479
not in labor force	32.0%	31.5%	31.7%
armed forces	0.0%	0.0%	8.1%
civilian labor force	68.0%	68.5%	60.2%
CIVILIAN LABOR FORCE	1,024	36,040	435,780
unemployed	4.2%	4.0%	4.7%
TOTAL EMPLOYED, CIVILIAN LABOR FORCE	981	34,613	415,181
OCCUPATION:			
service	9.4%	20.7%	17.9%
management/professional	16.8%	18.8%	23.5%
technical, sales & administrative	13.0%	24.9%	32.0%
farm/fish/forest	36.9%	8.3%	3.4%
precision/craft/repair	4.8%	12.8%	11.6%
operators/fabricators/laborers	19.1%	9.4%	11.7%
INDUSTRY (selected):			
agriculture, forest, fish, mining	52.4%	8.9%	3.6%
construction	1.1%	9.7%	7.2%
manufacturing	16.2%	9.2%	7.9%
retail trade	7.1%	18.3%	19.9%
financial, insurance, real estate	1.5%	6.5%	7.6%
personal, entertainment and recreation service	1.9%	15.7%	9.2%
health, education, & professional	10.5%	12.5%	17.7%
public administration	5.9%	5.5%	10.0%

NOTES: All figures based on 15% sample; numbers hence represent estimates.

SOURCE: U.S. Bureau of the Census, 1981a, 1981b.

TABLE J-4

POTENTIAL AVAILABILITY, DOLE WORKERS LIVING ON LANAI

	Managers, Supervisors	Clerical, Non-Salaried	Total
Workforce (10/8/90)	35	357	392
Not Available for Resort-Related Work (Probable Immediate Retirement and/or Outmigration)	15	27	42
Estimated "Available"	20	330	350[1]
Plan to Stay at Dole Through Closing[2]	13	49	62
Near-Term "Available"[2]	7	281	288[1]

NOTES:

[1] About one-quarter of these are seasonals, many of whom are thought already to have part-time jobs.

[2] There may be some double-counting of those who plan to stay at Dole through closing and those who are not available for resort-related work. Thus, the Near-Term "Available" may be slightly higher than indicated.

TABLE J-5

SUMMARY OF MANELE GOLF COURSE JOBS/CHARACTERISTICS

No. of Jobs	Job Titles	Starting Annual Salaries
Golf Services:		
1	Director of golf	$60,000-$70,000
3	Golf professional	$30,000-$40,000
2	Starter	$17,000-$20,000
5	Cart & bag attendant	$15,000
3-4	Pro shop sales	$20,000-$30,000
14-15		
Grounds Maintenance:		
0	Superintendent	$50,000-$60,000
1	Assistant superintendent	$30,000
3	Mechanic	$23,000
18	Equipment operator	$17,000
10	Groundskeeper	$16,000
32		
Clubhouse Administration:		
1	Club manager	$50,000
1	Accountant	$30,000-$40,000
1	Assistant accountant	$25,000-$30,000
1	Secretary	$20,000
1	Receptionist	$20,000
4	Maintenance	$15,000
9		
Clubhouse Food Service:		
1	Food & beverage manager	$35,000
2	Assistant food & beverage manager	$28,000
4	Cooks	$20,000
10	Waithelp	$18,000
3	Bartender	$27,000
5	Stewards, other	$17,000
25		

TOTAL: 80-81

TABLE J-6

NUMBER OF JOBS TO BE CREATED AT MANELE BAY HOTEL

Departments	No. of Jobs at 50% Occupancy	No. of Jobs at 80% Occupancy	Difference
Food & Beverage	155	211	56
Rooms Division	80	101	21
Repairs & Maintenance	15	18	3
Grounds & Landscaping	14	17	3
Security	12	14	2
Laundry	11	13	2
Health Spa	11	14	3
Cafeteria	7	9	2
Administrative & General	7	10	3
Retail Shops	6	7	1
Tennis Shop	5	7	2
Swimming Pool/Beach	5	7	2
Telephone	1	2	1
Personnel	1	1	0
Marketing & Sales	0	0	0
TOTAL	330	431	101

NOTE: Job estimates are in terms of Full-Time Equivalents (FTE).

SOURCE: RockResort's staffing schedule.

TABLE J-7

HOUSING STOCK AND CHARACTERISTICS, 1980

	Maui County	Lanai Island
TOTAL YEAR-ROUND HOUSING UNITS	32,728	757
vacant (total)	31.2%	14.1%
TOTAL YEAR-ROUND OCCUPIED UNITS	22,510	650
TENURE		
owner-occupied	57.6%	52.9%
renter-occupied	42.4%	47.1%
PERSONS PER HOUSEHOLD	3.11	3.06
MEDIAN CASH RENT (renter-occupied)	$305	$50
as % of median family income	16.2%	2.8%
MEDIAN VALUE (owner-occupied)	$113,600	$44,100
MEDIAN MONTHLY MORTGAGE (owner-occupied)	$383	$179
as % of median family income	20.3%	9.9%

SOURCES: U.S. Bureau of the Census, 1981a, 1981b.

TABLE J-8

IN-MIGRANT NON-RESORT POPULATION INCREASES ON LANAI DUE TO RESORT DEVELOPMENT[1]

	1991	1996	2001	2006
Without Project				
In-Migrant Workers:	-63	151	93	107
Excluded Construction Workers[2]	0	35	0	0
Remainder	-63	116	93	107
Population in In-Migrant Households[3]:				
Immediate Impact Scenario	-92	170	136	156
Ultimate Impact Scenario	-131	243	194	223
Number of In-Migrant Households[3]:				
Immediate Impact Scenario	-22	41	33	38
Ultimate Impact Scenario	-47	86	69	79
With Project				
In-Migrant Workers:	190	790	1,086	1,084
Excluded Construction Workers[2]	47	214	0	0
Remainder	143	575	1,086	1,084
Population in In-Migrant Households[3]:				
Immediate Impact Scenario	209	840	1,585	1,582
Ultimate Impact Scenario	299	1,203	2,270	2,265
Number of In-Migrant Households[3]:				
Immediate Impact Scenario	51	205	387	386
Ultimate Impact Scenario	106	428	808	806

TABLE J-8
(continued)

	1991	1996	2001	2006
Difference between With-Project and Without-Project Futures				
In-MigrantWorkers:	253	639	993	977
Excluded Construction Workers	47	179	0	0
Remainder	206	459	993	977
Population in In-Migrant Households:				
Immediate Impact Scenario	300	670	1,450	1,427
Ultimate Impact Scenario	430	959	2,076	2,042
Number of In-Migrant Households:				
Immediate Impact Scenario	73	163	354	348
Ultimate Impact Scenario	153	341	739	727
Resort Population	168	213	747	630

NOTES:

[1] "In-migrant" population includes persons who have already moved to Lanai to take resort jobs, and young Lanaians staying on-island or returning, beyond the 10% of Lanai High School graduates indicating that they expect to stay on-island (Matsuoka and Shera, 1990).

[2] The construction workforce is assumed to include 90 Lanaians. Of the off-island workers, 80% are "excluded" as staying in dormitories, and not adding to housing demand in Lanai City.

[3] In-migrant demand for housing is estimated by using two scenarios. The "Immediate Impact Scenario" is based on findings from a 1987 Community Resources, Inc. survey of newcomers working in South Kohala resorts (1.46 persons per in-migrant resort worker; household size of 4.1 persons/household). The "Ultimate Impact Scenario" is based on the 1988 State Department of Business and Economic Development's projected labor force and population for the year 2000 (2.09 persons/employed worker; household size of 2.81 persons/household). See discussion in the text concerning these scenarios.

TABLE J-9

PLANNED CASTLE & COOKE HOUSING PROJECTS FOR LANAI

Project	No. of Units	Target Date	Details
Lanai City Apartments	24 Rental Units	Occupancy in November 1990[A]	19 units at subsidized rent to low-income resident families. 5 units with no income restriction to current employees[1] at $350-$500/mo.
Lower Waialua Single-Family	120 Units: 50 Rental Units 65 Sales Units 5 lots for sale	County Zoning Approved[B]	5 improved lots to residents at $65,000/unit. 115 units to be sold at no more than C&C construction cost or 140 percent of County median income, whichever is lower. • 50 units on lease option (C&C to make 10 percent down payment at purchase) to current employees.[1] • 65 units immediately for sale (any units not sold immediately to be rented at approximately 80 percent of County median income) to residents, based on a selection process by C&C.[2] (Units to be sold at cost with buy-back option by Lanai Co. and prices to be subject to Maui County Council's approval.)
Waialua Multi-Family	128 Rental Units	Delivery end of 1991[C]	15 units for rent to Department of Education and County employees. 113 units for rent to residents with all units affordable to company employees earning 80 percent of Maui County's median income. Rentals vary by unit size; range of $500-$950 per month.
Land Donation To County	15 acres with capacity for 110 to 130 housing units	Undefined	No available data. (However, it is generally accepted that should County accept the land and build housing on it, the units will be available to Lanai residents, not just current employees.)
	Total 382 - 402 Units		

NOTES:

[1] "Employees" refer to employees hired by Lanai Company, Dole, and/or Lanai Resort Partners (Rockresorts).

[2] The criteria for selecting qualified residents for these 65 units have yet to be established by Castle & Cooke.

[A] Now occupied or ready for occupancy.

[B] Received County zoning approval. Awaiting building permits.

[C] Received Certificate of Occupancy.

(A, B and C are updates of information available at the time of the Draft EIS.)

TABLE J-10

DIFFERENCE IN REVENUES ACCRUING TO MAUI COUNTY WITH-PROJECT FUTURE AS OPPOSED TO WITHOUT-PROJECT FUTURE

	1991	1996	2001	2006	Cumulative Increase 1991-2010
Construction-Derived Revenues	$16,924	$128,595	$42,516	($28,911)	$794,312
Real Property Tax	$181,578	$1,709,452	$2,386,085	$2,550,632	$39,320,020
County Share of Transient Accommodations Tax	$115,861	$308,633	$441,099	$387,275	$6,908,272
County Revenues due to Increased Population					
Immediate Impact	$32,065	$107,485	$238,828	$226,505	$3,570,014
Ultimate Impact	$45,901	$151,878	$334,863	$320,998	$5,046,519
TOTAL COUNTY REVENUES					
Immediate Impact	$346,428	$2,254,164	$3,108,528	$3,135,501	$50,592,617
Ultimate Impact	$360,264	$2,298,558	$3,204,563	$3,229,994	$52,069,122

NOTES:

(1) Calculated for full-time resort residents and in-migrant non-resort Lanai residents.

(2) For selected years, annual revenues, not cumulative ones, are shown.

TABLE J-11

PER CAPITA ALLOCATION OF MAUI COUNTY GOVERNMENT EXPENDITURES

Function	1988 Expenditures	Service Population Includes Visitors?	Expenditures per Resident	Expenditures per Visitor
General Government	$9,882,500	No	$106.26	–
Public Safety	$18,646,972	Yes	$149.18	$149.18
Highways	$5,162,596	Yes	$41.30	$41.30
Health and Sanitation	$5,297,665	Yes	$42.38	$42.38
Hospitals and Institutions	$186,692	Yes	$1.49	$1.49
Public Welfare	$4,735,381	No	$50.92	–
Education	$188,682	No	$2.03	–
Recreation	$4,556,410	Yes	$36.45	$36.45
Interest	$2,557,249	No	$27.50	–
Bond Redemption	$1,172,500	No	$12.61	–
Retirement and Pension	$2,592,461	No	$27.88	–
Cash Capital Improvements	$14,497,025	Yes	$115.98	$115.98
Miscellaneous	$5,052,505	No	$54.33	–
Total	$74,529,000		$668.30	$386.78
Adjusted Total (1990 Dollars)			$745.73	$431.59

SOURCE: Tax Foundation of Hawaii, 1989.

TABLE J-12

DIFFERENCE IN COSTS FOR MAUI COUNTY WITH-PROJECT FUTURE AS OPPOSED TO WITHOUT-PROJECT FUTURE

	1991	1996	2001	2006	Cumulative Increase 1991-2010
Increase in Resident Population with Project					
Immediate Impact	209	700	1556	1476	
Ultimate Impact	299	989	2182	2091	
County Costs per Resident	$745.73	$745.73	$745.73	$745.73	
County Costs for Project-Related Residents					
Immediate Impact	$155,786	$522,214	$1,160,345	$1,100,472	$17,344,885
Ultimate Impact	$223,009	$737,899	$1,626,932	$1,559,565	$24,518,474
Increase in Visitor Population with Project	168	183	641	581	
County Costs per Visitor	$431.59	$431.59	$431.59	$431.59	
County Costs for Project-Related Visitors	$72,507	$78,981	$276,649	$250,754	
Total County Costs					
Immediate Impact	$228,293	$601,195	$1,436,994	$1,351,226	$21,321,986
Ultimate Impact	$295,516	$816,880	$1,903,581	$1,810,319	$28,495,576

TABLE J-13

DIFFERENCE IN COSTS AND BENEFITS ACCRUING TO MAUI COUNTY
WITH-PROJECT FUTURE AS OPPOSED TO WITHOUT-PROJECT FUTURE

	1991	1996	2001	2006	Cumulative Increase 1991-2010
Total Revenues					
Immediate Impact	$346,428	$2,254,164	$3,108,528	$3,135,501	$50,592,617
Ultimate Impact	$360,264	$2,298,558	$3,204,563	$3,229,994	$52,069,122
Total Costs					
Immediate Impact	$228,293	$601,195	$1,436,994	$1,351,226	$21,321,986
Ultimate Impact	$295,516	$816,880	$1,903,581	$1,810,319	$28,495,576
BALANCE					
Immediate Impact	$118,135	$1,652,970	$1,671,534	$1,784,275	$29,270,631
Ultimate Impact	$64,748	$1,481,678	$1,300,982	$1,419,675	$23,573,546

SOURCE: Tables J-10, J-11, and J-12

TABLE J-14

DIFFERENCE IN REVENUES ACCRUING TO THE STATE OF HAWAII WITH-PROJECT FUTURE AS OPPOSED TO WITHOUT-PROJECT FUTURE

Difference	1991	1996	2001	2006	Cumulative Increase 1991-2010
Construction-Derived Revenues	$1,490,643	$4,494,672	($995,666)	($883,303)	$13,686,528
Resort Resident Income Tax	$0	$1,320,310	$3,770,043	$2,624,713	$41,836,338
State Share of Transient Accommodations Tax	$26,745	$71,245	$101,823	$89,399	$1,594,707
State Revenues Derived from Visitor Spending					
Estimate A	$2,351,821	$2,561,805	$8,973,316	$8,133,379	$129,000,168
Estimate B	$2,792,787	$3,042,142	$10,655,812	$9,658,389	$153,187,695
Estimate C	$3,233,753	$3,522,481	$12,338,309	$11,183,398	$177,375,226
TOTAL STATE REVENUES					
Estimate A	$3,869,209	$8,448,032	$11,849,516	$9,964,188	$186,117,741
Estimate B	$4,310,175	$8,928,369	$13,532,012	$11,489,198	$210,305,268
Estimate C	$4,751,141	$9,408,708	$15,214,509	$13,014,207	$234,492,799

NOTES:

(1) For calculations of visitor spending, part-time residents count as visitors. Estimates based on alternative assumptions concerning average daily visitor spending per person:
(A) $400
(B) $475
(C) $550

TABLE J-15

PER CAPITA ALLOCATION OF STATE OF HAWAII GOVERNMENT EXPENDITURES

Function	1988 Expenditures	Service Population Includes Visitors?	Expenditures per Resident	Expenditures per Visitor
General Government	$227,087,985	No	$206.78	–
Public Safety	$112,668,465	Yes	$92.44	$92.44
Highways	$78,624,434	Yes	$64.51	$64.51
Natural Resources	$36,031,668	Yes	$29.56	$29.56
Health and Sanitation	$126,173,783	Yes	$103.52	$103.52
Hospitals and Institutions	$104,934,445	No	$95.55	–
Public Welfare	$380,823,381	No	$346.77	–
Education	$886,244,283	No	$807.00	–
Recreation	$19,221,645	Yes	$15.77	$15.77
Utilities	$194,074,820	No	$176.72	–
Debt Service	$279,664,578	No	$254.66	–
Retirement and Pension	$131,079,086	No	$119.36	–
Employees' Health and Hospital Insurance	$441,644	No	$0.40	–
Unemployment Compensation	$55,827,128	No	$50.84	–
Grants-in-Aid to Counties	$32,867,045	No	$29.93	–
Urban redevelopment and Housing	$146,462,001	No	$133.37	–
Cash Capital Improvements	$109,635,672	Yes	$89.95	$89.95
Miscellaneous	$58,877,586	No	$53.61	–
Total	$2,980,739,649		$2,670.74	$395.76
Adjusted Total (1990 Dollars)			$2,980.17	$441.62

SOURCE: Tax Foundation of Hawaii, 1989.

TABLE J-16

DIFFERENCE IN COSTS FOR THE STATE OF HAWAII WITH-PROJECT FUTURE AS OPPOSED TO WITHOUT-PROJECT FUTURE

	1991	1996	2001	2006	Cumulative Increase 1991-2010
Increase in Resident Population with Project[1]					
Immediate Impact	487	1446	2137	2066	
Ultimate Impact	617	1735	2763	2682	
State Costs per Resident	$2,980	$2,980	$2,980	$2,980	
State Costs for Project-Related Residents					
Immediate Impact	$1,452,491	$4,308,594	$6,368,484	$6,158,032	$102,215,114
Ultimate Impact	$1,838,833	$5,170,540	$8,233,112	$7,992,713	$131,264,684
Increase in Visitor Population with Project[2]	168	183	641	581	
State Costs per Visitor	$442	$442	$442	$442	
State Costs for Project-Related Visitors	$74,192	$80,816	$283,078	$256,581	
Total State Costs					
Immediate Impact	$1,526,684	$4,389,411	$6,651,562	$6,414,613	$106,284,643
Ultimate Impact	$1,913,025	$5,251,356	$8,516,190	$8,249,294	$135,334,212

NOTES:

[1] Calculated for full-time Lanai resort residents and in-migrant non-resort statewide residents.

[2] For selected years, annual revenues, not cumulative ones are shown.

TABLE J-17

DIFFERENCE IN COSTS AND BENEFITS ACCRUING TO THE STATE OF HAWAII WITH-PROJECT FUTURE AS OPPOSED TO WITHOUT-PROJECT FUTURE

	1991	1996	2001	2006	Cumulative Increase 1991-2010
Total Revenues					
Estimate A	$3,869,209	$8,448,032	$11,849,516	$9,964,189	$186,117,741
Estimate B	$4,310,175	$8,928,369	$13,532,012	$11,489,198	$210,305,268
Estimate C	$4,751,141	$9,408,708	$15,214,509	$13,014,207	$234,492,799
Total Costs					
Immediate Impact	$1,526,684	$4,389,411	$6,651,562	$6,414,613	$106,284,643
Ultimate Impact	$1,913,025	$5,251,356	$8,516,190	$8,249,294	$135,334,212
BALANCE					
Estimate A					
minus Immediate Impact	$2,342,526	$4,058,622	$5,197,954	$3,549,576	$79,833,099
minus Ultimate Impact	$1,956,184	$3,196,676	$3,333,326	$1,714,895	$50,783,529
Estimate B					
minus Immediate Impact	$2,783,492	$4,538,959	$6,880,450	$5,074,585	$104,020,626
minus Ultimate Impact	$2,397,150	$3,677,013	$5,015,822	$3,239,904	$74,971,056
Estimate C					
minus Immediate Impact	$3,224,458	$5,019,298	$8,562,947	$6,599,594	$128,208,157
minus Ultimate Impact	$2,838,116	$4,157,352	$6,698,319	$4,764,913	$99,158,587

SOURCE: Tables J-14, J-15, and J-16

TABLE J-18

LANAI RESIDENT ATTITUDES ON RESORT DEVELOPMENT, LATE 1980s

1988 Statewide Tourism Impact Core Study

		State	Maui County	Lanai
"Would you say life in this part of the island is better, worse, or about the same as it was five years ago?"	Better	29%	32%	50%
	Worse	24%	31%	4%
	Same	46%	36%	43%
"Overall, has tourism been mostly good or mostly bad for you and your family?"	Good	60%	66%	45%
	Bad	4%	5%	2%
	No Effect	30%	22%	46%
"Overall, tourism has brought more benefits than problems to this island."	Agree	74%	72%	54%
	Disagree	18%	20%	35%
"It is time to stop building new hotels on this island."	Agree	68%	67%	52%
	Disagree	27%	29%	41%
"We need more tourism jobs on this island."	Agree	43%	38%	60%
	Disagree	47%	56%	32%

1989 University of Hawaii Social Work Survey

"Overall, how do you rate Lanai as a place to live?"	Very Good/Good	81%
	Average	16%
	Poor/Very Poor	3%
"How do yo feel about the resorts coming to Lanai?"	Positive	57%
	Mixed	32%
	Negative	10%
"Do you see tourism as a good type of economic development for Lanai?"	Yes	68%
	No	16%
"Resort development and tourism will have an impact on the economy of Lanai. Do you think this impact will be..."	Positive/Very Pos.	77%
	Neutral	20%
	Negative/Very Neg.	3%
"Resort development may have...impacts on families and the community of Lanai. In your opinion, will these be..."	Positive/Very Pos.	55%
	Neutral	31%
	Negative/Very Neg.	14%
"How do you think the development on Lanai will affect your overall quality of life?"	Positive Effect	30%
	No Effect	31%
	Negative Effect	18%

NOTE: Percentages for some questions sum to less than 100% because results for replies such as "Don't Know" are omitted.

TABLE J-19

LANAI POPULATION AND ETHNIC SHIFTS, 1930 - 1980

	1930	1940	1950	1960	1970	1980
Total Pop.	2356	3720	3136	2115	2204	2119
Filipino	37%	42%	45%	50%	58%	51%
Japanese	40%	35%	32%	33%	23%	18%
Caucasian	7%	4%	6%	5%	8%	11%
Hawaiian/part-Hawaiian	6%	10%	12%	9%	8%	9%
Other	7%	7%	3%	2%	3%	10%

TABLE J-20

FAMILY CHARACTERISTICS AND INCOME LEVELS
LANAI ISLAND, MAUI COUNTY, AND STATE OF HAWAII, 1980

	LANAI ISLAND 1980	MAUI COUNTY 1980	STATE OF HAWAII 1980
NUMBER OF FAMILIES	470	16,916	227,974
Median Family Income	$21,667	$22,579	$22,750
% of families with incomes $35,000 or more	10.2%	22.6%	25.1%
% of families below poverty level	2.3%	7.6%	7.8%
HOUSEHOLDS	611	22,523	294,934
% of non-family householders below poverty level	4.1%	5.5%	4.0%
% receiving public assistance	5.4%	8.2%	8.8%

NOTES: All figures (except "Population in Families" and "Non-Family Households") based on 15 percent sample; numbers hence represent estimates.

SOURCES: U.S. Bureau of the Census, 1981a, 1981b.

TABLE J-21

MAJOR CASTLE & COOKE CONTRIBUTIONS TO LANAI COMMUNITY

Capital Subsidies

Major renovations and replacement of Lanai water system (benefits only Lanai City residential and commercial users)	$ 4,500,000
Donation of land and complete construction of new recreational center--including building, pool, and athletic fields	$ 2,850,000
Improvement to Hulopoe Beach Park and a grant of perpetual public use over 66 acres	$ 5,640,000
Grant of conservancy easement on 600 acres	$ 600,000
Remodeling of Social Hall for community use	$ 200,000
Improvements to general community, including repaving public roads, landscaping, beach cleaning, rented home renovations, etc.	$ 6,600,000
Donation of land to the County for fire and police stations	$ 200,000
Donation of land to the State for airport and medical/hospital use	$ 1,200,000
Upgrade of public golf course	$ 250,000
Budgeted renovation of town theater	$ 100,000
Total capital budget for affordable housing construction, including:	$ 50,000,000

- $4.8 million subsidy for Lalakoa III
- $0.5 million subsidy for Lower Waialua
- $7.8 million capitalized subsidy on Waialua Multi-Family
- $1.1 million capitalized subsidy on Lanai City Apartments

Donation of land and overhead for affordable housing projects (Lalakoa III, Lanai City Apartments, Lower Waialua, Wailua Multi-Family, and future government projects)	$ 14,330,000
Preservation of historic sites and historic studies	$ 800,000
Establishment of Lanai Institute for Business and Culture (charitable endowment fund aimed partially at Lanai)	$ 6,000,000
Capitalized donation of lease for State telecommunication site	$ 375,000
Budgeted commitment for child care facility/operations	$ 250,000

TABLE J-21

(Continued)

Annual or Operating Subsidies

Subsidization of residential rents in city	$	965,000/yr
Free rent to community groups such as Maui Community College, churches, medical clinic, etc.	$	61,000/yr
Subsidy to residents for water service	$	307,000/yr
Opening, repair, and maintenance costs for recreation center	$	85,000/yr
Scholarship program for local students	$	20,000/yr
Hunting agreement with State for public hunting/private hunting program for public subsidize barge service for product deliveries	N/A	
No charge lease to County for community building	N/A	
Minimal cost lease to community for horse pasture	N/A	

SOURCE: Castle & Cooke Properties

TABLE J-22

NOTE: Persons interviewed provided their comments as individuals and were not speaking on behalf of their organizations. Organizational affiliations are provided only to indicate the interests and networks of those interviewed.

Name	Organization/Affiliation
Lydian Batoon	Treasurer, Ilocos Norte Club Member, Sacred Hearts Church Member, Lanai Filipino Community Association Sales Associate, The Lodge Gift Shop at Koele
Dodge Baybayan	Member, Lanai Golf Association Supervisor, Dole Company
Duane Black	Administrator, Lanai Community Hospital
Sheila Black	Teacher, Lanai School Chapter Vice President, Hawaii State Teachers Association Member, Library Advisory Commission Area Director, Hawaii Special Olympics Member, Maui County Grants Review
Dixie Buckley	President, Lanai Lions Club President, University of Hawaii Extension President, Lanai Community Hospital Auxiliary Member, Decisions Lanai
Rosita Camero	Corresponding Secretary, Lanai Filipino Community Association Member, Sacred Hearts Church Member, Aloha Week Committee
Martha Evans	President, Lanaians for Sensible Growth
Dolores Fabrao	Director of Nursing, Lanai Community Hospital Secretary, Lanaians for Sensible Growth Secretary, Decisions Lanai Secretary, Lanai Community Development Corporation
Charlotte Felipe	Bus Driver, Lanai Company
Guy Fujimura	Secretary-Treasurer, Local 142, ILWU
Butch Gima	Social Worker, Lanai Counseling Services, Department of Health, Mental Health Division Founder, Keiki Network Member, Lanai Lions Club Member, Boy Scouts of America, Maui County Council Member, Lanai Home Health Advisory Committee Member, Maternal and Child Health Committee, Department of Health, State of Hawaii

TABLE J-22

(Continued)

Goro Hokama	Member, Maui County Council Chairman, Unit 2301, ILWU Local 142
Solomon Kaupuiki	Kapuna for site of Manele Bay Hotel, proposed golf course and proposed resort housing
Kurt Matsumoto	Food and Beverage Manager, Manele Bay Hotel
Tomo Mitsunaga	Member, Maui Planning Commission
Kay Okamoto	Co-Chair, Decisions Lanai President, Lanai Community Association Librarian, Lanai Public and School Library
Glenn Oshiro	Owner, Oshiro Service and U-Drive
Kathy Oshiro	Oshiro Service and U-Drive
Shirley Oshiro	Coordinator, Senior Citizen Programs, County of Maui, Department of Human Services
Irene Pascua	Housekeeper, Lanai Company
Rev. Joe Puchek	Lanai Union Church Co-Chair, Decisions Lanai
Bob Saiki	Lanai Businessman
Father Bob Schwarzhaupt	Sacred Hearts Church
Nancy Tamashiro	Lanai Resident
Wallace Tamashiro	Owner, Richard's Shopping Center
Mary Torralba	Cook, Hotel Lanai, Lanai Company
Lt. Paul Winters	Commander, Lanai Police Station
Jackie Woolsey	Public Health Nurse, Department of Health, State of Hawaii Member, Board of Directors, Keiki O Lanai Pre-School Member, Decisions Lanai Member, Lanai Community Development Corporation Member, Native Hawaiian Task Force
Jean Sumaqit	Member, Lanai Filipino Community Association Member, University of Hawaii Extension Member, Sacred Hearts Church

K. MEMORANDUM OF AGREEMENT
OCTOBER 10, 1900

MEMORANDUM OF AGREEMENT

This Memorandum of Agreement ("Agreement") is made on this 10th day of October, 1990, by and between LANAIANS FOR SENSIBLE GROWTH, a Hawaii nonprofit corporation ("LSG"), the OFFICE OF HAWAIIAN AFFAIRS, a Hawaii Body Corporate ("OHA"), and LANAI COMPANY, INC., a Hawaii corporation, and CASTLE & COOKE, INC., a Hawaii corporation, (collectively the "COMPANY").

R E C I T A L S

1. Over the years there has evolved a unique and special relationship between Castle & Cooke, Inc., as the principal landowner and employer on Lanai, and the community of residents of Lanai. In ancient times, Hawaiians first inhabited the island as their home. In the 19th Century, cattle ranching was introduced, and in 1922, James Dole, through his labors and the labors of people who came to Lanai from many parts of the world, proceeded to cultivate what became the world's largest pineapple plantation. Through the history of this relationship and mutual contributions and endeavors, there has developed a special island community on Lanai.

2. Lanai is a place of natural beauty, with clean air, unspoiled beaches and mountain trails, and a shoreline providing food, recreation, and a place for people to realize and enjoy their relationship with nature. Lanai's beauty is also found in its social environment and the special lifestyle of its people: where life moves at a quiet pace; where people from many places have come together to share the best of each of their cultures; and where people are truly neighbors and live their lives in a spirit of mutual care and "Aloha".

3. The world is changing and Lanai is not immune from change. Company has proposed and embarked upon the development of a visitor-based industry for the island. Company has made substantial investments, both in terms of financial and human resources, in connection with this development. These investments are reflected in, among other things, the Lodge at Koele, additional housing, significant infrastructure improvements and recreational amenities. This development, as well as other changes for Lanai in its economic base, are inevitable and essential. With that change in economy will come social changes: the island's population will grow; its composition will change; and the work that people will do will change. But with change, will come new opportunities: job opportunities for young people; cultural and educational opportunities for residents; housing opportunities for families; and better facilities to provide for senior citizens needs.

4. It is the mutual desire of the parties that the positive aspects of Lanai's natural, social, and cultural environments, which have made it a special place to live, be protected, managed, and promoted for the benefit of present and future generations of residents and to enhance the experience Lanai will offer as a visitor destination -- unique to anywhere else in the world. It is also their mutual desire that the development of a visitor-based industry on the island proceed so that the island's residents may come to realize and enjoy the economic, cultural, educational and housing benefits of a vital and diverse economy.

5. The Company has development plans for Lanai which include, among other things, a hotel, golf course and residential development at Manele, a hotel, golf course and residential development at Koele, affordable housing, airport improvements, and various amenities for visitors and residents (collectively the "Development").

6. In the past, the parties hereto have had disputes and disagreements regarding the course and direction of the Development. Nevertheless, the parties agree that to attempt to maintain those things which are the best about Lanai, and to achieve the benefits of economic development in a manner consistent with preserving such things, it is essential that Company and the residents of Lanai work together in mutual cooperation. It is in this spirit of the mutual care, concern, and cooperation for the benefit of people of Lanai, the things that make Lanai a special place, and the continuing viability of the economy of the island that the parties hereto have arrived at this Agreement.

W I T N E S S E T H :

NOW THEREFORE, in consideration of the mutual promises and agreements herein, the parties hereto recite and agree as follows:

I. MANELE GOLF COURSE AND RESIDENTIAL DEVELOPMENT PROJECT

A. Recitals

1. Company has filed a petition (Docket No. A89-649) before the Land Use Commission of the State of Hawaii ("LUC") to reclassify certain acreage from the Rural and Agriculture Land

Use District, TMK: 4-9-02:01 (Por), situated at Manele, Lanai, Hawaii, to the Urban Land Use District (the "LUC Petition").

2. Company has filed (Docket No. 90/CPA004) before the Maui Planning Commission ("Commission") an Application for an Amendment to the Lanai Community Plan and Manele Project District to Expand the Manele Project District Boundaries ("Maui Application"); the Commission issued a Notice of Determination on the Maui Application which required the preparation of an Environmental Impact Statement ("EIS"); and Company filed a Petition for Reconsideration of such Notice of Determination which revised the Maui Application to limit it to plans for a golf course, golf clubhouse and related golf facilities (hereinafter referred to as the "Manele Golf Development") (the "Maui Petition").

3. LSG and OHA have opposed the LUC Petition and the Maui Petition by, among other things, filing intervention with the LUC ("LUC Opposition") and filing an Opposition to Petition for Reconsideration with respect to the Maui Petition ("Maui Opposition"), seeking the requirement of an environmental impact statement before Company may proceed with its development plans for Manele.

4. All parties acknowledge the need to proceed as soon as possible with the Manele Golf Development to support the economic viability of the Manele Bay Hotel. All parties also acknowledge the need to wisely protect the natural resources and the social environment upon which the success of the development relies.

B. Agreement

1. Manele Golf Development. Subject to obtaining the necessary approvals and the terms of Articles I, II and III of this Agreement, LSG and OHA agree that Company may proceed with the development, construction, operation and maintenance of the Manele Golf Development without first obtaining an EIS, and LSG and OHA agree that, in accordance with Subsection B.3 below, they will not oppose the Company so proceeding.

2. Pending Petitions and Motions. Company agrees to take the necessary and appropriate steps so that the LUC Petition and the Maui Petition seek the issuance of orders of reclassifications or approvals of only the Manele Golf Development prior to the completion and acceptance of the EIS as more fully described in Section I.B.5. below. Company will not seek the issuance of orders of reclassifications or approvals for

the development of the residential subdivision adjacent to the golf course until the completion and acceptance of such EIS.

3. Conditional Withdrawal of Objections. LSG and OHA agree to withdraw with prejudice all objections to the pending applications related to the Manele Golf Development, including without limitation, the LUC Opposition and Maui Opposition as they pertain to the Manele Golf Development, and will not object, in the future, to the Manele Golf Development substantially in form and substance as currently proposed, subject to the provisions of this Agreement.

4. Future Residential Development Plans. LSG and OHA acknowledge and agree that Company shall seek approval for a residential subdivision development immediately adjacent to the golf course development (the "Residential Development"). LSG and OHA agree they will not oppose the concept of the Residential Development and will not seek to delay its approval. LSG and OHA further acknowledge and agree that they will not oppose the concept of residential housing in the Manele Project Area, and that such housing will be of a luxury character. LSG represents that its total membership on the date of this Agreement is in excess of 250, and understands that Company is relying upon LSG as an organization to support and carry out the objectives of this Agreement. Consequently, should another group which includes Lanai residents be formed to oppose the objectives of this Agreement ("Opposition Group"), LSG acknowledges that the benefits of this Agreement could be lost to Company. Accordingly, LSG and its current and future officers and directors agree not to support or be a member of any Opposition Group. However, LSG reserves its rights to raise issues and concerns regarding such development before any approving entity with respect to the specifics of such development, including its scope and design, and concerns over the environmental and social impact of such a development which are not addressed to the satisfaction of LSG through the EIS and permit approval process.

5. Preparation of Environmental Impact Statement. Company agrees to proceed to cause to be prepared, in accordance with Chapter 343 of the Hawaii Revised Statutes, a cumulative EIS on the Manele Golf Development and Residential Development as required by law. In this regard, Company agrees that:

(a) It has caused the preparation and filing of a notice of preparation of the EIS pursuant to applicable state law and shall promptly process the EIS without delay, at every phase of preparation.

(b) The EIS shall incorporate a social impact component which shall incorporate social impact analysis as well as data compilation.

(c) The Draft EIS shall be completed within 90 days following September 18, 1990.

(d) It shall provide LSG with four copies of the Draft EIS immediately upon its issuance.

(e) Upon issuance of the Draft EIS, Company and LSG shall promptly meet as frequently as reasonably required to discuss, address, and, where appropriate, attempt to reach agreement with regard to any concerns identified by the EIS or raised by LSG as a result of, and within the scope of, the EIS; provided, however, that such discussions shall not hinder or delay the EIS approval process.

(f) It will complete and obtain Acceptance (as defined by Section 343-2 of the Hawaii Revised Statutes) of the Final EIS by the appropriate government entities prior to Company's submission of any petition or application to the LUC, the County Planning Commission, or any other governmental body, for approvals to permit the development of the residential subdivision.

(g) Notwithstanding the provisions of this Section, the Company may proceed with residential development already approved or permitted within the Manele Project District.

(h) Subject to Section I.B.4. above, this Agreement shall not be construed as a waiver of LSG's right to raise any concerns identified in the EIS or raised as a result of the EIS at any subsequent proceeding before any governmental body or agency if such concerns are not addressed to the satisfaction of LSG through the EIS process.

6. Environmental Protection. In developing, constructing, operating, and maintaining the golf course and any subsequent residential development in the Manele Project District, Company agrees that it will continue to cause such activities to take place with sensitivity to the environmental impact which may result. To that end, Company promises and agrees that it will:

(a) Conduct such activities and take appropriate preventive measures so that such development, construction, operation and maintenance activities do not cause any deterioration in the Class AA water quality standards currently in existence for Hulopoe Bay and the coastal waters adjacent to

the Manele Bay Hotel and the golf course, or any comparable standards as may be established by law in the future, taking into account temporary perturbations from natural occurrences ("Water Quality").

(b) Promptly do such things as may be reasonably necessary to fully mitigate any condition caused by its development activities which results in deterioration of the Water Quality of Hulopoe Bay and the coastal waters adjacent to the Manele Bay Hotel and the golf course.

(c) In order to comply with Subsection (a) above, promptly retain Environmental Assessment Company or such other third-party entity (the "Monitor") as may be mutually agreed between Company and LSG for the purpose of monitoring the Water Quality for Hulopoe Bay and the coastal waters adjacent to the Manele Bay Hotel and the golf course. The monitoring program shall promptly make its results available to the State Department of Health. The program shall include baseline studies of such coastal waters and ongoing water quality monitoring on not less than a quarterly basis. The monitoring program will be conducted with a frequency and in a manner so as to be at least as effective, in the opinion of the Monitor, as any other coastal water quality monitoring program for similar waters implemented in the State of Hawaii.

(d) Ensure that no high level ground water aquifer will be used for golf course maintenance or operation (other than as water for human consumption) and that all irrigation of the golf course shall be through alternative non-potable water sources.

(e) Keep LSG informed through periodic meetings between Company and LSG of the Manele Golf Development plans and progress of the construction of the golf course. These meetings shall be held on a quarterly or other periodic basis as may be mutually agreed to.

7. Shoreline Access. In developing and operating the golf course and any future residential development in the Manele Project District, Company shall protect public access along the accessible cliff coastline. In this regard, Company agrees it will:

(a) Dedicate a public easement along the accessible cliff coastline from Hulopoe Bay to the intersection of the coastline with the Westernmost boundary of the project area which will allow public pedestrian access in perpetuity without obstruction or interference of such use, subject to reasonable rules and regulations for public safety; provided,

however, that access shall be maintained. Company may, at its option, accomplish such dedication by, among other things, dedicating such easement or granting fee title to the County of Maui or State of Hawaii; granting fee title or a perpetual and irrevocable "conservation easement", as that term is defined in Section 198-1 of the Hawaii Revised Statutes, to a "qualified organization" as that term is defined in Section 170(h)(3) of the Internal Revenue Code of 1986, as amended; or providing such access as a condition of approval by the LUC in connection with the Manele Golf Development.

(b) Subject to the Signature Hole Exception discussed below, cause to be established a setback zone of 50 feet from the edge of the cliff along the accessible cliff coastline from Hulopoe Bay to the intersection of the coastline with the Westernmost boundary of the project area within which there shall be no improvements of any kind, other than improvements which may be reasonably necessary for purposes of public safety ("Safety Improvements"), and where the property will be left in its natural state. This 50-foot setback zone shall be the zone to allow for public access as provided in Subsection (a) above. The location of the setback along a "signature hole" presently planned and designated as the 16th hole may have a setback of less than 50 feet from the edge of the cliff, with the exact setback being determined by mutual agreement between LSG and Company in order that such hole not unreasonably interfere with the public's access but still achieve "signature" status as presently planned by Company (the "Signature Hole Exception").

(c) Cause the area within 75 feet of the edge of the cliff along the accessible cliff coastline from Hulopoe Bay to the intersection of the coastline with the Westernmost boundary of the project area to remain in its natural state without improvement, except with respect to the three proposed "signature holes" of the golf course. Company shall, at its option, either (i) incorporate covenants, conditions and restrictions in any conveyance of real property which shall require that the real property within this 75-foot setback zone be maintained in its natural state and which prohibit any landscaping, erection of fences, walls or other barriers, or any other improvements, other than Safety Improvements, within this zone; or (ii) by any of the means referred to in Subparagraph (a) above in order to satisfy the requirements of this Subsection.

(d) Prohibit any vertical improvements, other than landscaping and Permitted Improvements (as defined below), to be constructed or erected within 150 feet of the edge of the cliff along the accessible cliff coastline from Hulopoe Bay to the intersection of the coastline with the Westernmost boundary

of the project area. Company shall incorporate covenants, conditions and restrictions in any conveyance of real property which shall prohibit the erection or construction of any vertical improvements, other than landscaping and Permitted Improvements within this 150-foot setback zone. Subject to applicable County standards and variances therefrom, improvements such as unenclosed patios, pools, and approved fences (the "Permitted Improvements") shall be allowed within the 150-foot setback zone as determined by the County; provided, however, that such improvements shall not be closer than 90 feet from the edge of the cliff along the accessible cliff coastline from Hulopoe Bay to the intersection of the coastline with the Westernmost boundary of the project area.

(e) Work with LSG to incorporate mauka pathways which may be tied to golf course and residential area pathways which will provide alternate access routes to the accessible cliff coastline area.

(f) Adopt golf course rules and provide mutually agreeable and appropriate signage which will protect the access along the public access areas and pathways.

(g) Provide LSG with plans for the golf course layout, location of holes, access pathways, and signage in advance of any final approval of such plans by the appropriate governmental agencies.

(h) Company shall record with the appropriate governmental agency all necessary and appropriate instruments to accomplish the purposes of this Section I.B.7.

II. COMMUNITY DEVELOPMENT CORPORATION/COMMUNITY FOUNDATION

A. Recitals

1. Company and LSG recognize that the development plans of Company will have an impact upon the social and economic fabric of Lanai. In this regard, the parties support the creation of a Hawaii nonprofit corporation in the form of a Community Development Corporation ("CDC") and/or a Community Foundation for the purpose of developing programs to deal with and address the social and economic impacts of the development plans through social impact programs, educational and cultural programs, and economic diversification and development programs. Company has acknowledged the need for such programs and is committed to supporting a CDC and/or Community Foundation and its programs through funding and other support.

In the spirit of mutual care and concern as embodied by this Agreement LSG and Company agree as follows:

B. Agreement

1. Organizational Funding. Company shall provide an annual grant in an amount set forth in a separate letter agreement between the parties dated as of the effective date of this Agreement (the "CDC Letter") for two consecutive years for the purpose of funding the organization and creation of a CDC/Community Foundation; the preparation of grant proposals for submission by CDC/Community Foundation to Company and/or other entities; and costs connected with lobbying Federal, State, and County agencies for programs and support of activities connected with the CDC/Community Foundation. The first annual grant shall be made to LSG within 15 days from the date of this Agreement or upon the receipt by Company of adequate proof that LSG is a nonprofit corporation formed in accordance with the applicable provisions of the Hawaii Revised Statutes, whichever is later. The second annual grant shall be made to CDC/Community Foundation 12 months following the date of payment of the first annual grant or upon the receipt by Company of adequate proof that CDC/Community Foundation is a nonprofit corporation formed in accordance with the applicable provisions of the Hawaii Revised Statutes, whichever is later.

2. Project Funding. Company agrees to provide grants to fund projects, proposals, and programs as submitted through the CDC/Community Foundation in an aggregate amount of not less than the amount set forth in the CDC Letter during the first twelve-month period following the CDC/Community Foundation's submission of the initial grant proposal to Company. All grant proposals submitted to the Company shall be in such form and of sufficient detail as to be consistent with the requirements for grant proposals as would be required by other philanthropic foundations for similar grants. Among the projects to be proposed and funded during the first twelve-month period shall be a "backyard aquaculture" demonstration project similar to those being established by the Waianae Alternative Economic Development Corporation on the Island of Oahu.

3. Future Project Funding. After the initial twelve month funding period provided in Subsection B.2 of this Section II, Company agrees to provide funding for other projects, proposals and programs as may be submitted by the CDC/Community Foundation and reviewed and approved by Company on a case-by-case basis. Although funding for future grant requests to be submitted to Company shall be subject to review and approval by Company, Company acknowledges its commitment to supporting the concept of the CDC/Community Foundation. Company further

acknowledges its social responsibility to financially support the benevolent objectives of the CDC/Community Foundation and projects for the welfare of the Lanai community.

4. Office and Administrative Support. Company will provide its cooperation and assistance to LSG in the formation and operation of the CDC/Community Foundation and, for a period of 2 years following the date of this Agreement, will provide appropriate office space and office support services to the CDC/Community Foundation at no charge.

5. CDC/Community Foundation Governance. In organizing the CDC/Community Foundation, LSG shall establish a governing body for the CDC/Community Foundation which shall include representatives of a cross-section of the Lanai community and provide for participation of Company in either a representative or advisory capacity. The CDC/Community Foundation will conduct its activities so as to be consistent with the intent and purpose of this Agreement.

III. ARCHAEOLOGICAL AND CULTURAL RESOURCES

A. Recital

Company, LSG and OHA recognize the importance of preserving for posterity the archaeological resources of Lanai, which for Hawaiians, also represent cultural resources. These resources provide a significant tie to Lanai's history and the origins of human habitation of the island. In the spirit of mutual cooperation as set forth in this Agreement, Company, LSG and OHA agree as follows:

B. Agreement

1. Archaeological Agreement. Company agrees to meet with the Lanai Archaeological Committee established pursuant to the 1987 Memorandum of Agreement between LSG and Company concerning the archaeological resources in the Manele project district to discuss and negotiate an agreement resolving concerns related to preservation and regulations of archaeological resources within the area of the golf course and future proposed residential subdivision in the Manele Project District. In the event that Company and the Lanai Archaeological Committee are unable to reach agreement resolving all current archaeological concerns within such area within 90 days from the date of this Agreement, then it is agreed that any matters not resolved by agreement shall be submitted to a mediator or other third party as may be mutually agreed upon between Company and LSG.

IV. PARK COUNCIL OPERATIONS

LSG and Company previously entered into a Memorandum of Agreement dated November 19, 1987, providing for the establishment of a Joint Community Park Council ("Park Council") with respect to the Hulopoe Beach Park Complex. To ensure that the Park Council fulfills its role and responsibilities as agreed in the Memorandum of Agreement, LSG and Company agree to take steps to implement that Memorandum of Agreement and activate and promote the work of the Park Council. Company further agrees to provide the Park Council with reasonable operational and administrative support services, to facilitate the conduct of the business of the Park Council.

V. ONGOING DISCUSSIONS

A. Recital

In the spirit of mutual cooperation upon which this Agreement is based, both Company and LSG wish to establish a framework for communication, mutual understanding, and ongoing cooperation between Company and the Lanai community. Through such a framework, it is the mutual desire of the parties that the development of Lanai may proceed in a manner which will ensure its harmonious integration into the island community and also ensure its economic success and viability. To further the establishment of such a framework, the parties agree as follows:

B. Agreement

1. The parties shall engage in a series of regular periodic meetings with other appropriate community groups for the purpose of identifying, discussing, and addressing community concerns and, where appropriate, negotiating in good faith and attempting to reach agreement regarding the following issues related to the development of Lanai:

(a) How to make the Lanai resort experience a unique and rewarding experience for visitors so as to ensure the success of the resort.

(b) How to integrate the resort development with the existing resident lifestyle on Lanai with a view to preserving and protecting the positive aspects of Lanai's natural, social, and cultural environments.

(c) How to sensitively handle and mitigate the consequences of development so as to prevent a division of the community between different economic groups.

(d) Conditions and concerns relating to the proposed residential development adjacent to the Manele Golf Course.

(e) Affordable housing needs for Lanai.

(f) Issues and concerns affecting retail merchants on Lanai.

(g) Hunting and fishing opportunities for residents of Lanai.

(h) Restrictions on development of the Shark's Bay area.

(i) Hulopoe Beach access and development.

(j) Trail access and gathering activities.

(k) Water resource management and informational concerns.

(l) Public play opportunities at golf courses on Lanai.

(m) Additional funding for the CDC/Community Foundation.

(n) Timely information regarding pending and future planned development activity on Lanai.

(o) Development of an agricultural park in conjunction with the State Department of Agriculture and/or the County of Maui. In this regard, LSG acknowledges that Company has already initiated discussions and reached certain agreements concerning such agricultural park.

2. Schedule of Meetings. The meetings contemplated by this Section V shall be scheduled at least quarterly or at such other times as may be mutually agreed upon. An initial organizational meeting shall be scheduled by the Director, Center for Alternative Dispute Resolution, within 30 days of this Agreement to help establish the structure of future meetings.

3. Policy of Encouraging Comment on the Merits. To encourage broad-based community participation in the series of meetings contemplated by this Agreement, Company shall take reasonable steps to affirmatively inform all its employees and tenants on Lanai that the Company will continue to encourage public participation in such meetings and fair comment on the merits of the issues raised in such meetings consistent with the exercise of constitutionally protected free speech, and that, consistent with its practice, the Company does not discriminate against, retaliate against, punish, threaten, penalize, or otherwise restrain the right of any individual who engages in such activities or exercises such rights regarding Company's development plans, operations and activities on Lanai as they affect Lanai residents and its natural resources; provided, however, that the exercise of such rights shall not permit employees to engage in acts of speech which is unrelated to the merits of such issues and which also would (a) disclose proprietary or confidential information; (b) be injurious to the privacy or personal reputation of any individual; or (c) is not legally protected in the employer-employee relationship.

VI. MUTUAL AGREEMENTS

A. Company and LSG each agree as follows:

1. Good Faith and Aloha Spirit. Company, LSG and OHA agree to abide by the terms and conditions of this Agreement in good faith and in accordance with the spirit and intent in which it is entered into by both parties. It is the intent of all parties that this Agreement be governed by the "Aloha Spirit" as defined in Section 5-7.5 of the Hawaii Revised Statutes.

2. Entire Agreement. This Agreement constitutes the entire Agreement between the parties pertaining to the subject matter hereof. No supplement, modification, or amendment of this Agreement shall be effective unless executed in writing by the parties hereto.

3. Binding on Successors. The terms, provisions, covenants, undertakings, agreements, obligations and conditions of this Agreement shall be binding upon and shall inure to the benefit of the successors in interest and the assigns of the parties hereto, and Company further covenants that, in the event it enters into an agreement to sell or otherwise dispose of a controlling interest (i.e., fifty percent [50%] or more) of a major component (i.e., hotel, golf course and related facilities, or property for development; provided, however, that purchasers of residential and commercial lots shall not be bound by any of the provisions of this Agreement) of its real property in a project district (i.e., Manele, Koele or Lanai City) on Lanai

("Sale Agreement"), Company shall (i) include the applicable provisions of this Agreement in such Sale Agreement and require that the purchaser also include such provisions in any other sale agreement whereby it subsequently sells such property to another purchaser, and (ii) notify LSG of such Sale Agreement as soon as possible, taking into account applicable Federal Securities Law requirements.

4. Applicable Law. This Agreement shall be governed by and construed and enforced in accordance with the laws of the State of Hawaii.

5. No Waiver.

(a) The waiver by any party of any breach of any term, covenant or condition contained herein shall not be deemed to be a waiver of such term, covenant or condition or any subsequent breach of the same or any other term, condition or covenant herein contained.

(b) Failure of any party to insist upon compliance with any provision hereof shall not constitute a waiver of the rights of such party to subsequently insist upon compliance with that provision or any other provision of this Agreement.

(c) No delay or omission in the exercise of a right or remedy accruing to any party on any breach or default by any other shall impair any such right or remedy, and the same shall not be construed as a waiver of any such breach or default.

(d) Any waiver must be in writing and shall be effective only to the extent specifically allowed by such writing.

6. Dispute Resolution. While all parties enter into this Agreement in good faith and with the sincere desire to work together to implement its purposes and intents, each party recognizes that disagreements may arise from time to time. In the event that a disagreement, dispute or alleged material default or breach of any obligation hereunder (collectively a "Dispute") cannot be resolved among the parties themselves, the parties hereby agree to resolve such matters as follows:

(a) Mediation. Before seeking recourse in a court of law, the parties agree first to seek to mediate any Dispute which may arise between or among them. The parties agree

that, upon written request by any party for mediation, each of the affected parties shall participate in such mediation process and shall make good faith attempts to resolve such Dispute. In the event that mediation is requested, the parties agree to seek the assistance of the Director, Center for Alternative Dispute Resolution, to mediate and help resolve any Dispute between the parties. If said Director is unavailable or unwilling to serve as mediator, then the parties shall mutually agree upon a substitute mediator.

(b) Litigation. In the event that mediation does not result in the resolution of a Dispute involving an alleged material default or breach of its obligations hereunder by any party, the non-defaulting party or parties shall, upon the conclusion of the mediation process described in Section VI.6.a., be free to file a lawsuit seeking such legal remedies as may be available under the circumstances in respect to said material default or breach; provided, however, that in pursuing its legal remedies, no party shall seek to block or delay the development and construction of the Manele Golf Development.

7. Announcement of Agreement. LSG and Company agree to make a public announcement of this Agreement which shall mutually be agreed to and made jointly by Company and LSG.

8. Evidence of Agreement. The parties agree that this Agreement may be submitted to any governmental authority or introduced as evidence of the parties agreement in any administrative or judicial proceeding involving the subject matter of this Agreement.

9. Severability. If any provision of this Agreement is declared invalid or unenforceable, such provision shall be deemed modified to the extent necessary to render it valid and enforceable. In any event, the unenforceability or invalidity of any provision shall not affect any other provision of this Agreement, and this Agreement shall continue in full force and effect and be construed and enforced as if such provision had not been included, or had been modified as above provided, as the case may be.

10. Authorities. Each party represents and warrants to the other that (i) it has duly executed, authorized and delivered this Agreement, (ii) this Agreement constitutes the

legal, valid and binding obligation of it, enforceable in accordance with its terms, and (iii) no further approval of any board, court or other body is necessary in order to permit it to execute this Agreement or to consummate the transactions contemplated hereunder.

11. Effective Date. This Agreement shall become effective upon its execution by all parties.

12. Notice. Unless otherwise expressly provided herein, all notices and statements required or permitted to be given pursuant to this Agreement (with the exception of day to day operational communication), and all payments to be made hereunder, shall be delivered in person or sent by registered or certified mail, return receipt requested, and shall be given or made to the following respective addresses of the parties or to such other address as may have been designated in writing in such manner:

As to LSG:

Lanaians for Sensible Growth
Lanai City, Hawaii 96763

Attention: Martha Evans

As to OHA:

1600 Kapiolani Boulevard, Suite 1500
Honolulu, Hawaii 96814

Attention: Richard Paglinawan

As to Company:

Lanai Company, Inc.
650 Iwilei Road
Honolulu, Hawaii 96817

Attention: James E. Pierce

With a copy to:

Castle & Cooke, Inc.
650 Iwilei Road
Honolulu, Hawaii 96817

Attention: Law Department

13. Force Majeure. No party shall be liable to any other party for any delay or failure of such party to perform any obligation hereunder on the basis of events beyond its reasonable control. Upon resolution of any such events, the rights and obligations of the parties shall resume with full force and effect according to the terms of this Agreement.

14. Attorneys' Fees. Should an action be instituted by Company or LSG in any court of law or equity (or in arbitration) pertaining to the enforcement of any of the provisions of this Agreement, the prevailing party shall be entitled to recover, in addition to any judgment or decree rendered therein, any and all court costs and reasonable attorneys' fees and expenses.

15. Counterparts. This Agreement may be executed in any number of counterparts, each of which shall be deemed an original, but all of which together shall constitute a single instrument.

16. No Third-Party Beneficiaries. This Agreement is solely for the benefit of the parties hereto and should not be deemed to confer upon third parties, except the CDC/Community Foundation, any remedy, claim, liability, reimbursement, cause of action or other right in excess of those existing without reference to this Agreement.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date and year first above written.

CASTLE & COOKE, INC.,
a Hawaii corporation

David H. Murdock
Chairman of the Board and
Chief Executive Officer

Thomas C. Leppert
Vice President, Castle & Cooke, Inc. and President and Chief Executive Officer, Oceanic Properties, Inc.

OFFICE OF HAWAIIAN AFFAIRS,
a Hawaii Body Corporate

Thomas Kaulukukui
Chairperson

LANAIANS FOR SENSIBLE GROWTH,
a Hawaii non-profit corporation

Martha Evans, President

Mary Catiel, Vice President

Dolores Fabrao, Secretary

Phyllis McOmber, Treasurer

CASTLE & COOKE, INC.,
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James F. Gary
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Milton Abrahams
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Mike Curb
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Jason Fujie, Director

Henry Aki, Director

Ron McOmber, Director

LANAI COMPANY, INC.,
a Hawaii corporation

James E. Pierce
President & Chief Operating Officer

Robert W. Brant
Sr. Vice President & Chief Financial Officer

Thomas C. Leppert
Sr. Vice President

R. Randolph Lyon, Jr.
Sr. Vice President

George Yim
Sr. Vice President

Richard Y. Kido
Vice President & Controller

Beverly Garcia
Vice President & Treasurer

Ralph N. Masuda
Vice President

Errol R. Dierks
Vice President

Kevin R. Shaney
Secretary

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James F. Gary
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Milton Abrahams
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Mike Curb
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Lewis B. Harder
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(resigned)
Paul Winters, Director

Jason Fujie, Director

Henry Aki, Director

Ron McOmber, Director

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LANAIANS FOR SENSIBLE GROWTH,
a Hawaii non-profit corporation

Paul Winters, Director

Jason Fujie, Director

Henry Aki, Director

Ron McOmber, Director

LANAI COMPANY, INC.,
a Hawaii corporation

James E. Pierce
President & Chief Operating Officer

Robert W. Brant
Sr. Vice President & Chief Financial Officer

Thomas C. Leppert
Sr. Vice President

R. Randolph Lyon, Jr.
Sr. Vice President

George Yim
Sr. Vice President

Richard Y. Kido
Vice President & Controller

Beverly Garcia
Vice President & Treasurer

Ralph N. Masuda
Vice President

Errol R. Dierks
Vice President

Kevin R. Shaney
Secretary

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Vice President & Treasurer

Ralph N. Masuda
Vice President

Errol R. Dierks
Vice President

Kevin R. Shaney
Secretary

FIRST AMENDMENT TO
MEMORANDUM OF AGREEMENT

This First Amendment is made on this 5th day of November, 1990, by and between LANAIANS FOR SENSIBLE GROWTH, a Hawaii nonprofit corporation ("LSG"), the OFFICE OF HAWAIIAN AFFAIRS, a Hawaii Body Corporate ("OHA"), LANAI COMPANY, INC., a Hawaii corporation, and CASTLE & COOKE, INC., a Hawaii corporation (collectively the "Company").

WHEREAS, the parties are all of the parties to that certain Memorandum of Agreement dated October 10, 1990 (the "MOA"); and

WHEREAS, the parties desire to amend the MOA for the purpose of clarifying certain of their rights and obligations under the MOA.

NOW, THEREFORE, in consideration of the foregoing recitals and the mutual covenants and agreements contained herein and in the MOA, the parties hereto agree as follows:

1. Section I.B.4 of the MOA, entitled "Future Residential Development Plans" is changed so that the last sentence reads as follows:

> However, LSG and OHA reserve their rights to raise issues and concerns regarding such development before any approving entity with regard to the specifics of such development, including its scope and design, and concerns over the environmental and social impact of such a development which are not addressed to the satisfaction of LSG and OHA through the EIS and permit approval process.

2. Section I.B.5.(h) of the MOA is changed to read as follows:

> Subject to Section I.B.4. above, this Agreement shall not be construed as a waiver of LSG's or OHA's right to raise any concerns identified in the EIS or raised as a result of the EIS at any subsequent proceeding before any governmental body or agency if such concerns are not addressed to the satisfaction of LSG or OHA through the EIS process.

3. Section III.B.1. entitled "Archaeological Agreement" is changed to read as follows:

> Archaeological Agreement. Company agrees to meet with the Lanai Archaeological Committee established pursuant to the 1987 Memorandum of Agreement between LSG, OHA and Company concerning the archaeological resources in the Manele project district to discuss and negotiate an agreement resolving concerns related to preservation and regulations of archaeological resources within the area of the golf course and future proposed residential subdivision in the Manele Project District. In the event that Company and the Lanai Archaeological Committee are unable to reach agreement resolving all current archaeological concerns within such area within 90 days from the date of this Agreement, then it is agreed that any matters not resolved by agreement shall be submitted to a mediator or other third party as may be mutually agreed upon between Company, LSG and OHA.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date and year first above written.

LANAI COMPANY, INC.,
a Hawaii corporation

James E. Pierce
President

CASTLE & COOKE, INC.,
a Hawaii corporation

Thomas C. Leppert
Vice President

OFFICE OF HAWAIIAN AFFAIRS,
a Hawaii Body Corporate

Thomas Kaulukukui
Chairperson

LANAIANS FOR SENSIBLE GROWTH,
a Hawaii nonprofit corporation

Martha Evans
President