HAWAII DEEP WATER CABLE PROGRAM

PHASE II-C

TASK 5

SUBMARINE VS. OVERHEAD ROUTING:

A COST COMPARISON FOR MOLOKAI

Department of Planning and Economic Development

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A COST COMPARISON FOR MOLOKAI

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Department of Planning and Economic Development

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1.0 RATIONALE

The Hawaii Deep Water Cable (HDWC) Program is determining the technical and economic feasibility of electrically interconnecting the islands of Hawaii, Maui and Oahu with a high voltage, direct current, submarine cable system. Confirmation of technical feasibility involves determination of the constraints imposed by the route, design of a system which satisfies feasibility criteria based on these environmental constraints as well as other operational design factors, and thorough laboratory and field testing. Work completed to date indicates both the technical and economic feasibility of installing, operating, maintaining and repairing a cable system along a "preferred route" from Mahukona, Hawaii to Waimanalo, Oahu with an overland segment across the south corner of east Maui from Huakini to Ahihi. In defining this preferred route, the technical risks of numerous route options were examined and areas or segments of unacceptable risk were discarded while attempting to maximize the submarine length. Thus, the preferred route is technically feasible using the most rigorous criteria. Economics did not enter into the selection of this route and therefore, further optimization may be possible, for example, by relaxing the criterion to maximize the length of submarine segments. An obvious alternative in this regard would be to use an overhead line segment across Molokai, reducing system costs and eliminating a section of more risky submarine cable in favor of less risky overhead lines. The question addressed in this report and described in greater detail below is whether or not an overhead segment across Molokai is truely less costly than a submarine cable bypassing the island if the costs of environmental impact mitigation and schedule delays due to land use controversies are factored in.

2.0 OBJECTIVE

The objective of this comparative cost analysis is to quantify and compare the costs of the preferred submarine route (Figure 1) with an "alternative" route which proceeds overland on Molokai (Figure 2). Two types of costs are taken into consideration. The first are installation costs such as for planning and design, engineering and surveying, materials, equipment and supplies, labor and land acquisition. The second are costs related to land use issues: costs of mitigating environmental impacts and the costs due to schedule delays.

3.0 METHODOLOGY

Four steps are necessary to meet the objective.

A. Develop installation cost estimates for overland and submarine routes.

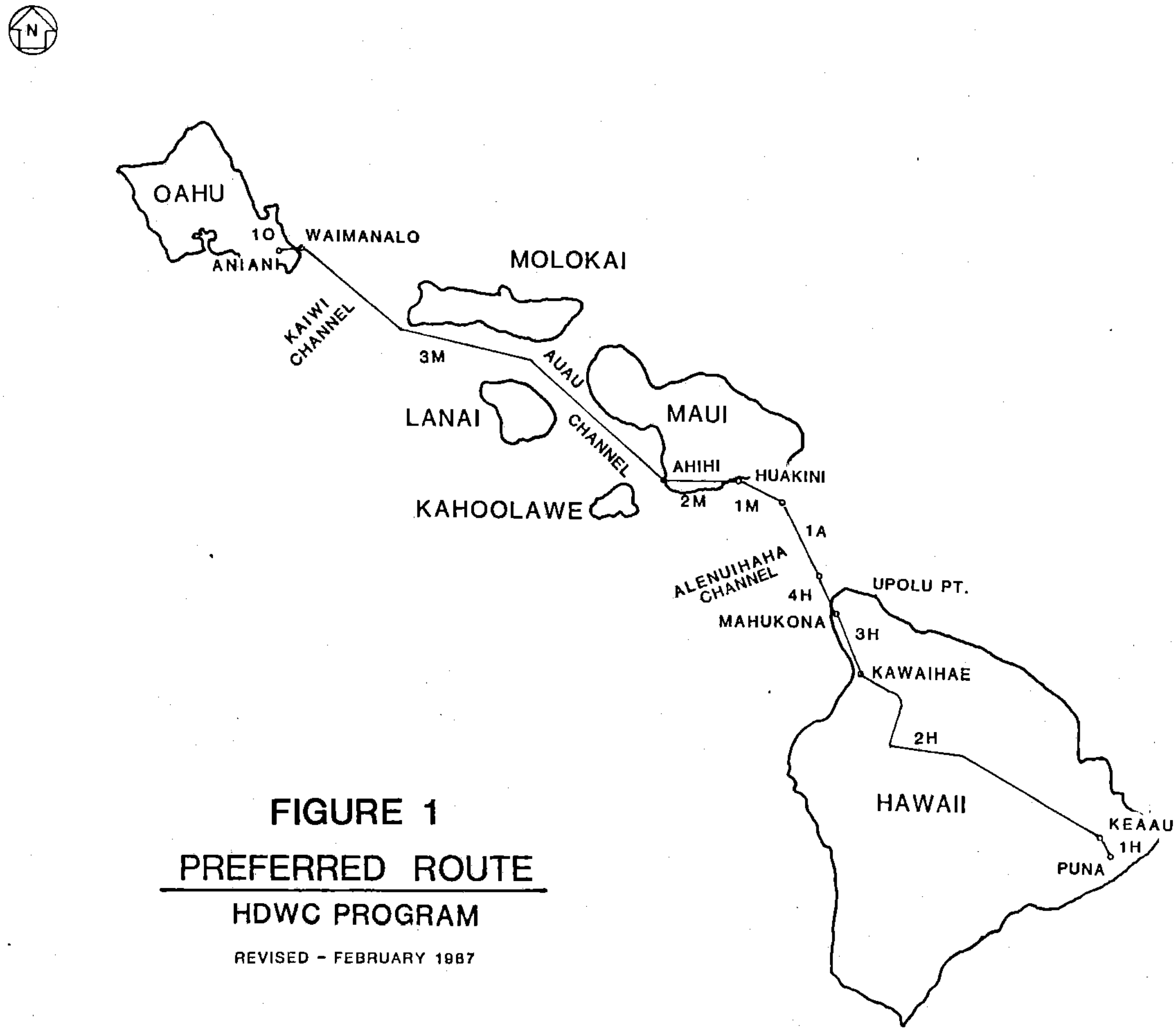

FIGURE 1

PREFERRED ROUTE

HDWC PROGRAM

REVISED - FEBRUARY 1987

MOLOKA'I

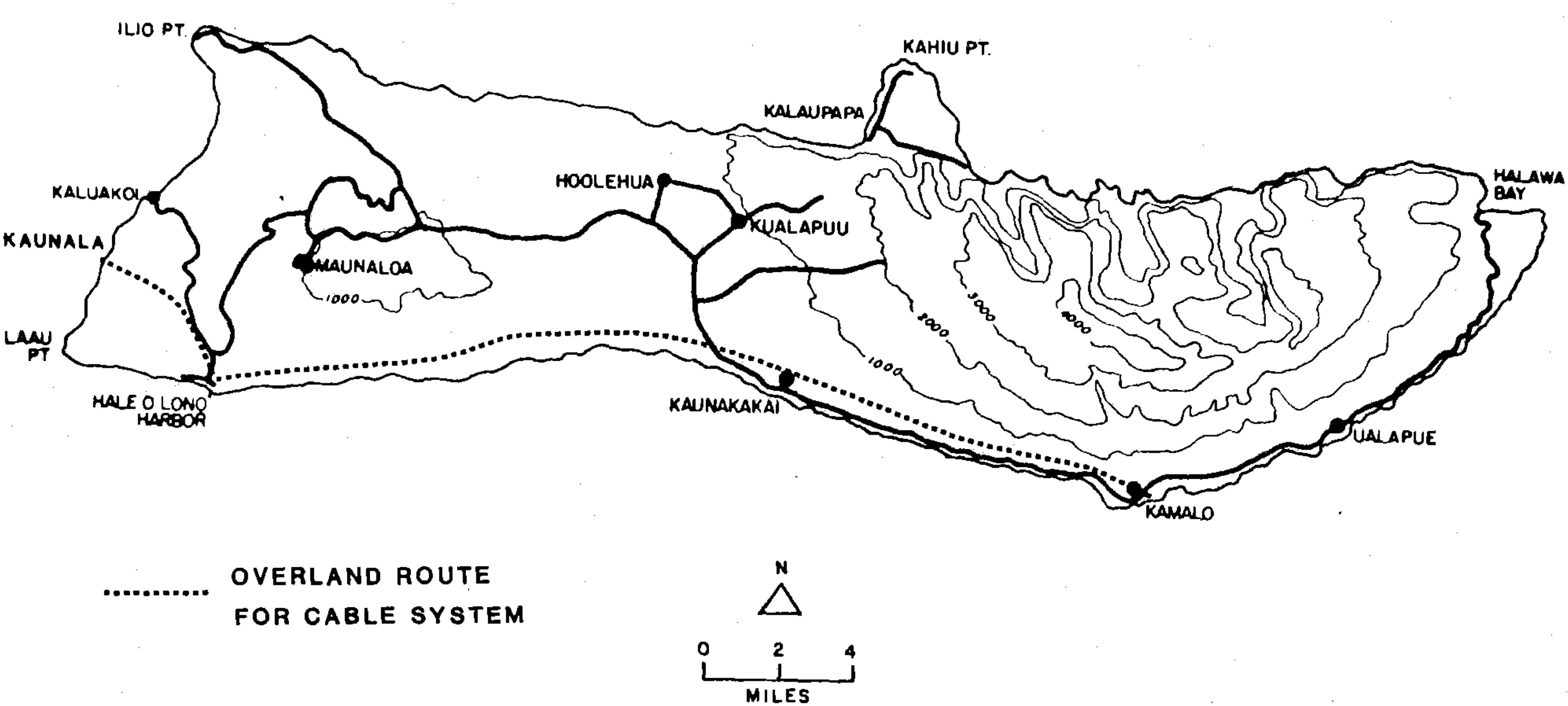

FIGURE 2
ALTERNATIVE ROUTE

In this step are identified the necessary system hardware components, quantities and unit prices, and the costs for such things as engineering design and surveying, site preparation and installation labor. The costs for the preferred and alternative routes are then summed to allow preliminary comparison in the absence of costs due to environmental-based concerns.

B. Prepare an environmental assessment to determine potential environmental impacts for Molokai and compare with those for Maui.

To estimate the potential significance of environmental-based controversy, it is first necessary to assess the potential environmental impacts resulting from implementation of the alternative route scenario. This is done in the second step. Because some of the permitting and environmental work for Molokai would parallel similar work on Maui, schedule delays specific to election of the Molokai overland option must be identified at this stage. Processes which may proceed concurrently on Maui and Molokai do not result in schedule delays or associated costs.

C. Quantify the costs of mitigating impacts identified for Molokai, and quantify estimated schedule delays.

The third step quantifies the potential impacts and concerns identified in the previous step in terms of the cost of mitigation measures (additional costs to the project which would not be incurred were the preferred route used) and the costs of delaying implementation of the project. The potential schedule delay is arrived at using data from previous large-scale alternate energy projects in Hawaii and making some assumptions on the allowable duration of the concern from the utility's viewpoint. The cost of this delay is then calculated based on deferral of receipt of the net benefits of the project for the assumed schedule delay.

D. Sum and compare costs of preferred and alternative routes.

The costs estimated in the above step are added to the costs arrived at in the first step for the alternative route scenario and this total is then compared with the costs for the preferred scenario to reveal which scenario is truly the most cost-effective.

4.0 ANALYSIS/RESULTS

This section provides the analysis and results of applying the methodology described in section 3.0 above.

A. Installation Cost Estimates

This first step of the methodology describes and quantifies differences in costs between an all-submarine cable route from

Maui to Oahu and a route which proceeds overland on Molokai. The cost estimates provided vary somewhat in precision, depending on their source, intent, and age. The level of precision is considered adequate because of the much greater level of uncertainty characteristic of the costs associated with potential land use concerns. Data sources included HDWC Program documents, interviews with Program participants and Parsons' in-house estimates. The sections below discuss each significant cost component which would vary between submarine and overhead routes. Table 1 at the end of this section summarizes the differences.

Cable

The preferred route assumes a landing on Maui. One of the recognized benefits of an intermediate landing point in the system is the opportunity to change cable types to optimize cable designs with respect to ambient environmental conditions along the respective route segments. The Pirelli Cable Corporation (PCC) cable cost estimate (PCC and SCP, 1986) recommends use of a solid type cable from Maui to Oahu. This assumption was likewise supplied to Decision Analysts Hawaii, Inc. for analysis of the economic feasibility of cable-transmitted geothermal power, and, therefore, is also used in this analysis. The effect of this assumption in the present analysis is to reduce the difference between the costs of the preferred scenario and the alternative due to reduced per unit cable costs and elimination of the need for two additional repressurization facilities for the SCOF cable. The Pirelli report further recommends a slightly different solid type cable (double armored rather than single armored) beginning west of Molokai at depths of 140 m and continuing to Oahu. A Molokai take-off point at Kaunala would require slightly more of the double-armored solid cable than would be used for the preferred route. Of course, a landing on Molokai would also require an additional length of cable to shore. The effects of this route alteration would be to reduce the necessary length of the single-armored solid cable by 26.5 miles and increase the length of double-armored solid cable by 3.0 miles. Rounding to the nearest $1,000, PCC estimates the cost of these two cables at $1,282,000 and $1,305,000 per mile, respectively. The net savings of the alternative route in cable costs would be $30,058,000.

Cable Laying

Reduction in the length of submarine cable to be deployed would reduce the deployment time and associated costs. Because the preferred submarine route from Maui to Oahu is longer than the cable length capacity of the cable laying vessel, an at-sea splice would be required. Use of the alternative route would eliminate this requirement as well as reduce overall ship time requirements. Program estimates (HD&C, 1986) are 5 days to lay the cable between Hawaii and Maui, 5 days to lay the first half of the cable from Maui to Oahu, and 21 days to complete the link due to the time required to splice the cable between Maui and Oahu. These estimates are for each of the three cables in the system. If we assume that each section will now require 5 days laying time, then the total time savings for deployment is 48 days. The total cost of a deployment day consists of leasing costs for the cable vessel ($2,000/day), and the crew, supplies and fuel ($14,500/day). The total savings for cable laying would therefore be $792,000.

Bathymetric Surveying

Elimination of about 25 miles of submarine route would reduce the requirements for precise bathymetric surveys. Based on the costs to the Program for similar work, and considering the relatively shallow and flat character of the avoided area of seafloor, we estimate an approximate savings of $250,000.

Submarine System Planning and Engineering

In contrast to the situation for the overland route segments, much of the costs for planning and engineering of the submarine route segments are included within the HDWC Program. The total "Planning and Design" costs for the commercial system have been estimated at $35.9 million including all past and projected HDWC Program costs. Subtracting the latter ($21,394,000 federal; $4,838,636 state) leaves $9,667,364. Data provided by HECO (itemized in a below section) indicate a per mile cost for planning and engineering overhead lines of $67,200. The preferred route includes 131 miles of overhead lines which would total $8,803,200, leaving $864,164 for the 138 miles of submarine route. This is approximately $6,262 per mile. Therefore, eliminating about 23.5 miles of submarine route would save $147,157.

Trenching

For each additional landing site, trenching and embedment would be required in very shallow depths. The cost estimating methodology used by Hawaiian Dredging & Construction Company (HD&C, 1986) for the other four landing sites was used to arrive at our estimated cost for two sites on Molokai. The method assumes trenching only to depths of 20 m and the cost per meter offshore is $735. The area offshore Kamalo is shallow and silted in; a 2,000 meter trench would be necessary. Offshore Kaunala, however, the bottom is steep and a trench length of 300 meters would be adequate. The total cost for the alternative route is therefore $1,690,500.

Overhead Lines and Towers

The hypothetical route across Molokai measures approximately 31 miles. Based on cost data provided by HECO to Power Technologies Inc. (PTI) (PTI, 1986) and stated utility preferences for tower design and spacing (DHM Planners, Inc., 1987), the following summarizes the costs for this overland link. The analysis assumes use of self-supporting steel lattice towers and 1,300 feet spans. Costs per tower for hardware and installation are as follows:

foundation excavation	$ 17,892
foundation materials	3,560
foundation assembly	16,082
tower materials	12,145
tower erection	13,097
tower set up	11,211
insulator hardware	600
	$ 74,587

Thirty-one miles of route would require 126 towers, or a total cost of $9,397,962. To this must be added the costs for two conductor wires, one shield wire and stringing. Stringing costs are estimated in PTI's latest report (PTI, 1986) at $32,000 per mile, or $992,000 for the alternative route. Conductors were optimized by PTI according to tower type and fuel oil price escalation rate. For a self-supporting steel tower and a medium oil price escalation rate, the optimum conductor is an "AAC, 3,500 Kcmil" design. This conductor costs $0.64/lb and weighs 3,350 lb/1,000 ft. One conductor per pole is required, so for a 31-mile long bipole, the conductor cost would total $701,860. A single 3/8-inch galvanized EHS shield wire would cost $0.57/lb and weigh 273 lb/1,000 ft. For a 31-mile length, the total cost would be $25,470. The total cost for conductors and shield wire would be $727,330.

Shoreside Facilities

Because we have assumed use of a solid conductor cable from Maui to Oahu, no repressurization facilities would be necessary on Molokai. Shoreside facilities would be minimal at the landing and take-off sites. PCC (1986) estimated the cost of terminations (potheads, stress cones, etc.) at $300,000 each, and the cost of jointing, terminating and testing for a pair of landings at $2,900,000. These total to $3,500,000. To this would be added costs for site acquisition and site preparation which are addressed separately below.

Land Acquisition

As background data for PTI's Phase II-B study, HECO provided the following information:

> "HECO does not normally include the cost of the right-of-way and/or the cost of clearing the right-of-way in the cost for a transmission line. For the purposes of this study, a right-of-way cost of approximately $5,000 per mile for a 150-foot wide right-of-way can be utilized. The cost of clearing the right-of-way will be negligible since minimal clearing is usually required" (July 28, 1983 letter from G. Okura to J. Mountford).

Our right-of-way is estimated at only 135 feet in width (DHM Planners, Inc., 1987), but these costs are also nearly four years old. Assuming these factors offset, ROW costs would total \$155,000. Additional land would be required at each landing site for the terminations and transition to overhead lines. The costs assumed above for easement rights are much too low to be used for these parcels. We estimate a cost of \$10 per square foot and that one half acre would be required at each site. Total landing site costs would thus be \$435,600.

Planning and Engineering

A number of different activities are included in this category. All data were provided by HECO based on in-house experiences.

route selection, environmental studies, EIS preparation and permitting @ \$34,900/mile	\$ 1,081,900
photogrammetric survey and mapping @ \$8,000/mile	248,000
engineering @ \$21,500/mile	666,500
survey easement document preparation @ \$1,000/mile	31,000
survey construction stakeout @ \$1,800/mile	55,800
	\$ 2,083,200

COMPARATIVE COST ANALYSIS

Table 1. COMPARISON OF COSTS OF OVERHEAD TRANSMISSION ON MOLOKAI WITH A SUBMARINE CABLE SYSTEM.

<u>Submarine Cable Costs</u>	
Cable and Accessories	$ 30,058,000
Cable Laying	792,000
Bathymetric Surveying	250,000
Planning and Engineering	147,157
	$ 31,247,157
<u>Overhead Transmission Costs</u>	
Trenching and Embedment	$ 1,690,500
Towers and Foundations	9,397,962
Conductor and Shield Wires	727,330
Stringing	992,000
Termination Stations and Connections	3,500,000
Land	590,600
Planning and Engineering	2,083,200
	$ 18,981,592
Difference =	$ 12,265,565

This means that in the absence of environmental or land use concerns causing expenses related to schedule delays or mitigation measures, the overland alternative would be some twelve million dollars cheaper.

B. Environmental Assessment of Molokai Corridor

To estimate the scope of potential environmental and/or land use controversies, a brief environmental assessment of the alternative overland route on Molokai was prepared. Standard environmental assessment guidelines and general knowledge of the island determined the range of features to examine. The key features that could be significantly impacted were more closely studied so that mitigation measures could be selected where possible. The significance of these potential environmental impacts and the effectiveness of the mitigation measures are very important factors in the selection of a cable system route.

Description of Alternative Route Corridor

The cable would come onshore at Kamalo, on the east side of Kamalo Wharf, where it would connect to overhead lines. The overland corridor would head west, parallel to Kamehameha V Highway, on the mauka side of the road. The route would continue through Kaunakakai town and Kalanianaole Colony, and then follow Palaau Road, which is a jeep trail. Again on the mauka-side of the road, the lines would head west to Haleolono Harbor. At this point, the corridor would turn inland to follow a private road north as far as the intersection above Kaunala Gulch. From there, the corridor would follow a jeep trail directly west to Kaunala Bay, which would be the landfall site for the cable.

Description of Environmental Features

1. Exclusion Areas: All fishponds would be avoided, including the unnamed fishpond east of Kamalo Wharf. Kakahaia National Wildlife Refuge and Beach Park would also be avoided.

2. Geophysical Factors: The following geophysical features are prominent along the route - Mahana Saddle, dissected upland, sand beaches, coastal swamps, and cliffed and uncliffed volcanic coasts (Univ. of Hawaii, 1983). Although these features would not provide insurmountable engineering constraints to route selection, uses of some of the areas might create concerns, as discussed in the sections below.

3. Recreation: The Kamalo Wharf access, three county beach parks and Haleolono Harbor are the major recreational facilities along the corridor. Ocean recreational activities take place along the shoreline, inshore (inside the reef) and offshore (outside the reef). These activities include pole-and-line fishing, gill-netting, throw-netting, spearfishing, aquarium fish collecting, sport-diving, shell collecting, crabbing, and others (U.S. Army Corps of Engineers, 1984). Board surfing and canoe paddling are the ocean sports that occur in a few places along the makai-side of the route. The transmission system would not interfere with any of these recreational activities except during installation, and therefore loss of recreational use would not be expected to be an issue.

4. Land Use: The main residential areas along the corridor are on the eastern side of Molokai at Kamalo, Kawela, Moku, Kamiloloa Heights and Kaunakakai. Homesites generally abut Kamehameha V Highway. The transmission lines would be visible from these homesites but would not otherwise affect them. Visual intrusion is discussed further below. The western side of Molokai has very few homes. It is primarily range and pastureland. The transmission lines would not affect present uses of the land, but future construction within the corridor would be restricted. This is not an impact which could be mitigated and so no direct costs would result, however, it could form part of the basis for concern and thus be a factor in schedule delays.

5. Land Ownership: Land owners along the route are listed from the largest to the smallest as follows - Molokai Ranch, Kawela Plantation Development Association, State of Hawaii/Dept. of Hawaiian Home Lands, small private landowners, Kamehameha Schools/Bishop Estate. Purchase of an easement would be sought from these various landowners. For the purposes of this analysis we assume that the easements would be available at the price used in estimating the installation costs, and that negotiations would proceed concurrently with those on Maui.

6. Land Regulation: The corridor would be mostly in the Agricultural State Land Use District. Along the coast are Conservation Districts; Kaunakakai and neighboring areas are in

the Urban District. A small area west of Kaunakakai is designated Rural. Several land use regulations apply to areas along the corridor. Major permit requirements would be triggered by activities in the Coastal Zone Management area, the Special Management Area, the shoreline setback and the Corps of Engineers shorewaters area. Acquisition of these and other minor permits would be a part of the cable program's complex regulatory schedule, which would include preparation of an EIS. Environmental-based concerns would find expression in the EIS process and the underlying permit requirements.

7. Archaeological and Historic Resources: The corridor has 4 miles of land with recorded sites; 15 miles of land with a high potential for unrecorded sites; and 12 miles of land with a low probability for unrecorded sites. The Kamalo area is within the Southeast Molokai Archaeological District (a recognized but unofficial district). The Kaunala Bay area is within the official Southwest Molokai Archaeological District. Recorded sites would be avoided and an archaeologist would be contracted for both reconnaissance level and more intensive surveys at the pole-sites and in the corridor area with high potential for unrecorded sites. This is considered a potentially significant impact because of this high potential for unrecorded sites, and costs for mitigation are likely.

8. Soil Erosion: A significant potential construction related impact is soil erosion. Mitigation measures such as critical area planting, brush management and utilization of existing access roads would likely be required, adding costs to the project.

9. Wildlife: The eastern half of the corridor contains common bird species and domesticated animals. The western half of the corridor is in range and pastureland where cattle and other ranch animals may be found along with common bird and mammal species. The transmission lines would not alter the wildlife habitat in any significant manner and this is not expected to be a significant issue.

10. Vegetation: The eastern half of the corridor is predominately urban and rural landscapes, altered by homesteaders. The western half of the corridor is mainly low shrubs, grazed land or barren land. Very small amounts of vegetation would be removed to construct the lines and this is not expected to be a significant concern.

11. Endangered/Threatened Species: There are no endangered or threatened plant or animal species common to the corridor area. Endangered or threatened bird habitats are located at higher elevations. Nevertheless, a biological survey of the corridor would precede any permit approval or final corridor selection.

12. Visual Quality: Molokai is noted for its unique rural landscape. Specific viewsheds have not been formally recognized, but the lack of extensive manmade developments allows excellent natural scenic vistas. The visual intrusion of the transmission lines would be considered a significant impact, and as such would probably be a concern. The eastern half of the corridor would require screening, using the field windbreak technique of planting shrubs and trees, as a mitigation measure for the more populated areas. The western half of the corridor is on private land, near a less frequently traveled road, and mitigation requirements would be reduced.

13. Primary Economic Potential: A study prepared for Alu Like, a private, non-profit advocate for Hawaiian economic and social self-sufficiency, concluded that fishing and diversified agriculture have immediate and significant potential for small business development on Molokai (DPED, 1983). Secondary economic activities identified in the report are retail-commercial opportunities, and crafts and food product production. The cable system would not interfere with these economic pursuits.

From this assessment, four significant environmental impacts of the alternative route on Molokai were identified. Each of these impacts would also occur on Hawaii and Maui, but to a greater degree on Molokai. The four impacts are described further as follows:

COMPARATIVE COST ANALYSIS

Impact on Land and Land Use

The amount of land to be impacted and the number of land use regulations that apply to those areas are important factors because they illustrate the magnitude of the project. The potential overhead transmission line corridor would be 31 miles long and 135 feet wide. There would be 126 towers spaced 1,300 feet apart. The transition stations near the landfall areas would each take a maximum of 0.5 acres. Therefore, the amount of land to be cleared is only 1.65 acres and the amount of land that would be within the corridor but not disturbed (except for tree trimming) is 506.5 acres. However, this is a significant amount given that the corridor would traverse three quarters of the length of the island and one half of the length of the main highway. This would cause a much greater impact on the residents and visitors of the island than the corridors proposed for Hawaii and Maui. There are no mitigation measures to prevent this, other than to not choose the alternative route overland on Molokai. No direct mitigation costs are included below for this category, however land use would certainly be a major concern during the permitting process.

Ten Maui County land use regulations requiring permits would apply to the project: Special Management Area Use permit; Shoreline Setback Variance; Zoning Waiver (height-for Urban District only); Building Permit; Grading & Grubbing Permit; Permit for Work Performed on County Highways; Conditional Use

Permit (for Urban District only); Electrical Permit; EIS Assessment/Determination; and Flood Hazard District Permit. Five State permits would be required: Conservation District Use Permit; Permit for Work in the Shorewaters; Permit to Perform Work Upon State Highway; EIS Approval; and CZM Consistency Certification. Two Federal permits would be required: Dept. of the Army - Corps of Engineers Permit and NEPA EIS Approval. An EIS that covered four islands (Hawaii, Maui, Molokai and Oahu) instead of the three along the preferred route (Hawaii, Maui and Oahu) would have the potential to generate more concerns. Although the EIS approval process and its timing are established in regulations and would not change, acquisition of the associated permits could well be delayed by legal proceedings such as contested case hearings and direct litigation.

Impact on Scenic Value

The entire route of 31 miles would cross landscape characteristic of Molokai - rural developments and undeveloped land. Maintaining this unique rural character of the island is one of the planning principles that guided the preparation of the Molokai Community Plan (County of Maui, 1984). Molokai is smaller in size than Hawaii or Maui. This means that per mile the impact from the transmission system would be relatively greater on Molokai. Because of the geography of Molokai, the predominately linear development pattern along the coast and the necessity to route the system near the coast, the visual impact would likely be a major concern.

Impact on Archaeological Resources

The Island of Molokai is known to be rich in historic and archaeological resources, although very few areas have been formally surveyed. In fact, most surveys have been carried out as a prerequisite to land use approvals and not for the purpose of archaeological discovery and preservation. However, preservation of historically and archaeologically sensitive sites is a specific recommended policy in the Community Plan, and generally, is a significant community value. The potential corridor would cross through 15 miles of land with a high potential of unrecorded archaeological sites and 4 miles of land with many recorded sites. Maui also has many identified archaeological sites. On both Maui and Molokai the high potential areas are along the coastline. The corridor on Maui follows the coast for only a short distance, while on Molokai the corridor **leaves** the coast for only a short distance. That is why the impact may be greater on Molokai than Maui and require more extensive mitigation measures.

Impact on Soil Erosion

Soil erosion is a recognized island-wide problem on Molokai. It was rated as the eighth greatest concern out of seventeen major concerns for Molokai as reported by the Hawaii Association of Soil and Water Conservation Districts (1980). Loss of top soil reduces the productivity of the land and causes siltation in coastal waters which leads to degradation of reef and nearshore aquatic communities. Western Molokai, in particular, is a priority area for controlling erosion (Dept. of Health, 1978). The corridor would cross 17 miles of land with erosion potential and almost the entire corridor follows coastline with "coastal red waters" after heavy rainfall. Roadside erosion is especially heavy on the west side of Molokai. On Maui, erosion and "coastal red water" is a problem for only a quarter of the corridor. The southwest area of Maui is the lowest priority area for that island in terms of implementing erosion control practices. Therefore, the potential impact due to soil erosion is greater on Molokai.

These latter three environmental impacts would require mitigation measures, involving both time and money, and result in increased project costs and possible schedule delays caused by concern over the overland route on Molokai.

C. Costs of Mitigating Impacts on Molokai and Schedule Delay Estimates

Mitigation Measures

For the environmental impacts identified above which can be mitigated, Table 2 summarizes the costs.

Table 2. COSTS OF IMPACT MITIGATION MEASURES

Scenic Value:

Mitigation Measures = $5,670.00

For Visual Screening:
Use Field Windbreak Technique @ $3.00* per foot

126 towers/ 15 feet wide = 1890 feet of screening required
1890 feet @ $3.00 per foot = $5,670.00

Archaeological Resources:

Mitigation Measures = $300,000.00

The estimated cost for archaeological work was provided by Aki Sinoto, Public Archaeology Contract Manager, Anthropology Dept., B.P. Bishop Museum.

Soil Erosion:

Mitigation Measures = $71,178.00

For Erosion Control:
Use Critical Area Planting Technique @ $600.00* per acre

(4 miles) 21,120 feet x 135 feet wide corridor = 2,851,200 sq.ft.
2,851,200 sq.ft. divided by 43,560 sq. ft./1 acre = 65.45 acres
65.45 acres @ $600.00 per acre = $39,270.00

For Erosion Control:
Use Brush Management Technique @ $150.00* per acre

(13 miles) 68,640 feet x 135 feet wide corridor = 9,266,400 sq.ft.
9,266,400 sq.ft. divided by 43,560 sq. ft./1 acre = 212.72 acres
212.72 acres @ $150.00 per acre = $31,908.00

Erosion Control Cost Total: $39,270.00 + $31,908.00 = $71,178.00

* Source: pers. comm., John Bedish, Soil Conservation Service, U.S. Dept. of Agriculture.

Total Cost of Mitigation Measures: $376,848.00

Schedule Delay

Delays based on environmental objections have become chronic in most large-scale development programs. Over the last dozen years, at least four specific reasons for time delays have surfaced nationwide (School of Natural Resources, 1979).

- o New requirements for detailed evaluation of the environmental effects of proposed actions.
- o New substantive standards for health and safety and environmental protection.
- o Litigation introduced by citizen intervention
- o Procedural obstacles.

Each of these has appeared in the course of Hawaii's energy development projects. Schedule delay due to community concern over particular project issues was estimated for the alternative cable system route by examining earlier major alternative energy development projects in Hawaii and by proposing a time period that would represent a logical limit to the length of the controversy. Four alternative energy projects - geothermal, H-power, OTEC and biomass - were examined to understand the problem of schedule delay. The length of **active** controversy for these projects had a wide range.

- o Geothermal 4/77 - 10/86 = 9 years 2 months (ending here with the U.S. Senate approving land exchange, but controversy over development of geothermal continues)
- o H-Power 1/81 - 5/83 = 2 years 7 months (ending here with EPA and State discussing pollution control equipment, but

Table 3. CITIZEN ISSUES OR CONCERNS REGARDING SPECIFIC ALTERNATE ENERGY DEVELOPMENT PROJECTS

Citizen Issues or Concerns	Geothermal	H-Power	Biomass	OTEC	Cable
1. Aesthetic Degradation	x	x	x	x	x
2. Inadequate or Inappropriate Public Involvement in Decision Making	x	x	x	x	x
3. Environmental Degradation	x	x	x	x	x
4. Lack of Adequate or Accessible Information	x	x	x	x	x
5. Trust in Government to Protect the Public Interest	x	x	x	x	x
6. Technological or Scientific Uncertainties	x	x		x	x
7. Threat to Unique Environment	x		x	x	x
8. Unclear or Inadequate Regulatory Schema	x	x	x		x
9. Natural Resources Should be Public Resources	x		x	x	
10. Danger to Health	x	x		x	x
11. Consequences of Economic Failure	x	x		x	x
12. Violation of Hawaiian Religious and Cultural Values	x		x	x	
13. Accuracy of Data is Questioned	x	x		x	x
14. Development of Rural Areas	x			x	x
15. Uses of End Product	x			x	x
16. Impacts on Air Quality	x	x			
17. Increase in Traffic		x		x	
18. Increase in Noise	x	x			x
19. "Dumping" of Projects in Area		x		x	

Source (except for CABLE info.): Program on Conflict Resolution, Monthly Forum - 10/23/86. "Alternative Energy Development Disputes in Hawaii. University of Hawaii, Manoa.

controversy over development of H-power continues)

- OTEC 11/83 - 8/84 = 10 months
  (ending with final informational meeting sponsored by Waianae Neighborhood Board #24)

- Biomass 11/84 - 4/86 = 1 year 6 months
  (ending with Campbell Estate's claim that cutting of ohia forest has ceased and Bio Power is bankrupt)

None of the four cases were resolved with any kind of "win-win solution." Actually, three of the four are still unresolved. The shortest-lived controversy (10 months) was with development of OTEC. At the time when OTEC's financing could not be obtained, putting the project on hold, the community claimed that their concerns were still inadequately addressed. To attempt to estimate how long the cable project might be delayed, an examination of the causes for delays of the above reference developments is helpful.

For the alternative route overland on Molokai only three mitigatable impacts could be identified and quantified. However, there are other real and perceived impacts that have the potential to cause schedule delays and consequent costs. These are called social impacts; they deal with community values and perceptions of the project. Table 3 summarizes the community issues/concerns which were prominent in the four cases examined, and provides a prediction of which of these issues/concerns may affect the development of the cable system.

All of the other four alternate energy development projects examined had in common five citizen issues/concerns (1-5 in Table

3). The cable development, with a strong early effort to inform and involve the public, might be able to avoid several of these, but the fact is, these are perceived issues and an education program may or may not be effective. In any event, at least two - aesthetic degradation (visual impacts) and environmental degradation (soil erosion, coastal trenching), would surely arise as community issues/concerns.

In the next group of issues/concerns (6-13 in Table 3), each was shared by three of the four reference developments. For the cable development, as many as six of these eight could arise.

From the last group, those shared by two of the four reference developments (14-19 in Table 3), the cable development could generate possible concerns in three areas.

In summary, of the 19 citizen concerns associated with other large scale alternative energy developments in Hawaii, the cable development could trigger as many as 14. This does not translate directly into any measure of schedule delay because the intensity of opposition which could be generated by these concerns is not known. Nevertheless, there appears no lack of potential focal points for community opposition.

These community issues/concerns may manifest themselves in litigation costs, vandalism costs, cost to the developer's reputation, and so on. Regardless of the quality of the supporting analysis, if the development decisions appear to impose negative impacts on a segment of the population, they will protest. The perception that some group will be worse off with the project than without it may result in schedule delays.

There are a number of useful techniques which may help to both anticipate and avoid delay. They are described as follows:

1. Anticipation of Disputes
   - Early assessment of likely impediments and likely history of the dispute.
   - Early notification to interested parties
   - Community education
   - Policy dialogue with the key individuals before all the commitments are made.
   - Joint fact-finding and working together so facts may be trusted by all.

2. Potential Intervention Strategies
   - Facilitated meetings
   - Negotiation
   - Mediation

An examination by University of Hawaii Urban Planning students of over ninety land use disputes that have occurred in Hawaii resulted in the identification of nine 'patterns' based on common characteristics of these cases (Dept. of Urban and Regional Planning, 1985). These patterns can be referred to when scoping for potential issues that could lead to a dispute in a land use proposal or development. There are four patterns that might apply if the alternative route overland across Molokai were to be pursued. By title they are:

1. Not-In-My-Backyard
2. Organized Community
3. Skip-Over
4. Government-As-Developer

The first pattern, 'Not-In-My-Backyard', is a familiar one, known as a NIMBY, and for our alternative route example would need to be stretched to reflect the possible sentiment of "Not-on-our-Island" for the cable system. It is not far-reaching to expect expression of this sentiment. Project opponents may be indifferent as to where the facility is eventually located as long as it is not sited in their neighborhood. They may employ a full range of means available to them in seeking to block the proposed development in their area.

The 'Organized Community' may take an adversarial or non-adversarial position regarding the proposed development. Molokai, though a small community by population count, has many active interest groups. This often makes negotiation or mediation with a community easier. Though the well-organized community may not always achieve its goals, it has a better chance of doing so.

The 'Skip-Over' pattern may occur when important issues are not addressed or resolved over time then appear in other arenas where they prolong the decision process. This may occur on Molokai where the need for affordable electrical energy is a key concern. The cable development would not directly address that issue but it would definitely come up in discussions about the transmission system.

The 'Government-As-Developer' pattern refers to the dual role that government plays in some disputes, namely as the developer, and the decision maker or adjudicator. "In such instances government is not a neutral referee settling a dispute. Instead, government is a powerful and active stakeholder, affected by and affecting both the process of the dispute and its resolution" (Dept. of Urban and Regional Planning, 1985). In these cases, disputes become clouded, continuing for many years. The commercial cable program does not have a developer at this time. However, in the four other alternative energy development disputes cited above, this problem was evident in every case.

A recent land use dispute on Molokai involving a resort development evolved in an unpredictable fashion and later showed signs of the 'organized community' and the 'skip-over' patterns. The developer worked closely with community organizations and many proponents agreed to support the project with its benefits of employment and economic opportunities. However, there was not the same unity later, among the (then) opponents because some important issues, such as water resources, housing, historic sites, and beach access were skipped-over until the dispute became so complex that these issues rose to the surface.

To enhance its perceived acceptability, the project must be seen as a package: the facilities, the benefits, guarantees, special conditions, and adverse impacts. There will usually be some adverse impacts, but they can be tolerated when they are balanced with benefits. In the case of the alternative route across Molokai, this presents a very great problem. To the people of Molokai, there is no tangible direct benefit, but obvious negative impacts. Thus, the potential for controversy is great, and given the intensity of anti-development sentiment previously expressed on the island, significant delays could be expected. It is certainly within the realm of possibility, and perhaps even likely, that delays measuring years could be experienced. The key issue is at what point are these delays intolerable? When is it more cost-effective to abandon the possibility of using the alternative route and stay with the preferred submarine route? The next section provides a basis for making this decision.

Cost of Schedule Delay

One way to estimate the cost of a schedule delay is to calculate the difference in the net present value of the net benefits of the project as scheduled and as delayed. For the present analysis, several assumptions are necessary to do this. It must be recognized that no benefits result from installation of a cable system in the absence of development of the geothermal power. Therefore, lost benefits must be calculated considering development of the integrated geothermal/cable system. The net present value of the combined net project benefits has been calculated by Decision Analysts Hawaii, Inc. (1987) for various scenarios of interest rates and fuel price escalation rates. To arrive at our estimate of lost benefits we assumed a "medium" fuel price escalation rate and a "real interest rate" of 4% (no inflation), corresponding to a nominal interest rate of 9.13% (with inflation). This was selected somewhat arbitrarily because the interest rates on the financing instruments for the integrated development are undetermined at this time, but this rate appears most reasonable based on present market conditions and a projected financing mix (Plasch, pers. comm.). With these assumptions, the net present value of the net benefits of the integrated development is $1,661 million. Table 4 summarizes the cost impact of delaying the net benefits of the integrated cable/geothermal project for various lengths of time from one month to three and a half years. These are conservative estimates as they assume both investments and returns are equally delayed. If investments proceed as scheduled and returns are delayed, a greater loss of benefits would result.

Table 4. COST OF SCHEDULE DELAY

Month of Delay/Lost Benefits ($ Millions)	Month of Delay/Lost Benefits ($ Millions)
1 = $ 5.42	12 = $ 63.89
2 = $ 10.82	18 = $ 94.90
3 = $ 16.21	24 = $125.31
4 = $ 21.57	30 = $155.14
5 = $ 26.92	36 = $184.38
6 = $ 32.26	42 = $213.05

D. Cost Comparison/Conclusions

The installation cost for a submarine system along the preferred route is $31,247,157. The installation cost for an overland system across Molokai, including the costs of mitigation measures, is $19,358,440. This is considerably less costly than the submarine route bypassing Molokai. The difference is $11,888,717. However, the information summarized in the previous section highlights the very high cost in lost benefits of schedule delays - more than $5 million per month. At this rate, a delay of only three months would more than eliminate any potential savings resulting from selection of the alternate route. Given the history of controversies surrounding alternative energy development projects in Hawaii, the vocal, organized anti-development attitude of a segment of the Molokai population, and the lack of tangible benefits to Molokai from this development, a delay of three months or more should certainly be expected.

Clearly then, any attempt to proceed with an alternate route across Molokai would require a great deal of community liaison prior to attaining financing commitments. In other words, delay in beginning receipt of net benefits is essentially intolerable. Only if the "delay" is brought forward in time to parallel other aspects of the overall planning process and not allowed to become a critical path item can this option be considered. The current development planning schedule for the commercial cable program shows that the cable procurement process, a critical path item, would begin in either mid-1989 or mid-1990 with completion of the HDWC Program. Were this to transpire, there would be no time within the commercial cable program to develop the necessary understandings between the community and the developers. In this case the appropriate time to initiate this is during the HDWC Program, specifically in Phase II-D of the State-funded portion of the program.

The methods outlined earlier in this report could provide a starting point for approaching the community. The critical factor, however, remains the lack of tangible benefits to Molokai from this alternative. The "package" must be made more attractive. Resources with which to do this are found in the potential installation cost saving. Some portion of the potential savings of nearly $12 million could be used to finance developments desirable to the community. Obvious needs of the community include lower energy costs and job opportunities. If an acceptable balance of benefits and negative impacts is unforeseeable after sufficient community liaison, the alternative route scenario might need to be discarded.

6. RECOMMENDATIONS

1. Carry out an informal scoping process to determine the community issues and intensity of opposition which would arise if the alternative route were formally proposed. In this process, contact all community leaders, politicians, influential business people and other community spokespersons.

2. In conjunction with the above scoping process, identify and evaluate (technically and economically) possible developments desirable to the community which could be made part of the overall development package, thus providing tangible benefits to the community to offset real and perceived negative impacts.

3. If, after thorough community liaison, it appears that a "win-win" consensus cannot be readily achieved, consider abandonment of the alternative route scenario and recommend that the commercial system developers plan to use the preferred submarine route from Maui to Oahu.

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