ENVIRONMENTAL IMPACT STATEMENT

INTERSTATE ROUTE H-3

June 1971 Draft DOT Impast Statement

July 1971 Env. Center Review of H-3

Jan. 1972 Env. Center Review of "Pre-Fina
DOT Impact Statement

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UNIVERSITY OF HAWAII

Environmental Center

Office of the Director

INTERSTATE ROUTE H-3

Statement for Department of Transportation Hearing
31 August 1973

By
Jerry M. Johnson, Acting Director
Environmental Center

The major part of the testimony I am presenting tonight is a brief summary of the formal Environmental Center review of the "Preface to Final Environmental Impact Statement Administrative Action" for Interstate Route H-3 Halawa Interchange to Halekou Interchange, Oahu, Hawaii, submitted to the Governor's Office of Environmental Quality Control on July 23, 1973. I have attached the complete Environmental Center review for the official record of this hearing. Contributing specifically to that review were Doak C. Cox (Environmental Center), Anders Daniels (Department of Meteorology), Peter Ho (Department of Civil Engineering), and John Holmstrom (Pacific Urban Studies and Planning Program). The review comments on noise will be expanded herein on the basis of advice from John Burgess (Department of Mechanical Engineering), who was not available for the Preface review.

My summary is organized in accordance with the organization of the Preface.

A. Impact on Trans-Koolau Mass Transit Utilization

It is recognized in the Preface that the permanent exclusive commitment of one traffic lane each way to mass transit will result in an increased diversion of personal transportation to mass transit as compared with the utilization of mass transit in mixed traffic flows. It seems probable that the diversion to mass transit, together with the attendant reduction in air pollution, would be even greater if the corridor used for mass transit represented less of a detour for most potential users. In that respect we question why the bus service to be provided on the more direct Likelike highway should not be permanent rather than temporary.

B. Noise

The Preface to the Final Environmental Statement devotes its noise evaluation entirely to the Moanalua Valley portion of the proposed Route H-3. The effects on residential areas through or near which the route passes are not identified in this Final Statement, although some attention was given to them in the Preliminary Statement.

The major conclusion reached by the Environmental Center as a result of evaluating the Preliminary Statement is not substantially altered by the modifications identified in the Final Statement. The Statement shows that most of the Moanalua Valley area having slopes small enough to be attractive for park development will be impacted by noise. All park plans identified show much of the land area most suitable for park use devoted either to the route or to noise buffer zones parallel to the route. The expected noise levels in most of the proposed park areas are similar to those in urban residential areas near airports, railroads, and heavy traffic arteries. From a noise standpoint, these will be urban parks similar to Foster Gardens or Thomas Square, not suburban or country parks.

The Preliminary Statement identified existing residential and other areas on each side of the Koolau range which would be affected by noise. For such areas, the Environmental Center pointed out that the criterion for "no impact" used by the consultants, that there would be few complaints, was not appropriate. Disturbing the night-time sleep of even a few people constitutes some impact.

Although the noise barriers are not described in detail, it seems certain that they will interfere with the views of Kamananui valley from the highway on which much stress was laid in the EIS.

C. Air Pollution

The analysis of air pollution levels in Moanalua appears to be based on the same model which, as was pointed out by the Environmental Center in its review of the pre-final EIS, is completely wrong. Our opinion has not been altered by subsequent correspondence concerning this model. Our analysis of the air pollution potential recently reviewed and to be published in a leading international air pollution journal shows that both federal and state CO standards will be exceeded very frequently during the morning rush hour traffic. Even with a reduction in the number of lanes the concentration will be above standards at locations described in the forthcoming paper. As recently ruled by the U.S. Supreme Court,

degradation of air quality must be a matter of federal concern, regardless of the quality in relation to standards. In addition, degradation of air quality without approval of the Director of Health is prohibited by Public Health Regulations, Chapter 42.

D. Land Use

The 1969 OTS land file is at best a crude source for making estimates of effective land availability. The amount of developable land free of environmental hazards is significantly smaller than that indicated in the OTS figures. Possible environmental impacts occurring due to the increased development of marginal lands does not appear to have been addressed. Pressure for Windward land use changes as a result of H-3 will likely be greater than indicated in the Preface, although such pressures may be moderated if high density residential development is permitted.

Further analysis suggests that the supply of available developable land in Windward Oahu may not be sufficient to meet demands indicated by the OTS model output. It is recognized that the model incorporates land supply constraints, so that, in fact, no more development is assigned by it to a region than that region can accommodate. The contradiction between the figures for available land given above and in the Preface suggests that the model should be rerun using a more discriminating land use file than that now employed. Such a run might well result in an estimate of less growth on Windward Oahu than the Preface indicates. In light of the discrepancy between the estimates of land availability in Table 1 of the Center's review, this result should not be surprising. If this should be the case, another question arises: Would any shortage of traffic volumes (compared with those based on existing land use projections) significantly alter the quantification of costs and benefits of H-3? That is, how necessary is H-3 recognizing the limited supply of developable land on Windward Oahu? If significant reductions in residential land consumption were not to result from such a modified run of the model, significant pressure on the supply of available land would be indicated, and the conclusion of the Preface that land use changes would not be required would have little foundation.

Sedimentation effects of H-3 construction

Also pertinent to the subject of this hearing is a review just completed by the Hawaii Environmental Simulation Laboratory (HESL) at the University of a consultant's report to the Department of Transportation: "Effects of construction of H-3 Interstate Highway on Erosion and Sedimentation Yield in Kaneohe Drainage Basins and in Kaneohe Bay" by Ocean Engineering Consultants, Inc.

Technical Report 103, 31 January 1973. The entire review is attached to our written statement for the official record of this hearing.

In summary, HESL checked the consultant's estimate of sediment production by the H-3 construction by an independent method. Considering the indirectness of the methods necessarily employed, HESL's estimate of about 20,000 tons per year is in reasonable agreement with the consultant's estimate of about 13,000 tons per year. HESL points out, however, that the rate of sediment delivery to Kaneohe Bay as estimated from the accumulation in the lagoon is 3 1/2 times the rate as estimated from sediment production and stream delivery, and, hence, that all estimates are subject to considerable uncertainty. HESL also points out that the estimated sediment contribution in the Bay resulting from the H-3 construction, although appearing very small in terms of annual increment of depth accumulation, is expected to be on the order of 2 or 3 times the present rate of sediment delivery from Kamooalii Stream and on the order of 20 or 30 percent of the present total sediment deliveries to the Bay from all streams. This contribution may, therefore, be quite significant in terms of biological effects.

The actual rate of sediment production by H-3 construction may differ considerably from the estimates, depending on the average area of soil unprotected and climatic conditions during the period of exposure. The estimates provided pertain only to the construction period. Some augmentation of sediment production is likely to continue after construction as the result of increased runoff, increased channelization of runoff, and changes in runoff routing.

HAWAII ENVIRONMENTAL SIMULATION LABORATORY

28 August 1973
TM73-078

MEMORANDUM

TO : Jerry Johnson
U. H. Environmental Center

FROM : Doak C. Cox, Principal Investigator
Hawaii Environmental Simulation Laboratory

RE : HESL Review of OEC II-3 Construction Report

Attached is a copy of a review of "Effects of Construction of II-3 Interstate Highway on Erosion and Sedimentation Yield in Kaneohe Drainage Basins and in Kaneohe Bay," Ocean Engineering Consultants, Inc. Technical Report 103, 31 January 1973, that HESL has recently completed. HESL did the study at the request of Hui Malama Aina O Ko'olau (Ms. Lucy Naluai).

HESL's objective is to increase the environmental information available to all decision-makers and community groups in the Kaneohe Bay region. In keeping with this objective, we make available to the public results from any research we may do for a specific user of HESL services.

We hope you will find this information useful in your activities.

Doak C. Cox
Principal Investigator

DCC:ra
Enclosure

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REVIEW OF "EFFECTS OF CONSTRUCTION OF H-3 INTERSTATE HIGHWAY ON EROSION AND SEDIMENTATION YIELD IN KANEOHE DRAINAGE BASINS AND IN KANEOHE BAY", OCEAN ENGINEERING CONSULTANTS, INC.. TECHNICAL REPORT 103, 31 JANUARY, 1973

The estimation of rates of sediment delivery to a body of water in which they will be deposited may be approached in three ways:

a. By estimation of the rates of accumulation of sediments in the body of water;

b. By estimation of rates of sediment deliveries by the streams to the body of water; and

c. By estimation of rates of erosion in the tributary watersheds, application of correction factors for losses and gains in stream transport, and use of assumptions as to sediment distribution in the body of water.

The first method, being the most direct, is potentially the most reliable, but is not applicable to the estimation of the change in rate of sediment delivery that will result from some future change in the watershed. For this purpose, only the third method can be used. For reliability, however, the third method should be checked by the second, and the second by the first. That no method can, at present, be considered reliable as applied to conditions in the watersheds tributary to Kaneohe Bay is best indicated by a comparison between the best results available from applications of the first and second methods to the overall delivery of terrigenous sediments by streams to the Bay.

Roy (1970), through comparisons of bathymetric surveys of Kaneohe Bay found that the deep waters of the lagoon portion of the Bay shoaled on the average 3.4 ft. between 1927 and 1969. From the ratio of terrigenous (stream delivered) sediments to total sediments, the area of the deep-water part of the Bay, and the specific weight of the sediments, he calculated a mean annual rate of delivery of suspended stream sediments, capable of being distributed across the deep-water

portions of the lagoon, at 131,000 tons per year.

Jones, et. al. (1971), from a correlation of suspended sediment concentrations in the waters of Kamooalii Stream and the stream discharge, and the duration discharge relationship for that stream and other streams tributary to Kaneohe Bay calculated the same parameter at 37,000 tons per year.

The estimate by the first method (Roy, 1970) is 3 1/2 times the estimate by the second. No conclusive evidence is at hand to indicate which of these two methods is the more reliable. Since the reliability of the third method depends upon its checking by the second, its reliability also is in doubt.

Ocean Engineering Consultants, Inc. (OCE, 1973) have approached the estimation of the additional sedimentation that may result from the construction of the H-3 highway by an ingenious combination of the second and third methods involving a number of assumptions. The most important of these are that the major source of the sediment now carried by Kamooalii Stream is a single erosion scar of measured area and that the rate of sediment production per unit area will be the same from areas of soil exposed during H-3 construction as from this erosion scar. Individually, these assumptions cannot easily be tested. However, we have made an independent estimate of the rate of soil loss from the same assumed area of soil exposed by H-3 construction, based in part on a soil-loss equation we have tested in overall fashion against stream sediment loads in the Kaneohe region, and on standard but nevertheless questionable assumptions including rates of gain and loss of sediment downstream. (See attached 21 August 1973 memo from Bartram.)

The OCE estimate is approximately 13,000 tons per year, ours is 20,000 tons per year. Considering the discrepancy between first- and second-method estimate of overall suspended sediment deliveries to the Bay, we consider the difference between our estimate and OCE's of little significance.

The following table compares estimated rates of sediment production from the H-3 construction with present rates of sediment transport by streams in the Kaneohe region:

Ratio	OCE	HESL
H-3 addition/present Kamooalii load	1.8	2.8
H-3 addition/present load of all streams	0.2	0.3

OCE recognizes that the sediments carried as bedload in the streams will be deposited in deltas close to the stream mouths but that the suspended load sediments will be widely dispersed. They estimate average depths of deposit in the Kaneohe part of the bay at 0.3 mm/yr. and in the Kahaluu part at 0.08 mm/yr. A weighted mean would be 0.12 mm/yr. (0.0004 ft./yr.). Roy has shown, however, that the suspended sediment load accumulates mainly in the lagoon whose area, exclusive of patch reefs, is a small fraction of the total bay area. Using our estimate of the H-3 sediment production and Roy's measurement of the lagoon area, we calculate the H-3 contribution to shoaling in the lagoon at 0.0024 ft./yr.

OCE has properly recognized that the actual rate of sediment production from the H-3 construction may vary considerably from the estimated rate depending on the length of the period during which the soil will be exposed and the climatologic conditions during that period. It has also recognized that the total sediment contribution to H-3 construction will depend on the actual areas of soil exposed during the construction period and the durations of exposure. If the product of average area and exposure duration were 17 acre-years, the total sediment contribution would be numerically identical to the annual rate of contribution. We consider it more likely that the area x duration product will exceed that it will be less than 17 acre-years.

It should be recognized that the estimate of additional sediment production from the H-3 construction is limited to the construction period. Augmented sediment production is likely to continue from increased runoff, increased channelization of runoff, and changes in runoff routing when the highway construction is

complete, although doubtless the highway drainage system is designed to minimize this augmentation.

It should also be recognized that the present rates of sediment delivery from the streams at Kaneohe with which we and OCE have compared the estimated increase in sediment production associated with the H-3 production are not natural rates of sediment delivery. The development of the Kaneohe region might be assumed even without evidence to have resulted in accelerated rates of soil loss and sediment production. Roy has found that, in contrast to the rapid rate of filling of Kaneohe Bay from 1927 to 1969 (5.4 ft. in total in the lagoon), there was no significant filling between 1882 and 1927 -- in other words, the present rate of sedimentation greatly exceeds the natural rate.

With seemingly reasonable ranges for the product of average exposure area and duration and for climatologic conditions during exposure, the total sediment accumulation in the bay lagoon attributable to H-3 construction might range between 0.5 and 3.0 times the estimated annual rate of sedimentation, or from 0.001 to 0.007 ft. This may seem insignificant, but in terms of the ecology of the bay it may not be. As shown in our table above, the mean rate of sediment delivery attributable to the H-3 construction is estimated to be 0.2 and 0.3 times the present total rate of sediment delivery to the bay from all streams. The biological importance of the present rate of sedimentation is not at present quantifiable, but it is regarded by some biologists as quite detrimental (Banner and Bailey) although probably not so detrimental as the excess nutrient load delivered to the Bay by streams and sewers. A 20 or 30 percent increase in sedimentation rate may, therefore, be quite significant.

REFERENCES

Banner, A. H. and J. H. Bailey. 1970. The effects of urban pollution upon a coral reef system. University of Hawaii. Hawaii Institute of Marine Biology Technical Report 25.

Jones, B. L., R. H. Nakahara and S. S. W. Chinn, 1971. Reconnaisance study of sediment transported by streams, Island of Oahu. U. S. Geological Survey (Honolulu) Circular C33.

OCE 1973. Effects of construction of H-3 Interstate Highway on erosion and sedimentation yield in Kaneohe drainage basins and in Kaneohe Bay. Ocean Engineering Consultants Technical Report 103.

Roy, K. J. 1970. Change in bathymetric configuration, Kaneohe Bay, Oahu, 1862-1969. University of Hawaii, Sea Grant 70-6; Hawaii Institute of Geophysics 70-15.

21 August 1973
TM73-075

MEMORANDUM

TO : Dr. D. C. Cox

FROM : P. Bartram PB

SUBJECT : Application of "Universal Soil Loss Equation" to H-3

This responds to Ocean Engineering Consultants, Inc., Technical Report No. 103, January 31, 1973, "Effects of Construction of H-3 Interstate Highway on Erosion and Sedimentation Yield in Kaneohe Drainage Basins and in Kaneohe Bay."

There are really two parts to that study -- one on sediment yield derived from H-3 construction and one on the oceanography aspects of sediment once it is in the Bay. I will not presume to comment on the latter part. However, HESL is qualified to address the problem of sediment production and sediment yield.

The major assumption in the study is that 75% of the present measured annual sediment yield in Kamooalii watershed -- 7,000 tons -- comes from 7 acres of an exposed ridge called "Red Dirt" near the proposed partial interchange for H-3 and Likelike Highway. This would mean that for every acre exposed, 750 tons of sediment would be carried downstream. This might be termed "net erosion," since it is well know that a great deal of sediment produced upland may never reach a channel and be carried downstream. At first glance, 750 tons of "net erosion" per acre seems a very high figure.

The Universal Soil Loss Equation, adapted to Hawaii rainfall and soil conditions, has application in the prediction of gross sheet erosion at the site of production since USLE is an empirically-derived equation with most of the data from small, bare plots comparable to construction sites.

The rainfall factor in the USLE was computed for several points in Kaneohe from a fairly average year of rainfall -- 1970. "Iso-erodent" lines were drawn on a base map in this analysis. Maps now being prepared by the Agricultural Research Service, based on rainfall data for the past 20 years, will show higher "R" values for the Kaneohe region.

The slope percent, length, and cover factors are fairly universal in the equation and have been developed for mainland use from 10,000 plot-years of data.

The soil erodibility factor is the weakest of the factors, as we have discussed previously. Under simulated rainfall, a "K" factor of between .179 and .235 was computed for bare Molokai soils by the Agricultural Research Service. By reconstructing the rainfal intensity data collected during the Kauai erosion tests on subsoil, I have been able to compute a "K" factor between .2 and .35 for bare subsoil. The following estimates of gross erosion from the H-3 construction are for a range of these possible "K" values.

Computations are based on:

"R" = 390

"S" = 18.59 (average slope of the portion of H-3 route in Kamooalii watershed is 21%)

"L" = 2.34 (prevailing right-of-way of H-3 is about 300 feet)

"C" = 1.00 (assumes 17 acres will be exposed all the time as per construction schedule)

"K" = ranges between .2 and .3

"P" = 1.00 (assumes no effective special practice on steep highway cuts)

Sheet erosion = $\frac{\text{if K = .2}}{\text{3393 tons/acre/year}}$ $\frac{\text{if K = .3}}{\text{5089 tons/acre/year}}$ 4241 mean

mean = approx. tons/acre/year

Sheet erosion contributes perhaps 80% of the gross erosion, the remaining 20% coming from gullying and channel erosion. If sheet erosion is increased by 20/80 = 25%, then total erosion is about 5,200 tons/acre/year.

The gross erosion must be reduced by a delivery ratio to get net sediment reaching the Bay. The delivery ratio curve generally used is shown on the next page. From this curve, a 22% delivery ratio is selected for a 4.38 square mile watershed (Kamooalii). This would give "net" sediment rates of about 1155 tons/acre/year for soil exposed year-round. If total soil acreage exposed in highway construction is 17 acres at any one time, then the total added sediment yield of this exposure is 17 x 1155 = about 19,600 tons/year. This compares with the 750 additional tons/year estimated by Ocean Engineering Consultants.

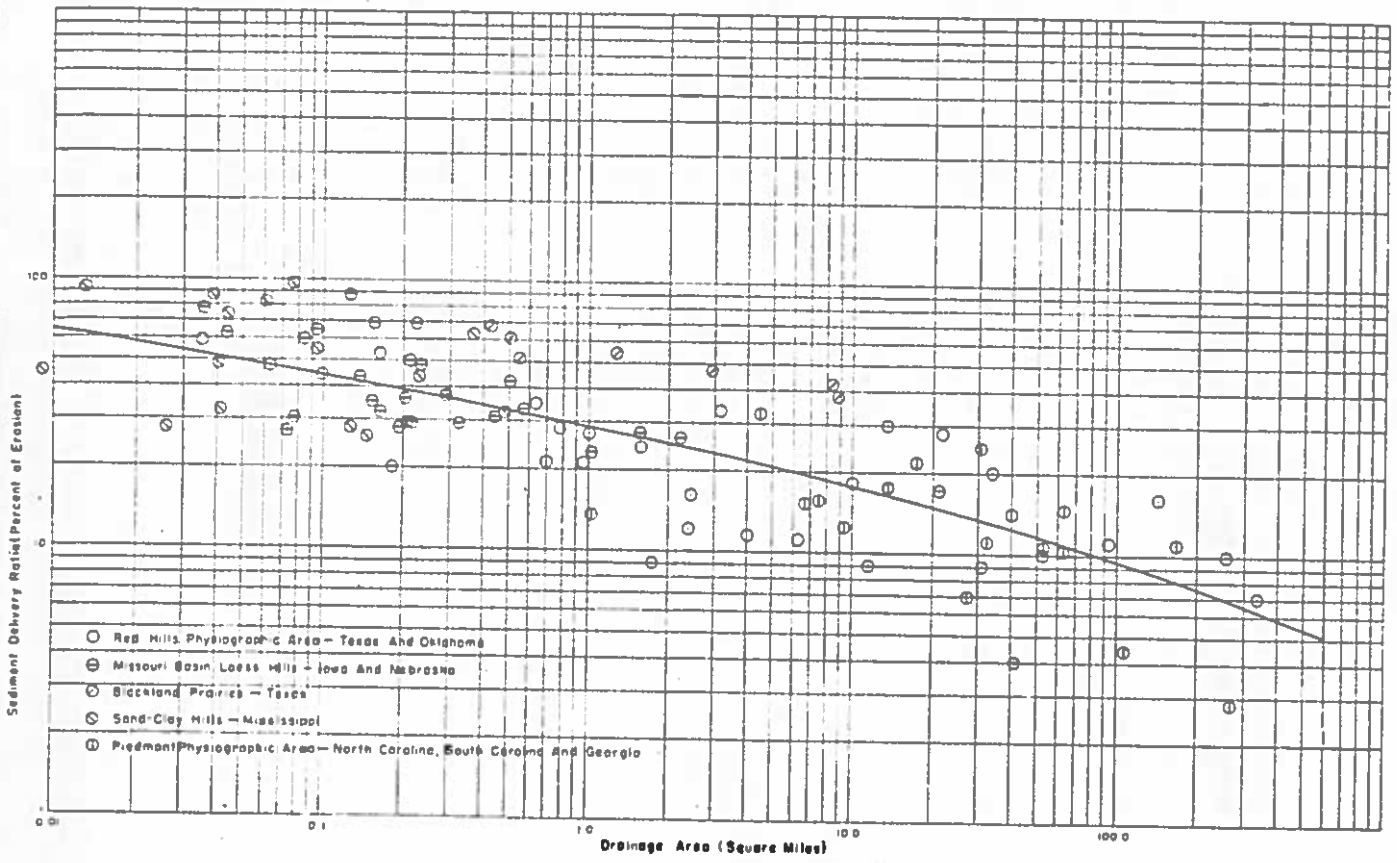

Fig. 2 — Sediment delivery ratio versus size of drainage area.

Source: John W. Roehl, "Sediment Source Areas, Delivery Rates and Influencing Morphological Factors," International Association of Scientific Hydrology, Publication No. 59, Commission of Land Erosion, pp. 202-213.

PB:ra
cc: D. Parker
B. Kloos
G. Lum
J. Moriyama

UNIVERSITY OF HAWAII

Environmental Center
Office of the Director

MEMORANDUM

January 6, 1972

RE:0037

TO: Marvin Miura, OEQC

FROM: Doak C. Cox, Director, E.C.

Interstate H-3
Environmental Impact Statement

This response is submitted to the "Pre-final" draft environmental impact statement submitted by the State Highways Division on the proposed Interstate H-3 highway route from the Halawa interchange to the Halekou interchange. In this critique are incorporated the gist of comments submitted by: Wilfrid Bach (Geography), Richard D. Bauman (Civil Engineering), John C. Burgess (Mechanical Engineering), Doak C. Cox (Geosciences and Environmental Center), Anders Daniels (Meteorology), Paul C. Ekern, Jr. (Soils and Agronomy and Water Resources), Dale N. Goodell (Agricultural Extension Service), P. Bion Griffin (Anthropology), Jerry M. Johnson (Public Health and Environmental Center), Dieter Mueller-Dombois (Botany), and Warren Y. S. Yee (Horticulture and Agricultural Extension Service). The response has been submitted for review not only by these contributors but also the following who contributed to our critique of the first draft of the impact statement: Hugh Burgess (Architecture), John R. Evans (Civil Engineering), L. Stephen Lau (Civil Engineering and Water Resources), Frank I. Peterson (Geosciences and Water Resources), Yoneo Sagawa (Horticulture and Lyon Arboretum), Tamotsu Sahara (Land Study Bureau), and Sanford Siegel (Botany).

Among the projects in Hawaii covered by federal environmental impact statements reviewed to date, this proposed interstate highway project certainly ranks among the first three or four with respect to the magnitude of environmental effects. Among that number, the potential environmental effects of the proposed H-3 project most seriously call into question the net social benefit or the proposed action. Because of the gravity of the question as to the justification of the H-3 project raised by its environmental impact, the description and assessment of this impact is of special importance.

In our critique of the first draft of the impact statement we stated that "if the H-3 route [could] be justified, the justification [would] require much more understanding and evaluation of the environmental impact of the project than [was] displayed in the impact statement under review, which [was] in some respects inaccurate or misleading, and which is in important aspects incomplete."

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The greatly expanded pre-final draft of the impact statement addresses itself much more thoroughly to the environmental effects of the proposed highway. The discussions of effects on water supply, stream flow, vegetation, wildlife, homes, businesses, schools, churches, and archaeological sites, demonstrate adequately that these effects will probably be minimal, although they contain a few minor understatements of probable effects.

Effects on agriculture are recognized but offset in the statement by claims that aid will be given to the relocation of displaced banana farms, whereas alternative sites for banana farming may be impossible to find on the island.

The scenic advantages which the highway will offer are well described in the statement, and the visual effects of the highway on the windward side of the Koolau Range are reasonably described. The visual impact in Moanalua Valley on a proposed park there is, however, not recognized, nor are a few historical sites which add, together with the special legendary significance of the valley, also unrecognized, especial attractions to the proposed park development.

The effects of the highway on noise and air quality appear significantly underestimated by the impact statement which, indeed, minimizes the local exceedance of the state air quality standards that will result even from the estimation cited by the statement. The importance of the noise and air quality effects may depend significantly on whether or not the proposed park in Moanalua is created, and, conversely, advantages of developing the park will be very seriously lessened if the highway is constructed.

The effects of the highway on increased erosion, sedimentation and turbidity, also appear seriously underestimated in the impact statement. The importance of these effects may in considerable measure be limited to the period of construction of the highway. However, there may be significant persistent ecological effects in the coastal waters to which drainage occurs from the highway, particularly Kaneohe Bay where such changes are now, already important.

Throughout history, transportation modes and routes have been major determinants of societal development and hence societal impacts on the environment. Initially the controls of transportation routes were natural, for example, rivers and river valleys, mountain passes, and lines of oases in desert areas. With modern technology the strictness of the controls set by natural features has been relaxed. However, it has generally been assumed that the development of transportation would be controlled by a complex of natural features, technology, and economics, and that the societal and environmental effects would continue to be involuntary. Only recently has serious attention been given to the public control of the development of transportation modes and routes as a deliberate means to change or control the change of society and the environment.

The present prescriptions of environmental impact statements call almost exclusively for descriptions of the direct environmental effects of the actions proposed, and it is perhaps unreasonable to expect in such a statement an exhaustive comparison of the direct and immediate environmental effects of the proposed action with the direct and immediate effects of alternative actions

to meet the same need, and even more unreasonable to expect examination of the indirect environmental consequences of the societal development that would be made possible or shaped by the proposed and alternative actions. Yet, if environmental changes are optimally to be controlled, the long term and indirect effects must eventually be estimated and evaluated in addition to the more direct and immediate effects.

In particular, for such a highway scheme as the H-3, a really significant environmental impact statement would have to compare the direct and immediate environmental effects of the highway on the proposed route with not only the equivalent effects of the alternative routes but also the equivalent effects with alternative modes of transport such as mass transit. Beyond this it would have to describe the societal effects of highway development on the proposed route with the equivalent effects of highway development on alternative routes and of alternative transportation modes on various routes, so as to address itself to the environmental consequences of these societal effects. The statement would also have to examine the possibility that the ratio of agricultural to urban land would be lessened and the air pollution problem worsened by the choice of highway construction on the proposed route in place of possibly less effective highway improvement on other routes coupled with the development of an effective mass transit system. Although a really thorough study of the effects of all the alternatives is, under the present circumstances, not expectable, it is regrettable that the H-3 impact statement gives so little evidence that these effects have been considered except in terms of justification of a decision already made to construct the highway.

The impact statement does present extensive discussion of alternatives (pp. 54-83) but hardly mentions differentials in environmental impacts that would result from their development. It does not hint at the differentials in indirect environmental impacts resulting from the development of alternative modes of transit.

This is not to say that a really satisfactory comparison could now be made between the environmental impact of the construction of the proposed H-3 freeway and the environmental impact of not constructing it. Some of the missing environmental information whose absence has been criticized in this review is lacking not only for the proposed H-3 route but for alternative routes as well, and the lacks would affect just as seriously statements of effects of not constructing the H-3 or constructing some alternative as the effects of constructing the H-3. Comparison of the indirect effects of the several alternatives, such as air pollution over the island as a whole and land use patterns with all of their environmental consequences, would be even less satisfactory. Yet the decision to construct or not construct the H-3 on the proposed route should be made only in consideration, as well as possible, of these indirect consequences as well as the direct ones.

The gist of the historical narrative in the impact statement (pp. 1-7) indicates that the choice of that H-3 route was predicated upon transportation planning and design concepts of 1960-65 vintage. The statement also indicates that the corridor selection was finalized two years before the completion of the Oahu Transportation Study in 1967.

Data from the OTS study, supported by projections in the impact statement itself, indicate that much of the traffic that will use the H-3 highway, if it is constructed, will do so because the present Pali and Likelike highways are overloaded and do not provide for mass transit, but in doing so, they will be forced to go out of their way, whether they travel by private vehicles or by bus. The failure to recognize the detouring that will be required, failure to take into account the effects of a potential mass transit system deliberately designed and financed to provide an attractive and efficient trans-Koolau transportation, failure to discuss thoroughly some of the more reasonable alternatives for expanded transportation along presently utilized corridors, and failure to discuss the substantial indirect environmental impacts of the choice of the H-3 highway are all important deficiencies of the impact statement.

The body of this review of the H-3 impact statement follows an outline paralleling that of the discussion of the environmental impact in the statement itself, except for the discussion in section O. of alternatives generally, rather than mass transit alone. To the review proper are appended:

A. A memorandum by J. Burgess on noise

B. A memorandum by A. Daniels and W. Bach on air pollution

C. A response to the Highway Division comments on our Environmental Center critique of the first draft of the H-3 impact statement.

A final comment is in order before the details are addressed. The purpose of this critique is to assess the validity of the description of the environmental effects in the impact statement. It is not to weigh the environmental detriments which may be caused by the proposed highway against the benefits that will accrue from its construction or to recommend for or against the construction of the highway.

A. General Environmental Impact: Moanalua Valley

The environmental impact of the highway in Moanalua Valley cannot be estimated satisfactorily until selection is made between at least two (and possibly more) alternative alignments and modes of construction. Section III of the impact statement (pp. 11-13) indicates that final selection has not yet been made between "at grade" construction, presumably following the more-or-less axial alignment shown in figure 2, and viaduct construction, which might perhaps follow more or less the same alignment or perhaps an alignment along one of the valley slopes. Profound differences on the effects of the highway on water, soil, and appearance depend upon the choice. Our further comments on the impact statement are based on the assumption that the axial alignment will be followed with "at grade" construction, because most of the impacts estimated in the statement itself seem to be based on this assumption.

According to the description of roadway characteristics (p. 9) the aggregate width of the two roadways plus paved shoulders will be 100 feet. A median strip "where the roadway is at grade" will add a minimum of 36 feet. If the "at grade" mode of construction is used, much of the highway will actually be in cuts and fills of such depth or height that, with any reasonable slope, the total width of the highway construction will be increased materially. Relocated stream channels and their associated cut banks will add considerably more to the total width of construction. The overall width of Moanalua Valley ranges from about 2500 feet to about 6000 feet and the average of the valley bottom, including its terraces is only about 1000 feet. It appears, therefore, that after construction of the highway, the relocated stream channels, and the proposed flood control dam, the undisturbed valley bottom, even including the terraces, will be reduced to a dozen or so discontinuous fragments, many of them only one or two hundred feet long, and even these fragments will be further reduced in area if road access is to be provided from the highway.

From these considerations of the width of the highway and its appurtenances, it appears that the project will have deleterious visual and noise effects on the park proposed in Moanalua much greater than is suggested in the impact statement.

Incidentally, the statement that Moanalua Valley is "virtually impenetrable" (p. 19) is incorrect. Access to the valley has been controlled by the owners, but permission to enter has been provided to large numbers of groups of people. Impenetrability is, in any case, a physical characteristic and not one related to legal restrictions. The main jeep trail up the valley is shown in the State's publication "Trails, Hunting, and Park Areas", there are many additional side trails, and the valley is, in fact, less impenetrable than most Hawaiian valleys of similar terrain.

B. Visual effects

The impact statement indicates (pp. 25-26) that the Highways Division is concerned with both views of the surroundings from the highway and views of the highway from its surroundings. Without question, the highway, even designed to defense highway specifications rather than to truly scenic highway specifications, will afford a scenic ride to the motorist in both Moanalua and windward portions. Doubtless, too, detriments to the scenic characteristics can be minimized by skillful architectural treatment and landscaping as suggested by the statement. However, the scale relation between the highway and Moanalua discussed earlier, and probably the similar relationship between the windward viaduct and the pali along which it is built, are such that it is extremely doubtful that the obtrusiveness of the highway in its surroundings can be obscured to viewers either on or at a distance from the highway. To visitors in the proposed park in Moanalua Valley, especially, even with the maximum care with design and planting, the field of view will be that of a major highway in a pleasing setting and not that of a beautiful valley incidentally containing a roadway.

According to the initial statement (p. 25) "the portal structures for the Red Hill and Trans-Koolau Tunnels will be constructed largely underground" (see also pp. 11 and 13). Figures 12 and 13 indicate that what is meant is that their structures will be mostly below natural ground level. A portal, as the interface between an underground tunnel and the open air, cannot appropriately be described as underground.

C. Noise

Based upon a report submitted by an acoustical consulting firm (Appendix 4a), the impact statement concludes that, with respect to noise, a "great impact" will result from the highway to a distance of approximately 200 feet from the centerline, with or without dense vegetation, and "some impact" will result to approximately 300 feet with dense vegetation and to approximately 700 feet without such vegetation. The statement claims that the Hawaii State Hospital and Our Lady of Bethany Seminary in Kaneohe and all residential areas except for 8 to 10 houses in Moanalua Valley fall into a "no impact" category. The Halawa Jail, it is stated, may be in either the "no impact" or "great impact" category depending on the noise emitted by vehicles in 1993.

As shown by J. C. Burgess in a memorandum appended to this critique (Appendix A), these conclusions are based on several questionable assumptions:

1) The assumption of unstated criteria for sleep interference;

2) The apparently hidden assumption that ambient levels will not change as a result of federal and state regulation of motor vehicle noise emissions;

3) The assumption that 12 dB attenuation can be assumed between outdoor sounds and their corresponding indoor levels;

4) The assumption that public response to noise in the past will be the same in the future;

5) The assumption that the public response to noise characteristics of mainland areas can be applied to Hawaii;

6) The apparent assumption that a uniform attenuation can be applied to the noise emitted by all vehicles operating on an elevated roadway;

7) The criterion of moderate speech interference to determine acceptability of recreation areas; and

8) The use of the criterion of "how much noise will the public take before they overtly react" rather than "what noise level will be acceptable to people when they are engaged in activities normal to the time and location of that activity."

Based on the assumptions:

1) that truck operating on the grades of this H-3 highway will cause maximum noise level of 88 dB(A) at distances of 50 feet;

2) that a more reasonable assumption for attenuation between outdoors and indoors for Hawaiian types of construction is 10 dB;

3) that additional to the attenuation attributive to distance alone, attenuations of 3 dB on the viaduct portion of the route and 2 dB to account for slant distance, are appropriate;

4) that maximum noise level in sleeping areas during the night should not exceed 30 dB; and the average, 25 dB; and

5) that vigorous complaints will follow from sleepers being awakened one or more times an hour. The "great impact" classification would extend to approximately 500 feet with dense vegetation and to approximately 1600 feet without such vegetation. According to these estimates, which are approximately double those cited in the impact statement, about half the building of the Kaneohe State Hospital and a sizable portion of Haiku Valley will be in the "great impact" area.

Assuming that, in a recreational area a 10 dB increase in noise from passing trucks over an average noise level of 50 dB would be certain to draw attention to the noise, noise impact significant in recreational area would extend to 400 or 500 feet from the highway centerline in areas densely foliated and to about 1000 feet in areas with sparse foliation. The criterion of the noise necessary to induce people to complain formally or threaten legal action appears extreme in the definition of great impact in a recreational area. A better criterion would be the noise acceptable to the majority of the people who may be expected to cure the recreational area.

In summary the impact statement appears to understate significantly the probable impact of noise.

D. Air Quality

The section on air quality in the impact statement (p. 30) is restricted to a discussion of pollution of the open air by vehicular emissions. Air pollution in the tunnels is not mentioned except in the section descriptions in the general discussion of environmental impact. These descriptions merely recognize that there will be emissions which will be exhausted through a ventilation structure to be located at the South Halawa Valley portal of the Red Hill tunnel (p. 18) and ventilation structures to be located at each portal of the Trans-Koolau Tunnel (p. 23), and claim that the emissions in the tunnels will have no significant effects in the open air.

Insofar as the mechanisms for exhaust are thus described, they might be the same as that used in the Wilson Tunnel on the Likelike Highway, located in a terrain very similar to that of the proposed H-3 Trans-Koolau Tunnel. The air quality in the Wilson Tunnel is often poor, at least in terms of objectionable odor. The possibility of adverse health effects due to carbon monoxide buildup if automobile traffic were stalled within the tunnel may be of concern. An appended report by Sturman on air pollution and emissions (Appendix 4b) indicates, however, that a semi-transverse ventilation system will be used in the Red Hill Tunnel and a full-transverse system in the Trans-Koolau Tunnel, with air supply distributed over each traffic lane. The report provides estimates of the total emission rates in each tunnel but not of the air pollution concentrations in the tunnels. Further discussion of possible air quality problems in the Trans-Koolau Tunnel is warranted.

The dismissal of the outdoor effects of the tunnel exhausts as insignificant, it is stated, is based on the Sturman report. This report utilizes the estimates of the total emission rates in the tunnels together with vehicular emissions on the open highway and estimates maximum 1-hour and 8-hour carbon monoxide concentrations, as of 1993, in seven sections, of which the nearest to a portal is one 600 feet down valley from the Moanalua portal of the Red Hill Tunnel (op. cit. pp. 1-2), passing through the nearest house in the Moanalua subdivision. In this section a maximum 8-hour CO concentration is estimated exceeding 9 mg/m^3 (op. cit. fig. 8) on the projection of the highway alignment and a concentration exceeding 50 mg/m^3 at a point 300 feet to the west. No estimates are presented for sites closer to the portals and none for other pollutants.

In addition to the high concentrations estimated in the section in Moanalua referred to above, the report estimates a CO concentration exceeding 20 mg/m^3 in a section passing through the Halawa Jail (op. cit., pp. 2, 10, fig. 11). The maximum concentrations in these Moanalua and Halawa sections greatly exceed the pertinent Hawaii air quality standards, 10 mg CO/m^3 maximum average for any 1-hour period. This standard is not a recommendation, as stated in the report (p. 10) but a mandate. As the report states these maximum estimated concentrations are "either located along Route H-3 or at high altitudes", but since the figures do not indicate the location of the house in Moanalua Valley or the Jail it is impossible to tell from them whether these structures lie within or without the contours representing the state standard. In any case, the standards are not restricted in their applicability to residential areas.

The basis for the estimates of pollutant concentrations is, itself, open to serious challenge as indicated in an appended memorandum by A. Daniels and W. Bach appended to this critique (Appendix B). Most seriously, the automobile speed has been added to the wind speed in the denominator of the formula used, resulting, so far as the contributions of vehicles travelling in the open air is concerned, in estimated concentrations only a small fraction of appropriate estimates. Failure to account for cold air drainage in the morning hours, to account for conditions with winds less than 2 knots, to recognize that during the morning peak period low-wind conditions are more persistent than daily averages indicate, and to use harmonic mean instead of arithmetic mean winds, all result in further underestimation of the pollutant concentrations.

Again it may be commented that no estimates of pollutants other than carbon monoxide are presented. Damaging effects to vegetation of ozone, PAN, and oxides of nitrogen and concentrations of lead in vegetation and soil along highways resulting from operation of internal combustion engines are well documented. However, no quantitative studies concerning the adverse effects of these pollutants on Hawaiian flora have been reported. Different species of plants vary tremendously in their sensitivity to these chemical pollutants. When gradually exposed to increasing pollution, some species of short-lived plants have been able to adapt successfully, but the flora of Moanalua has had no exposure to significant levels of automobile-generated air pollution. The effects on the indigenous flora even in the south branch of the valley and on the plantings proposed in the Moanalua Gardens park are thus matters of concern. The effects in the banana farms on the windward side of the Koolau range are not known, but it is pertinent that damage has not been evident in such farms located along the Likelike highway.

The conclusion must be drawn that the study of air pollution is seriously deficient and that the claim in the impact statement that "no significant impact on the environment due to air pollution is to be expected because of the existence of Interstate Route H-3" (p. 30) is unjustified.

E. Water Supply

As we commented in our critique of the first draft of the environmental impact statement:

> "Construction of the highway will prevent infiltration of precipitation through the pavement, perhaps restrict infiltration of precipitation on the shoulders and the steep slopes of cuts and fills, and prevent seepage from those parts of the stream confined to lined channels. The naturally occurring infiltration and seepage recharges dike compartments in and windward of the Koolau ridge and, to leeward, the basal (Herzberg lens) ground-water transitional between the Honolulu and Pearl Harbor areas. The dike water infiltrated from the vicinity of the proposed highway may supply part of the discharge of the Board of Water Supply Haiku Tunnel as well as providing low-flows of windward streams and recharge to the leeward basal ground-water body. The leeward basal ground-water body is the main source of water for the Honolulu-Pearl Harbor area. The effects of the reduction in infiltration on water supply do not seem likely to be important, but they should be estimated and taken into account."

The impact statement discusses at some length the possible effects of the Trans-Koolau Tunnel on ground water held between dikes, based on an even more extended study by Mink (Appendix 4g, part 1). The chance that the tunnel will have significant effects on the dike water supply is negligible. However, because "there is no sure way to categorically predict that the tunnel will, in fact, encounter a saturated zone between dikes" (Mink, op. cit. p. 5) it would seem impossible to state categorically "the dewatering of a saturated zone. . .will have no direct effect [whatever] on the Board of Water Supply's Luluku or Haiku Tunnel" (impact statement, p. 32). The chance of encountering water in the Red Hill tunnel is negligible, as stated by Abbott (Appendix 4g, part 2).

F. Stream Flow, Erosion, and Siltation

The impact statement describes appropriately the stream alterations in South Halawa Valley (p. 34) and assesses the resulting stream flow effects as minimal, probably correctly (p. 34).

On the unstated assumption that the axial route will be followed in Moanalua Valley, the statement indicates that Moanalua Stream will be crossed numerous times and that "considerable rechannelization" will be required and in addition culverts, chutes and stilling basins (p. 36). The extent of the rechannelization required would be better indicated by some rough quantitative expressions. Of the 4.3 miles of Moanalua Stream length in the part of the valley to be traversed by the highway, more than half, nearly 2.2 miles, is to be replaced by about 1.5 miles of concrete channel. The statement indicates that a flood control reservoir with a 59-foot earth-fill dam will be required in the South Branch of the valley to keep flood peaks during 50-year storms at natural flood peak levels.

Criteria and methods of analysis for the hydraulic design (as expanded in Appendix 4h) appear generally appropriate. It may be noted, however, that since 1967, when the hydraulic study was made, there have been several pertinent new analyses of flood hydrographs and storm rainfall (e.g. Wu, I. P., 1967, Water Resources Research Center Tech. Rept. 30; Cheng, E. and L. S. Lau, 1971, Water Resources Research Center Tech. Memos 23, 24). Noteworthy particularly is the anomalous response of the lower stream gage on Moanalua Stream. With the time constraints on the development of this response, it has been impossible to review fully the implications of these new analyses in relation to the proposed design. It may be noted that the basis for the design is the 50-year storm, when "maximum water level. . .should be no higher than one foot below edge of pavement," and only "minimal provisions should be made to reduce potential damage to the highway in the event of the maximum probable flood" (Appendix 4h, p. 20). Recognizing that "these criteria should be refined during the final design stage" (op. cit. p. 21), it may be urged that bank stability during the maximum probable flood should receive thorough consideration since more than "minimal provisions" may be found necessary.

Neither the impact statement nor the appendix discusses the source of the material for the construction of the dam. A borrow pit to provide the dam material is likely to have greater impact visually and on the flora of the valley than the dam itself. It may well be that a rock-fill dam utilizing materials from the excavation of the tunnels would be significantly more advantageous from an environmental standpoint than an earth-fill dam.

Very likely the most extensive direct effects of the proposed highway, at least for a few years, will be on the quality of water delivered by the streams on both the windward and leeward sides of the Koolau Range to coastal water bodies during and immediately following construction. The impact statement does not discuss the problem of water quality in relation to the State's Water Quality Standards. The following streams will be affected:

a) Halawa Stream, which flows to the Class A waters of the East Loch of Pearl Harbor, an estuary which has recently been designated by both federal and

state agencies for consideration as an environmental model and in which pollution by soil particles has been identified as a problem by the Governor's Task Force on Pearl Harbor;

b) Moanalua Stream, which flows to the Class A waters of Keehi Lagoon, also a pollution problem area; and

c) Heeia Stream and Kaneohe Stream which flow to Kaneohe Bay, now designated in its entirety as Class AA waters whose objective is "that they remain in as nearly their natural, pristine state as possible with an absolute minimum of pollution from any source" (Hawaii Public Health Regs., Chapt. 37-A, Sec. 3). Siltation and turbidity in the bay constitute major pollution problems in the Bay.

In Halawa, according to the impact statement (p. 34), "the State does not anticipate any problem with siltation caused by erosion" either during or subsequent to the construction because the measures for erosion and siltation control (Appendix 4h, part 2) have been used successfully on the Halawa Interchange. So far as we are aware these methods are being subjected to the first real tests during the present kona season. We wonder whether means have been provided for checking their success at the Halawa Interchange, and we wonder what criteria the Division of Highways uses to define success.

The basic principles of soil erosion control have been followed at the Halawa Interchange and with some, but only partial, success. The grading of the top of a fill away from the slopes and the provision of holding ponds on the fill has successfully eliminated loss of soil from the fill top. However, we have observations and photographic evidence of:

a) rilling beneath the vegetative cover on a fill slope;

b) fill slopes that have either not been vegetated or from which the vegetation has been removed on which rill erosion is evident together with sediment accumulation at the slope toe;

c) collection of drainage from the upper portion of the highway area in a lined ditch whose outlet is unprotected; and

d) the entire mountainward portion of an embankment, now being graded, bare and open to serious erosion during the period of maximum erosional risk.

The control of erosion in a project involving extensive grading and hence the control of turbid pollution of the runoff waters and siltation downstream is extremely difficult. The identification of means for the most effective control are engaging the attention of special committees of the Pearl Harbor Task Force, the Kaneohe Bay Task Force, and the Windward Citizens Planning Conference, as well as the local office of the Soil Conservation Service and a special Task Force of the Environmental Center. Such means cannot be fixed standards (such as are set forth in Appendix 4h, part 2) but must vary, with the climatic erosional hazard as it varies both geographically and seasonally with the erosional susceptibility of the soil, probably best indicated by the dispersion

ratio, and with water quality requirements in the receiving water downstream. Fertilization needs in connection with slope control planting (Appendix 4h, part 2, p. 680-1A) should not be regarded as fixed but determined by the State Soils Testing Laboratory. Although the control measures adopted by the Highways Division obviously represent an improvement over past practice, they cannot be considered to eliminate the problem, even in Halawa.

The erosional problem is greater in Moanalua. Moanalua Stream already runs red during floods. The source of the red soil it carries is uncertain, because the soils of the upper valley are brown and gray. Present rates of erosion and sediment transport in Moanalua are not known. Avalanching is undoubtedly a source of sediment production on the steep slopes in the high-rainfall upper part of the valley. There is no obvious evidence of either accelerated erosion or of valley filling at present. The erosional hazard obviously varies considerably in different parts of the valley depending upon rainfall characteristics, soil type, and slope. Recent soils mapping in the valley indicates that stony gray hydromorphic soils predominate in the valley bottom. These soils are characterized by low infiltration capacity and susceptibility to erosion and sliding. The maps are, however, generalized and the characteristics of the old-alluvium terraces may not be so undesirable as suggested by the maps.

Erosion control measures are liable to be even less successful in Moanalua Valley than in Halawa Valley because of the greater rainfall, especially toward the head of the valley. The narrowness of the valley will preclude the provision of silt-collection basins to remove settleable materials on the stream-side of highway fills. The impact statement recognizes that control measures will have to be specially adapted to the Moanalua situation (p. 38), and that erosion and prevention will be the subjects of a prevention program. The statement should indicate that even with special care accelerated erosion, sedimentation, and pollution by turbidity will result from the highway construction.

In the Kaneohe area the situation is similar to that in Moanalua, but the problem is likely to be aggravated by the extensive grading required for the interchange to be located in the Luluku Stream drainage basin. The impact statement's claim that "complete precaution will be taken. . .to prevent erosion and siltation either from the stream's banks or from any excavation or embankment areas in the vicinity" is at best quite misleading. Prevention of erosion and sedimentation is impossible, and even prevention of accelerated erosion and sedimentation is likely to be found completely impractical. The statement recognizes special problems associated with two ridges in the drainage basin of Kamooalii Stream, but points out that the streams in this drainage basin drain a reservoir proposed by the Corps of Engineers. It is true that the prior construction of this reservoir would effectively remove settleable particles from the stream water, but the sedimentation will occur at the expense of reservoir capacity and life, and the funding for the reservoir project is, in any case, not yet assured.

In summary, the control of erosion, sedimentation, and pollution by turbidity will be much more difficult than is implied by the environmental impact statement and, with the best control measures available, the proposed highway construction with respect to these effects will be much greater than implied.

APPENDIX A

UNIVERSITY OF HAWAII

Department of Mechanical Engineering

January 4, 1972

MEMORANDUM

TO: Dr. Doak C. Cox
Director, Environmental Center

FROM: John C. Burgess JCBurgess

SUBJECT: Review of Noise Assessment, Environmental Impact Statement for Interstate Route H-3

REFERENCES:
(1) Hawaii State Department of Transportation Environmental Impact Statement for Interstate H-3, November, 1971
(2) "Noise Assessment of Interstate Route H-3 from the Halawa Interchange to the Halekou Interchange", Bolt Beranek and Newman Report 2099, November, 1971 (Appendix 4(a) to Ref. (1))

The Department of Transportation has based its assessment of noise impact entirely on a report submitted by a mainland acoustical consulting firm [Ref (2)]. The primary conclusion quoted by DOT [Ref (1), p.29] is that a "great impact" classification extends approximately 200 feet from the route centerline with or without dense vegetation, and that the "some impact" classification extends to approximately 300 feet with dense vegetation and to approximately 700 feet without such vegetation.* The DOT statement [Ref (1)] states that all existing residential areas (except for a few in Moanalua Valley), the Hawaii State Hospital in Kaneohe, and Our Lady of Bethany Seminary all fall in the "no impact" classification. The Halawa Jail is stated to be either "no impact" or "great impact" depending upon the noise vehicles can be expected to make in 1993.

Some of the conclusions reached by the consultant and used by DOT are based upon questionable assumptions. These assumptions and the predictions of probable impact based upon them, deserve further evaluation. The principle questionable assumptions are:

(1) The assumption of unstated criteria for sleep interference,

(2) The apparently hidden assumption that ambient levels will not change as a result of federal and state regulation of motor vehicle noise emissions,

*These distances are stated for recreational areas, but they are probably approximately applicable to other areas.

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(3) The assumption that 12 dB attenuation can be assumed between outdoor sounds and their corresponding indoor levels,

(4) The assumption that public response to noise in the past will be the same in the future,

(5) The assumption that the public response to noise characteristics of mainland areas can be applied to Hawaii,

(6) The apparent assumption that a uniform attenuation can be applied to the noise emitted by all vehicles operating on an elevated roadway,

(7) The criterion of moderate speech interference to determine acceptability of recreation areas, and

(8) The use of the criterion of "how much noise will the public take before they overtly react" rather than "what noise level will be acceptable to people when they are engaged in activities normal to the time and location of that activity."

The criterion of sleep interference is probably more important than that of speech interference to estimating response in residential areas to noise from route H-3. There are several reasons which support this viewpoint. People are more sensitive to noise when they are trying to sleep than when they are engaged in play, listening to television, or talking. During the night-time hours when most people sleep, the ambient noise level is generally lower than it is during the day-time. Motor vehicles operated at night make just as much noise as they do during the day-time. Although there may be fewer of them operating at night, as long as there are a sufficient number to prevent or retard the process of attaining a deep sleep, their influence can be significant.

There are several sources of estimates of what are acceptable sound levels for bedroom areas. Kryter[1] surmises that sound levels reaching 27 dB(A) will be resented. Burns[2] identifies recommended maximum night-time sound levels in sleeping areas as

Country	25 dB(A)
Suburban	30 dB(A)
Urban	35 dB(A)
Busy Urban	40 dB(A)

Most of the area through which the H-3 route is planned is either country or suburban at this time. For the rest of this memorandum, 30 dB(A) will be used as a criterion for maximum noise level in sleeping areas during the night.

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[1]Karl D. Kryter, "The Effects of Noise on Man", Academic Press, New York, 1970, p. 459.

[2]William Burns, "Noise and Man", John Murray, London, p. 119.

It is well known that noise is attenuated when it passes through openings into a room. Using elementary sound transmission theory, an open window area 1/16 of the wall area (6.3%) will allow approximately 12 dB attenuation (the value used in Ref (2)). Although this value may be appropriate for mainland dwellings, it does not appear to be appropriate for Hawaii. Many dwellings have jalousies which allow the entire window to be opened. In one dwelling typical of home construction practice in Hawaii, a bedroom wall with an area of 92 sq. ft. has an open window area of 9.8 sq.ft., or 10.7% of the wall area. This works out to 9.7 dB attenuation. (In some schools in Hawaii, windows comprise as much as 50% of the wall area. This works out to only a 3 dB attenuation.) For the rest of this memorandum, 10 dB attenuation will be assumed for sleeping areas.

The existing ambient sound levels during the night-time (early morning hours) were measured and reported by the consultant [Ref (2)] approximately as (all in dB(A):

	L_{90}	L_{50}	L_{10}	
Country	22	28	35	(Position 2)
Suburban	28	35	40	(Position 3)

For the remainder of this memorandum, the value of 35 dB(A) will be used for the average external night-time ambient noise level. Together with 10 dB attenuation through the windows, this works out as 25 dB(A) inside sleeping areas.

Kryter[3] has pointed out that the threshold level for behavioral awakening is approximately 20 dB for a person who has been receiving a normal amount of sleep. In the remainder of this memorandum, a maximum noise level 20 dB greater than the average ambient (L_{50}) will be assumed to awaken a sleeping person.

Hawaii's truck fleet operates in quite a different manner from those on the mainland. Almost all trucks on Oahu will remain on Oahu during their entire operational life. Since distances are short, average life times expressed in years are considerably greater than they are for similar trucks on the mainland. A reasonable estimate of truck life is at least 20 years. Even with expected State regulation*, maximum noise levels from trucks on truck routes can be expected to be 88 dB(A) measured 50 feet away. Since much of the H-3 route is on grade, trucks can be expected to be using nearly full power while climbing the grades. On the Windward Viaduct portion, the lane most likely to be used by climbing trucks will be the outside lane. Since the exhaust stacks of most heavy diesel trucks have their open ends approximately ten feet above the highway, the roadway can be expected to provide little shielding of the noise from heavy truck exhaust systems. Assuming 3 dB attenuation on the viaduct portion of the route (ie, neglecting acoustical power reflected from the roadway surface), and assuming another 2 dB attenuation to

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[3] loc. cit. p. 518

*Regulations on motor vehicle noise have been proposed to the Governor of Hawaii by the Department of Health. Support of these regulations by the Department of Transportation would assist in decreasing the noise impact of highway use. The DOT impact statement assumes such regulations will be put into effect.

account for the slant distance to dwellings, maximum external sound levels from single trucks are likely to be these shown in the following table.

Horizontal Distance ft.	Maximum External Sound Level dB(A) No Foliage	Dense Foliage*
50	83	83
100	77	77
200	71	67
400	65	57
800	59	49
1600	53	43

Assuming that a normal sleeper will awaken if the truck pass-by noise outside his bedroom window exceeds 55 db(A) [35 dB(A) + 20 dB], and that vigorous complaint will follow from being so awakened one or more times each hour, the "great impact" classification would extend out nearly 1600 feet if there is no foliage, and to approximately 500 feet if there is dense foliage. The "some impact" classification would extend even further.

The distances from the H-3 route corresponding to "great impact" are more than double the distances predicted by the consultants. The distances for "some impact" probably have the same relationship to the consultants' predictions. Thus in the residential areas near the Windward Viaduct (where there is little foliage between the route and bedroom windows), the "great impact" area may include about half the buildings of the Kaneohe State Hospital and a sizable portion of the Haiku valley. The "some impact" classification can be expected to apply to a greater area.

For recreational areas, the consultants have applied the criterion of speech interference. While this criterion appears to be appropriate where the ambient noise level does not fluctuate greatly around the mean, its appropriateness is questionable where large fluctuations occur. The frequency with which heavy trucks can be expected to use the H-3 route will probably create large fluctuations in sound level randomly spaced in time. They can thus be expected to be intrusive within areas where the change in sound level from the mean is sufficient to draw attention to the noise. This effect probably will occur with a 5 dB increase and is almost certain to occur with a 10 dB increase. Where the mean noise level is 50 dB(A), the imposition of noise from passing trucks which increases the noise level to 60 dB(A) is likely to be considered intrusive. The effect of this is that a recreation area subjected to such a noise environment is not likely to be enjoyed by those who want to relax from the tensions of the city by spending a quiet day in the country.

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*Ref (2), p. 13.

A suggestion about the extent of the area which may be subject to this effect can be obtained from the table of maximum noise levels given earlier in this memorandum. For areas with dense foliage, the impact area would extend out to approximately 400 to 500 feet from the H-3 route. Where there is insufficient foliage, the impact area can extend out to about 1000 feet. These distances are more than double those predicted by the consultants for "great impact." Whether these areas should be called "great impact" or "some impact" depends upon the definition of these terms. The consultants appear to have used a definition which derives from the philosophy "how much noise will people take before they complain or threaten legal action." Perhaps a better criterion for recreational areas is"how much noise is acceptable to the majority of people who can be expected to use the recreational facilities."

The substance of this memorandum is that the impact statement [Ref (1)] appears to understate significantly the probable impact of noise. I believe the noise assessment should be reevaluated.

Review of the Environmental Impact Statement of Interstate Route H-3: Emission and Pollution Study, November, 1971

Since this report is based solely on one theoretical equation, it is of critical importance that this equation represents the latest state of art and is properly used. The equation used in the report is generally referred to as the Sutton equation. The theoretical approach behind this formula was found not to reflect reality. It was therefore abandoned, and today a model generally referred to as the statistical or Gaussian approach is the only acknowledged method. Additionally, concentrations obtained from the Sutton formula do not coincide with measured values.

A very serious objection must be raised to the author's modification of the Sutton formula, namely the addition of the automobile speed v to the mean wind speed u in the denominator of the formula. This implies that the pollutant molecules, after leaving the exhaust pipes of the automobiles, continue to travel with the speed of the cars and the mean wind speed. Physical argumentation clearly shows that such reasoning is totally unfounded. The consequences of such a decisive modification is demonstrated by the following example. For a 1 m.p.h. mean wind speed and a car speed of 50 m.p.h., this modification produces a 50 times smaller concentration than that obtained by using the acknowledged formula without the addition of v.

A further grave error results from the misconception of the behavior of meteorological phenomena. The author is under the illusion that the wind only blows along the major compass points which results in high concentrations only downwind of these discrete directions. Another misconception of the author is that particularly in the stable morning hours cold air drainage

does not follow the law of gravity, i.e. flowing down the valley close to the valley floor. This lack of understanding of basic physical processes makes the author produce maximum concentrations of 50 mg/m^3 of CO about 50 feet above the valley floor (Fig. 8). Based on all these misconceptions the author concludes that no significant impact on the environment should be expected.

In addition to the above fundamental objections which in themselves would be sufficient to disagree with the conclusions reached in this report, we shall proceed listing a further array of serious shortcomings and errors of this report.

1) p. 1 Ground-level calculations should be performed for all affected areas and not only for a few sections. Measurements for validating the predicted levels should be done for all present and future residential areas.

2) p. 2 The location of sections within the coordinate system is impossible to follow.

3) p. 3 Old emission factors were used (see Rose). One should have used data from McGraw and Duprey, EPA April '71.

4) p. 3 Emission characteristics of CO cannot be equated to other pollutants. E.g. in contrast to CO, NO_2 increases with the car speed (see also p. 9). Also, air quality standards have been set at different levels for different pollutants.

5) p. 3 Average 16-hrs. a day traffic counts for the H-3 are at least 95% and not 75% of the Likelike and the Pali Highways. This fact would result in doubling of the assumed number of cars for an average 8-hrs. as given on p. 3.

6) p. 4 The average speed of cars for an average 8-hr. day is not 50 m.p.h. Most cars travel about 10 to 30 m.p.h. during rush hour.

7) p. 5 It is impossible to use the mean wind speed and direction for Kaneohe Bay and a "Honolulu station". It is advisable to conduct at least in situ measurements and compare these with the data from the climatological stations.

8) p. 6 If calculations are to reflect the worst conditions (morning rush hour) one should also use the morning wind statistics and not average daily winds. For example, morning wind records show a 2 kt. wind from all directions 14% and not 8% of the time. ENE winds of this speed class occur 6 times more often than suggested in the report.

9) p. 6 The report defines 2 kts. as a "critical" wind speed. One asks oneself why is, e.g. 1 kt. not used as the critical wind speed? A 1 kt. wind speed would result in a doubling of the concentrations. Or, why not use 0.1 kt.? One should, of course, resort to probability statistics, which would resolve this critical question.

10) p. 7 The arithmetic mean wind speed is used. This is incorrect. Rightfully the harmonic mean wind should be used (e.g. see G. Hilst, Proceedings of Symposium on Multiple-Source Urban Diffusion Models, Raleigh, 1970). Such proper statistics will, e.g. give an ENE mean 8-hr. harmonic mean wind of 2.0 m.p.h. and not 11.9 m.p.h. as used in the report. This obviously would result in a 6 times higher pollutant concentration as presented in this report.

11) p. 8 The governing equation used in this report does <u>not</u> take the highway configuration into account.

12) p. 8 The report puts forth the argument that close to the source the concentration is 6-13 times the 30 minute-or-larger sampling periods. This argument is used later to justify the reduction of calculated receptor concentrations by a factor of 10. While this might be

justified close to the source, it is most definitely not justified for those distances used in the report.

13) p. 9 What is the logic behind reducing the 1-hr. concentration by 10 and the 8-hr. concentration by 5? If, as the report claims, one is interested in the critical concentration, should one then not use a reduction by only 6?

14) p. 9 The logic behind the statement that for an 11 kt. wind blowing into the tunnel the pollution emission from the tunnel is zero escapes us. One would not expect any emission from the tunnel for a wind blowing at any speed into the tunnel. Besides, there seems to be some mysterious accumulation of pollutants, since only 95% of the pollutants come out of the other end of the tunnel.

15) p. 11 Old and irrelevant references were used.

16) App.C Two serious sign errors in the only equation used seem to indicate the author's unfamiliarity with such equations.

D is the macro-and not the kinematic viscosity.

Conclusions and Recommendations

The lack of understanding of the basic physical processes and the inadequate statistical treatment of the data results in many misconceptions and grave errors. The presented results and conclusions drawn therefrom must therefore be rejected as utterly inadequate. Since the impact of H-3 on the environment must be considered of critical importance, we strongly recommend that a new study be conducted that will produce physically sound, unbiased, and realistic results.

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APPENDIX C

UNIVERSITY OF HAWAII

Environmental Center

Office of the Director

Responses to Highway Division comments on
Environmental Center critique of first draft, H-3 Impact Statement

1. We commented on the lack of discussion of the mode of construction of the highway in Moanalua Valley in the first draft, pointing out that the nature and extent of environmental impacts depend significantly on the alignment and construction adopted. The response refers to discussion in sections III and IV of the revision. Section III (pp. 11-13) indicates that final selection has not yet been made between "at-grade" construction, presumably more or less along the valley axis, or viaduct construction, alignment unspecified. It indicates recognition that the environmental impacts will be different depending on mode of construction. Section IV (p. 21-23) indicates that the environmental impacts will be evaluated in the final choice of alignments and construction mode. The fact remains that, in significant respects, the environmental impact in Moanalua Valley cannot be pinned down until the alignment and construction mode are determined. The problem here is not a fault of this impact statement but of the system that requires formal consideration of environmental impacts only once in the course of planning an extensive and complex project.

2. We commented on the plans for a flood-control dam that was not mentioned in the first draft except in relation to a request of the Trustees of the Damon Estate. The response refers to Appendix 4h that describes the proposed dam and its hydraulic effects. We note that the effects of the dam are still not mentioned in the description of the environmental impact of the project in Moanalua Valley (pp. 18-23) nor are other than flood and silt aspects discussed in the sections on special phases of environmental impacts. The section on vegetation does not even mention the dam, although Appendix 4c does discuss the effects of the dam on vegetation, concluding that the effects will probably be insignificant but raising a question with respect to koa.

3. We commented that the highway would occupy a significant part of the valley, based on an assumption that its width including cut-and-fill slopes might be 250 feet. The response states that the average width will be 150 feet and that where greater widths are taken, the margins will be made available for use by the Damon Estate. We point out that even with the narrower width, the highway would still occupy a greater part of the valley, and especially of the valley floor, than is the case of the highway through Nuuanu and Kalihi Valley; and that cut-and-fill slopes will be of little use to the Damon Estate. We wonder, however, whether the estimate of an average width of 150 feet is not misleading. According to description of

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roadway characteristics (revision, p. 9), the aggregate width of the two roadways plus paved shoulders will be 100 feet. A median strip "where the roadway is at grade" will add a minimum of 36 feet. If the "at grade" alignment and construction mode are selected, much of the highway will actually be in cuts or on fills and bridges. If the median strip is not to be provided through most of the valley, the width of the project inclusive of cut and fill banks, drains that presumably will be provided at the top of cuts, and realigned and lined stream channels, would seem necessarily greater than 150 feet.

4. We commented on the destruction of vegetation and on the questionable success of revegetating cuts-and-fills. The response indicates that the Highway Division is concerned with the proper application of ecological principles in revegetation. The Division now does call for extensive revegetation and temporary erosion control on cuts-and-fills. The success of these efforts remains questionable, however, because they have not yet been subjected to the test of a kona season.

5. We commented on the historical-ethno-eco-botanical plans of Moanalua Gardens Foundation. The response indicates that the Highway Division is concerned that its revegetation recognize these plans.

6. We commented on the problem of vegetation beneath the windward viaduct. The response indicates that the highway is aware of the problem, though it appears still not to be mentioned in the revised impact statement.

7. We commented on the apparent lack of concern with agricultural crops. The response indicates correctly that the problem is compounded with the efforts of several other projects. These are discussed in the revised impact statement (p. 41). Our original comments still appear pertinent.

8. We commented on the inadequacy of discussion of faunal effects. The response refers to rectification through Appendix 4d (and might also have mentioned pp. 45-47 in the revision).

9. We commented on inadequacies of treatment in the draft of recharge, and drainage of ground-water. The response indicates rectification through Appendix 4g (and might also have mentioned pp. 31-33 in the revised statement). Because "there is no sure way to categorically predict that the [trans-Koolau] tunnel will, in fact encounter a saturated zone," (Mink, App. 4g, p. 5) it would seem impossible also to predict categorically a total lack of interference with the flows of existing tunnels. As we stated originally, however, the chance of significant effects is negligible. There appears still to be no recognition of the reduction of infiltration resulting from the paving of the highway, the steeper slopes of cuts-and-fills, and the shortening and lining of the stream. To some extent the proposed flood storage will offset this reduction, possibly overbalancing it. Discussion of this point seems warranted.

10. For discussion of the flood-control dam question see item 2.

11 & 12. We commented on the water quality changes that would be induced by soil particles. The response, referring to Section IV F of the revision, discusses the effectiveness of current erosion control practices as indicated by experience with the construction of the Halawa interchange. Our observations of the effectiveness of the controls at Halawa during recent storms indicate only partial success. Further, experience in one climate-terrain regime, such as that of the Halawa interchange, cannot safely be extrapolated to another very different regime, such as that of upper Moanalua Valley. The present concern of the Highway Division with the problem of erosion control during construction is commendatory, but the problem will not be so easily solved as seems to suggested by the revision.

13 & 14. We commented on air pollution effects expectable in the tunnels and in Moanalua Valley. The response refers to Section IV D of the revision and Appendix 4b indicating that air pollution in the valley will not be important and states that the comparison of air pollution in the Wilson tunnel and the proposed tunnels is not valid because of differences in ventilation methods. In our critique and Appendix B we question the validity of the analysis presented by the Highway Division in Appendix 4b. The statement that the Red Hill tunnel ventilation will involve positive forced draft and the ventilation of the trans-Koolau tunnel will involve both positive forced draft and exhaust is not reflected by the sole statements in the revision on this topic, that the air from the Red Hill tunnel "will be exhausted through a ventilation structure to be located at the portal in South Halawa Valley" (p. 18) and that from the trans-Koolau tunnel "will be exhausted through ventilation structures at each portal."

15. We commented on the possible effects of air pollutants on the vegetation. The response indicates that the Highway Division recognizes a possible problem, and that replacement of vegetation within the right-of-way will be the responsibility of the State. Rectification of possible effects beyond the right-of-way is not mentioned.

16 & 17. We commented on apparent discrepancies between statements in the first draft and statements in source reports on archaeological sites within the project area. The response and the revision clarifies the matter.

18. We commented that planting could not be expected to eliminate the problem of noise, particularly of low-frequencies, in Moanalua Valley, especially in the light of reflection from the valley walls. The response cites a federal agricultural source indicating significant noise reductions by foliage and cites an appendix in the revision (App. 4a) to the effect that reflections will not be significant. In our critique and Appendix A we question the validity of the analysis presented by the Highway Division in Appendix 4a though not specifically with respect to reflections. We point out that the importance of reflections will depend in part upon the thermal structure in the valley. During the morning there exists an inversion which will tend to increase the effectiveness of reflection.

19. We commented on the impact at Kaneohe State Hospital. The response cites an appendix to the revision (App. 4a) which places the hospital in a "no impact" category. We call attention to the questionable validity of the analysis presented by the Highways Division (see our Appendix A).

20. We commented that visual separation of the two roadways will be difficult in the narrow valley and impossible in the windward viaduct. The response recognizes that visual separation will be achieved only where the median strip is provided. See item 3 on the question of the fraction of highway length in Moanalua Valley in which the median strip is to be provided.

21. We commented that placing tunnels underground smacks of magic. The response refers to 4 figures showing portal structures. These figures indicate that the portals in Moanalua Valley have obviously been designed with esthetics in mind. The structures are almost entirely below natural ground level, and planting over them is intended to make them as inconspicuous as possible. The fact remains that a portal, which is the interface between a tunnel (underground) and the open air, cannot itself be underground. Other figures indicate that the portals in Haiku and Halawa will be somewhat more conspicuous, though still esthetically designed.

22. We commented on the combination of historical and legendary background of Moanalua Valley as of special significance in combination with the historical zoning concepts involved in the plans for the park proposed in it. The response indicates unawareness of any historical significance during the periods of the Kingdom, the Republic, or the Territory, and claims that of the events listed by Barrere (App. 4e, pp. 51-65) none occurred in Kamananui. The Division of Highways has overlooked Kamehameha's naming, at Kahaukomo, of a new-born child after the sword he used in his battles with Kalanikupule (1794) (Barrere, op. cit. p. 55). Weissich (p. 7 of Att. B to Moanalua Gardens Foundation response to first draft, App. 2a of revision) reports that it was in Kahaukomo in the mauka section of Kahuluomanu that a young chief had been strangled in the stream for refusing to fight against Kamehameha. Although these events pertaining to Kamananui were not recorded in writing at the time, they belong to the historical period of the beginning of the Kingdom of Hawaii. As discussed by Barrere (op. cit. p. 56) the population in the upper valley was reduced rapidly by disease and migration in the 1780's and 1790's. Although the abandonment is not related to any specific site it is none the less historic and representative of the history of other valleys. Similarly, the spread of wild cattle and the plundering of sandlewood in the period before 1830, not mentioned in the historical documents appended to the revisions, must have affected Kamananui. During the 19th century, the upper valley was undoubtedly little used except for hunting--again a history representative of similar valleys elsewhere. More intensive utilization followed acquisition of the valley by the Damon family and accompanied the development of the Moanalua Gardens that were a well-known recreation area from the Victorian era into the 1930's. As early as 1900 Kamananui was accessible by two-wheeled gig (Weissich, op. cit. p. 16), and shortly

thereafter buggy road partly stone-paved, was constructed with attractive stone bridges, one of which bears the date 1909 (Ayres, App. 4e, p. 14). The sites of summer homes of Damon family members are still marked (Ayres, op. cit.) and, considering the efforts put into the improvement of access it cannot be doubted that the Damons arranged for visits to the valley by the notable visitors to Moanalua Gardens whose names are recorded in a Damon guest book and newspaper clippings (Frances Damon, personal communication). To have implied special "historical importance" to Kamananui Valley may have been an exaggeration. Clearly, however, the history of the valley may be tied to the history of its immediate surroundings and that of Hawaii in general so as to add to the special prehistorical significance (that is not challenged by the Highways Division) in supporting the legendary-historic-ecological zoning embodied in the plans for the proposed park.

23. We commented that "because the highway will occupy so large a part of [Moanalua] valley (most of the valley bottom), because of the traffic noise it will produce, and because of its overwhelming visual impact, it cannot appropriately be considered compatible with the park"[proposed by Moanalua Gardens]. The response indicates that the Highways Division disagrees. We still maintain our belief.

24. We commented that compatibility with the proposed public park on one of the branches of Kamooalii Stream was questionable. The response merely mentions that the highway and the park have been planned jointly since 1966. This does not assure, of course, that the visual effects of the highway and the noise associated with it will not detract from the attractiveness of the park.

25. We commented that the claim of virtual impenetrability of Moanalua Valley was incorrect. The response indicates that the Division of Highways still considers the valley "virtually impenetrable." Statements to the effect that it is comparatively difficult of access would have some validity because it has been closed to the public except by permission of the owners, although the comments of Moanalua Garden Foundation on the first draft (App. 2a, Moanalua Gardens Foundation, p. 5) indicate that large numbers of groups of people have had access to the valley. However, the term "impenetrable," in its ordinary dictionary meaning, is quite inappropriate.

26. We commented that a complete discussion of the environmental impacts associated with the decision to construct the H-3 should consider the direct and indirect environmental effects of all possibly practicable alternatives. The response indicates that the displacement of families associated with alternative routes was considered so unacceptable that consideration of their environmental effects was not needed, and that

mass transit could be considered only as an adjunct and not a replacement for the H-3. Displacement of families is, of course, a major social cost to be considered in the selection among possible alternative transportation facilities. It is obvious, however, that the Highways Division has not considered this cost so great in other circumstances as to constitute an overruling objection. The revision, in any case, presents some alternatives that require little displacement of homes, and we discuss an additional alternative in our critique. We did not argue that mass transit was likely to provide all of the additional trans-Koolau transportation facilities that will be needed.

27. We commented that the use of the H-3 for mass transit by busses was an afterthought in its intentions and justification. The response refers to 1965 studies that the selected network created the best system for mass transportation, but admits that no specific method of mass transportation was delineated at that time. It is our impression that mass transportation referred to all forms of transportation including automobiles.

28. We commented on the developments in mass transit since the highway route was selected and indicated that mass transit on the grades in trans-Koolau routes might not require rubber tired vehicles on paved rights of way. The response indicates no change in the Transportation Department view that the grades will require rubber-tired vehicles on paved rights of way. Our comment would have been more exact if we had restricted it to paved highways. The use of rubber-tired vehicles on rails or concrete trestles appears to be a possibility.

UNIVERSITY OF HAWAII

Environmental Center

Office of the Director

July 26, 1971

Dr. Shelley M. Mark
Director
Department of Planning
and Economic Development
P. O. Box 2359
Honolulu, Hawaii 96804

Dear Dr. Mark:

Interstate H-3
Environmental Impact Statement

This response is submitted to the June 1971 draft environmental impact statement prepared by the State Highways Division on the proposed Interstate H-3 highway route from the Halawa interchange to the Halekou interchange, submitted with your letter of 1 July 1971. In this response the following have been involved: Richard D. Bauman (Civil Engineering), John C. Burgess (Mechanical Engineering), Hugh Burgess (Architecture), Doak C. Cox (Geosciences and Environmental Center), Paul C. Ekern, Jr. (Soils and Agronomy and Water Resources), John R. Evans (Civil Engineering), Yu-Si Fok (Civil Engineering and Water Resources), Dale N. Goodell (Cooperative Extension Service), Jerry M. Johnson (Public Health and Environmental Center), L. Stephen Lau (Civil Engineering and Water Resources), Dieter Mueller-Dombois (Botany), Frank I. Peterson (Geosciences and Water Resources), Yoneo Sagawa (Horticulture and Arboretum), Tamotsu Sahara (Land Study), Richard Shutler (Anthropology), Sanford M. Siegel (Botany), and Warren Y. S. Yee (Horticulture and Extension Service). Many of those who were involved profited from a field trip through Moanalua Valley under the guidance of Miss Frances Damon.

Among the projects in Hawaii covered by federal environmental impact statements reviewed to date, this proposed interstate highway project certainly ranks among the first two or three with respect to the magnitude of environmental effects. Among that number, the environmental effects of the proposed H-3 project most seriously call into question the net social benefit of the proposed action. Because of the gravity of the question as to the justification of the H-3 project raised by its environmental impact, the description and assessment of

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this impact is of special importance. Because of limitations of time and of access during the time available to specialists in all of the disciplines involved, this review cannot be considered a thorough one. It will indicate, however, that if the H-3 route can be justified, the justification will require much more understanding and evaluation of the environmental impact of the project than is displayed in the impact statement under review, which is in some respects inaccurate or misleading, and which is in important aspects incomplete.

The harshness of this judgment should not be taken as criticism specifically directed toward the agency responsible for the preparation of the statement. The development of plans for a major highway is a protracted process. For two generations, society has placed increasing reliance on automobiles and highways to meet transportation needs, and although serious questions have long been raised as to the long-term implications, social as well as environmental, it is only in the last few years that significant changes in public policy in this regard have been made or appear imminent. The greatest challenges to past policy have been made only late in the period during which the plans for the H-3 route have been developed. Ample opportunity has been given during this period for the expression of objections to the plans, and it is no fault of those whose job it is to design highways that the public has only recently been led to challenge the policy of almost exclusive reliance on highways to meet transportation needs and to introduce environmental detriments into the weighing of benefits and costs. Now that the challenge has been made, however, it is appropriate to review thoroughly the whole H-3 scheme with respect to its overall social as well as environmental effects.

In the following review of the H-3 environmental impact statement, comments are made first on some environmental and design features that have general importance. Attention is next given to the "harder" environmental effects in the immediate vicinity of the route such as effects on the natural flora and fauna, water, and air, followed by "softer" effects such as noise and visual effects. Finally some broader concerns not restricted to the immediate vicinity of the route are discussed.

General features

Effects of highway design in Moanalua Valley

In one important respect, the environmental impact statement presents insufficient detail as to the design of the highway to permit anything like a satisfactory evaluation of environmental effects.

The route map accompanying the statement (fig. 2) shows that the proposed highway will cross the natural course of Moanalua Stream at least 20 times. Although the statement describes the windward portion

of the route as born by a viaduct, there is no discussion in the statement of the construction mode intended for the portion of the route within Moanalua Valley. Profound differences in the estimated effects of the highway on water, soil, and esthetic effects of the highway depend on whether the construction within Moanalua is to be primarily cut-and-fill with extensive stream relocation effectively reducing the number of stream crossings, or primarily a viaduct with limited cuts and fills.

The present design concepts are apparently those portrayed by preliminary plans developed in 1967 but not discussed in the statement. This design is primarily cut-and-fill with extensive stream relocation. Of the 4.3 miles of Moanalua Stream length in the part of the valley to be traversed by the highway from the portal of the Halawa tunnel to the portal of the Trans-Koolau tunnel,more than half, nearly 2.2 miles, is to be replaced by about 1.5 miles of concrete channel. The plans call for construction of a 75-foot flood control dam in the southern branch valley which, in a severe flood, would back the water in that valley nearly 0.2 miles.

Effects of Moanalua Valley width

Special note should be made of the width of the highway in relation to the width of Moanalua Valley and particularly the width of the valley bottom. Standard freeway design criteria indicate that the width of the 6-lane highway with minimal cut-and-fill slopes would be about 250 feet. Because of the inability of the highway to follow the curvature of the flood-plain, higher cut-and-fill slopes will require additional width. If the highway were built in accordance with the 1967 plans, after the construction of the roadways, the lined channels, the related cuts and fills, and the dam, the undisturbed part of the valley bottom, even including the terraces of old alluvium, would be reduced to a dozen or so discontinuous fragments, many of them only one or two hundred feet wide, and even these fragments would be further reduced in area if road access to them were to be provided from the highway. The highway and its appurtenances will, indeed, occupy a significant fraction of the entire valley, which ranges from about 2500 feet to about 6000 feet in width.

In these scale relationships the proposed highway in Moanalua will be quite different from the present 4-lane highways in the much broader Kalihi and Nuuanu valleys, and concepts as to hydrologic, aerologic, and visual effects based unthinkingly on the effects of the present highways have very limited applicability to the proposed freeway.

Effects on flora (including agricultural crops) and fauna

The portion of the impact statement dealing with "Vegetation and wild life" (pp. 16-17) hardly hints at some of the major questions that should be discussed, the degree of disruption of the various ecosystems traversed by the route and the value of preserving these ecosystems.

In Moanalua Valley, as in other leeward valleys of the Koolau Range, there is an enormous range in ecological conditions related especially to rainfall. Moderately dry-land vegetation predominates in the lower part of the valley and rain forest vegetation in the crest area. As pointed out in the statement, bulldozing and other clearing operations in the past have already effectively removed from the proposed route in Moanalua "the more valuable botanical specimens," though such operations have been more destructive in the lower than the upper part of the valley. More significantly the indigenous ecosystems, especially in the lower part of the valley, have been extensively altered by the historical changes that have been effective throughout Hawaii. Bishop and Herbst (On the vegetation and flora of Moanalua Valley, Oahu, February 1970, 56 pp.) show that "botanically the valley to the right of Mano Divide [i.e. the south branch of the valley] is by far the most interesting part of Moanalua." Vegetation in this branch would not be affected by the proposed highway construction, except possibly by the proposed flood control reservoir. Even in this branch valley, however, and certainly in the main valley, some effects might result from air pollution derived from the traffic on the highway, as discussed later. Certainly in the main valley there will be extensive destruction of present vegetation, and the success of revegetating of cuts and fills (pp. 12, 17) is questionable. Few substantial attempts have been made in Hawaii to establish vegetation on highway cuts and fills, and such as have been made have rarely succeeded, apparently because of inadequate attention to ecological principles including nutritional needs.

It is not clear to what extent any of the present ecosystems in the main valley are distinctive and worthy of preservation. The plans of the proposed Moanalua Gardens Foundation include extensive replanting in the valley bottom in accordance with an archaeological-historical zoning scheme, which suggests that even botanists do not put a high value on preserving the present vegetation in the areas that would be directly affected by the highway, but the question should be discussed specifically in the environmental impact statement. It is not inconceivable that part of the valley might appropriately be designated as a Natural Area, and that such designation would be compatible with the park development planned.

The lesser concern expressed over the dry-land flora of Halawa Valley may be appropriate in the light of its non-unique and non-indigenous character and its present state of disturbance.

Little concern is expressed in the statement (p. 16) over destruction of natural vegetation on the windward side of the range. It should be pointed out that, although the construction of a viaduct may require removal of very little vegetation, the viaduct itself, even with its proposed bifureated design, will substantially reduce the amounts of both light and

rain reaching the ground and hence have considerable effects on the vegetation beneath it. Further, the successful replacement of vegetation removed in the course of construction is quite questionable for the same reasons as apply in the case of revegetating cuts and fills.

Little concern is also expressed with the effects on agricultural crops (p. 14). It should be recognized that the effects will not merely be proportional to the crop area taken over by the highway construction because of the economic effects of size reductions of both fields and farms. Relocation of the banana farms is not so simple a matter as is implied. There is no statement where other lands with suitable soil, climate, terrain, access, and ownership will be found, and the success of such relocation may be questioned on the basis of past experience. The possible effects of air pollution on such banana fields as are left will be discussed later.

The statement does not discuss effects on fauna except to claim that "the highway will have negligible effect on the land animals and birds. Streams in the vicinity of the highway are generally intermittent, therefore supporting no appreciable aquatic life." Ignorance is very likely the major reason for the slight degree of concern with faunal effects. The effects on birds and insects, for example, are likely to be equivalent to those on the flora.

In addition to the effects on single individuals and species, the effects on ecosystems, and the effects on crop production, there are esthetic effects associated with the destruction of vegetation to be discussed later.

Effects on water (including soil erosion and sediment transport)

In its proposed route through Moanalua Valley and through the Koolau ridge the proposed H-3 freeway would or could have many effects on water--influencing groundwater recharge, groundwater storage, floods, dry-weather stream flows, and surface-water quality. The impact statement mentions only two effects, those having to do with groundwater storage (Trans-Koolau Tunnel, p. 11) and low-water stream flow (Vegetation and wild life, p. 17). The effects on flood flows and water quality, certainly the most significant expectable, are not even mentioned.

Groundwater

Construction of the highway will prevent infiltration of precipitation through the pavement, perhaps restrict infiltration of precipitation on the shoulders and the steep slopes of cuts and fills, and prevent seepage from those parts of the stream confined to lined channels. The naturally occurring infiltration and seepage recharges dike compartments in and windward of the Koolau ridge and, to leeward, the basal (Herzberg lens) groundwater transitional between the Honolulu and Pearl Harbor areas. The dike water infiltrated from the vicinity of the

proposed highway may supply part of the discharge of the Board of Water Supply Haiku Tunnel as well as providing low-flows of windward streams and recharge to the leeward basal groundwater body. The leeward basal groundwater body is the main source of water for the Honolulu-Pearl Harbor area. The effects of the reduction in infiltration on water supply do not seem likely to be important, but they should be estimated and taken into account.

According to the impact statement, "the Trans-Koolau Tunnel is located well above the water level within the Koolau Mountain range and the tunnel should have no effect on the Oahu water supply" (p. 11, see also pp. 3-4). It is unlikely that the tunnel would have a significant effect, but not unlikely that it might have some slight effect. There is no single water table within the Koolau Mountain range. The groundwater occurs in many dike compartments, each of which may have its own water table. Although the prevailing trend of the dikes is such that the water levels in the compartments in the vicinity of the proposed tunnel are lower than tunnel level by reason of drainage toward Haiku Valley and the Haiku water development tunnel, it is not unlikely that one or more semi-isolated compartments might be intercepted that would yield a little water to the highway tunnel, as in the case of the Kalihi Tunnel. Continuing flows should not be expected to be large.

Surface water flows

According to the impact statement: "Streams in the vicinity of the highway are generally intermittent, therefore supporting no appreciable aquatic life. All stream flow is to be maintained in any case" (p. 17). Moanalua Stream (Kamananui Stream) is shown on the U.S. Geological Survey topographic maps as an intermittent stream. Ecological evidence, however, suggests that minimum flows are perennial in some sections of the upper valley, especially in the south branch, although the flow system may involve underflows in the stream gravels. If the highway were carried on a viaduct through the valley or if cuts and fills were minimized and the use of culverts and bridges maximized, there might be little effect on the low flows. However if there is extensive stream realignment or channel lining, in accordance with the 1967 plans, the effects might be limited only to the extent that the total low flows are slight.

The effects on flood flows are likely to be very great, especially if the 1967 plans are followed. These plans call for the construction of a flood-control reservoir which is only hinted at in the statement in its reference to a request made by the Damon Estate trustees "that the State reexamine its plans to construct a reservoir at the South Branch of Moanalua Stream," a request to which the State agreed subject to determination of feasibility (pp. 10-11). It appears that this reservoir, not elsewhere discussed in the statement, has been designed to reduce the flood carrying capacity necessary in bridges, culverts,

and channels downstream, including already existing structures below that part of the valley to be occupied by the highway. Obviously the effects of this reservoir need discussion in a comprehensive environmental impact statement. So, too, should be included the possible effects of grading and paving on flood flows.

Since the 1967 plans were developed there have been several pertinent new analyses of flood hydrographs and storm rainfall (e.g. Wu, I. P., 1967, Water Resources Research Center Tech. Rept. 30; Cheng, E. and L. S. Lau, 1971, Water Resources Research Center Tech. Memos 23, 24). Noteworthy particularly is the anomalous response of the lower stream gage on Moanalua streams. With the time constraints on the development of this response, it has been impossible to review fully the implications of these new analyses in relation to the proposed design.

Erosion, sediment yield, and water pollution

Very likely the most profound effects of the proposed highway construction on water will be on the quality of the water delivered by Moanalua Stream through its channelized lower course to Keehi Lagoon. During floods, Moanalua already runs red. The source of the red soil it carries is uncertain, because the soils of the upper valley are brown and gray. With the extensive cut-and-fill work proposed by the 1967 plans for proposed highway, the additional burden of soil that will be carried by the stream will be very great. The resulting increase in water pollution, which needs to be thoroughly examined in the light of the State's water quality standards, is not mentioned in the impact statement.

Present rates of erosion and sediment transport in Moanalua are not known. Avalanching is undoubtedly a source of sediment production on the steep slopes in the high-rainfall upper part of the valley. There is no obvious evidence of either accelerated erosion or of valley filling at present.

The erosional hazard obviously varies considerably in different parts of the valley depending upon rainfall characteristics, soil type, and slope. Recent soils mapping in the valley indicates that stony gray hydromorphic soils predominate in the valley bottom. These soils are characterized by low infiltration capacity and susceptibility to erosion and sliding. The maps are, however, generalized and the characteristics of the old-alluvium terraces may not be so undesirable as suggested by the maps.

The flood control reservoir in the 1967 plans would reduce sediment yield from the southern branch of the valley, but at the expense of loss of useful life. Quite probably this reduction would be offset by the increase in erosion resulting from increased flood flows from the paved

and graded areas and the greater rates of flood discharge produced by the straightening and shortening of the stream channel. In particular, the cuts and fills will be extremely susceptible to erosion during construction. Stilling basins shown in the 1967 plans are obviously designed only for dissipation of hydraulic energy and not for sediment trapping. Limitations to the effectiveness of revegetation of cuts and fills is discussed in connection with effects on flora, and even with extraordinary controls on sediment production and transport, not indicated in the statement, acceleration of erosion and the transport down stream of sediments and turbidity should be expected.

Effects on air

The possible deleterious effects of automobile emissions produced along the proposed H-3 corridor were passed over lightly in the environmental impact statement in the discussion of the Red Hill Tunnel (pp. 6-7), the Trans-Koolau Tunnel (p. 11) and in a brief section on air (pp. 13-14).

Automobile emissions generated within the Red Hill and Trans-Koolau Tunnels are to be exhausted through ventilation structures located at the South Halawa Valley portal of the first and at both portals of the latter. These ventilation systems with the aid of the trade winds are expected to dissipate air pollutants rapidly. How rapidly is not stated; probably a quantitative statement cannot be made. Qualitative observations concerning the air quality of the Likelike Tunnel are pertinent. The Likelike Tunnel, located at approximately the same elevation and near the proposed Trans-Koolau Tunnel, utilizes the same mechanisms for automobile emission removal. The air quality of the present tunnel is often poor at least in terms of objectional odor. The possibility of adverse health effects due to carbon monoxide buildup if automobile traffic was stalled within the tunnel is also of concern.

The trade winds are expected to dissipate quickly and effectively automobile emissions generated within Moanalua Valley and those discharged by the tunnel ventilation systems. Again there is no quantitative expression and probably one could not now be drafted. It should be recognized, however, that strong trade winds blow only about 70% of the time. During the other 30% of the time there are either Kona or relatively calm conditions.

It is probable that air pollutants would be less effectively dissipated by any winds from the proposed highway in Moanalua Valley than from the present highway in Kalihi Valley or Nuuanu Valleys, first because the amount of pollution eventually generated on the proposed 6-lane highway will be greater than that generated on the present 4-lane highways, and second because Moanalua Valley is so much narrower than the others.

The air pollution problem in Halawa should expectably be similar to that in Moanalua except that the pollutants would be those generated along a shorter stretch of highway. The release of air pollutants along the windward viaduct would be similar to that in the valleys. However, the rate of dissipation expectable is greater because of the more open terrain.

Damaging effects to vegetation of ozone, PAN, and oxides of nitrogen and concentrations of lead in vegetation and soil along highways resulting from operation of internal combustion engines are well documented. However, no quantitative studies concerning the adverse effects of these pollutants on Hawaiian flora have been reported. Different species of plants vary tremendously in their sensitivity to these chemical pollutants. When gradually exposed to increasing pollution, some species of short-lived plants have been able to adapt successfully, but the flora of Moanalua has had no exposure to significant levels of automobile-generated air pollution. The effects on the indigenous flora even in the south branch of the valley and on the plantings proposed in the Moanalua Gardens park are thus matters of concern. The effects in the banana farms on the windward side of the Koolau range are not known, but it is pertinent that damage has not been evident in such farms located along the Likelike highway.

Effects on archaeological sites

The overall appraisal in the impact statement that the effects of the proposed highway on archaeological sites in Moanalua Valley will not be great (pp. 8-9, 17) may be correct, and the Highways Division is to be commended for its concern with these effects and its partial support of the comprehensive study of the sites (Ayres, W. S., 1970, Bishop Mus. Rept. 70-8, 71 pp.). It is however difficult to reconcile details in the statement with the Ayres report.

According to the report, 20 sites are included within the highway right of way. From Ayres data these may be categorized as follows:

Agricultural terraces	4 (incl. 1 questionable)
House platforms	5 (incl. 1 questionable)
House foundation stone lines	2
Stone mounds	3
Shrine	1
Historic stone wall	1
Historic firepit	1
Undesignated	3 (shown by symbols pertinent to minor historic sites)

According to the impact statement (p. 17) all but 4 of the sites will remain unaffected by the highway and these 4 will be relocated. The 4 sites are not identified.

Of the sites identified by Ayres within the right of way, the only one of significance possibly justifying extensive efforts at preservation is the shrine (site A7-41), near the edge of the right of way, consisting of a mound of small to medium sized stones with one upright stone and a stone slab that was possibly upright originally. It is questionable that a structure like this can effectively be relocated. Ayres points out that two petroglyph stones should be relocated if they are threatened by construction, but both of these stones lie outside of the right of way as plotted in Ayres map.

According to the impact statement (p. 18), "it appears that most of the archaeological sites in South Halawa Valley will be avoided by the highway alignment." Ayres report, however, states that 22 sites lie within the proposed right-of-way. It is encouraging that "The State is engaging the Bishop Museum for further exploration in the valley during the summer of 1971, and the same precautions adopted for the Moanalua Valley route will be adopted for the South Halawa portion of the highway." It appears, however, that the archaeological part of the impact of the highway in Halawa cannot yet be evaluated.

Noise effects

The statement indicates (p. 13) that the "Department of Transportation anticipates a substantial reduction in noise from motor vehicles. A special acoustics consultant is being engaged, and it is expected that the State's program of noise minimization will be effective."

Experiments have shown that sound can be attenuated if the path of propagation passes through extended areas of dense planting. The required thickness of planting varies with the density of plant material and the frequency of the sound. A given thickness is more effective at the high end of the audio frequency spectrum than at the low end. Generally speaking, a thickness of dense planting of the order of several hundred feet is required to have an appreciable effect.

The planting is effective only when the sound passes through it, since the attenuation results primarily from a combination of reflection, refraction, and absorption of the sound energy by the plant material. Where a highway is elevated, or surrounding land areas are elevated, the sound energy often can follow a direct path from the source to an observer. In valleys particularly, sound often is reflected from rock faces.

With respect to Moanalua Valley, it is doubtful that planting alone will allow retention of the valley's present noise-free quality. Large diesel trucks create significant amounts of acoustic energy at very low frequencies where planting has the least effect. The high large walls of the valley, on the other hand, are likely to be efficient reflectors of this same energy. It is probable that truck exhaust noise will be audible throughout most of the valley region, and it is likely to be distinctly intrusive within approximately 1000 feet of the highway.

Although planting will affect the distance at which truck noise will be intrusive, it should be assumed that planting will only modify the area affected, and will not eliminate the problem. It is appropriate to note that almost the entire bottom area of Moanalua Valley lies within approximately 500 feet of the proposed H-3 route and that the slopes, which are to be included in the proposed park, cannot be shielded effectively from noise by any plantings.

Another potential problem area is the "Windward Viaduct" section of the proposed route. The buildings of the Kaneohe State Hospital are located between 500 feet and 2500 feet of the "Windward Viaduct." Unless precautions are taken in the design of this viaduct, the patients at the hospital can be exposed to a psychological stress caused by traffic noise. Because of the nature of the patients at this hospital, the additional stress could have an important effect on their treatment.

Visual effects

The statement indicates (pp. 12-13) that the Highways Division is concerned with both views of the surroundings from the highway and views of the highway from its surroundings. Without question, the highway, even designed to defense highway specifications rather than to truly scenic highway specifications, will afford a scenic ride to the motorist in both Moanalua and windward portions. Doubtless, too, detriments to the scenic characteristics can be minimized by skillful architectural treatment and landscaping as suggested by the statement. However, the scale relation between the highway and Moanalua discussed earlier, and probably the similar relationship between the windward viaduct and the pali along which it is built, are such that it is extremely doubtful that the obtrusiveness of the highway in its surroundings can be obscured to viewers either on or at a distance from the highway. To visitors in the proposed park in Moanalua Valley, especially, even with the maximum care with design and planting, the field of view will be that of a major highway in a pleasing setting and not that of a beautiful valley incidentally containing a roadway.

In particular, it is difficult to imagine how, in either the narrow valley or on the windward pali, the opposing roadways can be obscured from each other as suggested on p. 12. The proposal to conceal the tunnel portal structures by constructing them underground (p. 13) suggests abandonment of engineering design in favor of magic.

Recreational effects

The adequacy of the impact statement with regard to its effects on flora, hydrology, archaeology and esthetics within Moanalua Valley has been challenged in previous sections. In those sections, however, it is admitted that the real significance of the destruction of flora, fauna, and archaeological sites may be slight. With extraordinary care perhaps the hydrologic effects, at least the long term ones could be reduced to a tolerable level. Further, though the beauty of the valley is unquestionable, any excess of its visual attractions over those of other valleys to the north and south is questionable. It is perfectly fair to ask, then, whether the environmental consequences of the construction of the highway within this valley would really be any more detrimental than those associated with alternative construction elsewhere to solve the same need for transportation. With respect to recreational opportunities this question may substantially be answered by reference to the plans for park development in Moanalua Valley and the lack of plans for park development or even land ownership and control in comparable valleys appropriate to or likely to result in the development of parks. In addition, there is a unique aspect of Moanalua Valley that needs to be considered in conjunction with the usual environmental aspects, the aspect of history and tradition.

It is, of course, a fortunate accident that the ancient traditions of the valley, only recently brought to light but now well publicized (Summarized by Barrere in Appendix A, Bishop Mus. Rept. 70-8, 1970, pp. 51-65), have been preserved in such detail. However, the proper name of the valley and the name of its major southern branch, Kamananui and Kamanaiki, should have indicated its special nature (mana means divine power). It is this pre-Cook traditional background, together with the historical importance of the valley during the period extending through the periods of the Kingdom, and the Republic and into the early period of the Territory, that give special significance to the historic zoning proposed for the park in the valley, which is intended to be not merely recreational but educational. The traditional and historical significance of the valley, and the historical zoning concepts embodied in the park plan are nowhere discussed in the environmental impact statement.

The statement declares (p. 15) that the park development and the proposed highway will be compatible and, indeed, that the highway will be advantageous in providing access to the park. Because the highway will occupy so large a part of the valley (most of the valley bottom),

because of the traffic noise it will produce, and because of its overwhelming visual impact, it cannot appropriately be considered compatible with the park.

The impact statement declares also that the windward portion of the highway is compatible with planned public recreational park extending mauka from the flood control project on one of the branches of Kamooalii Stream (not Kaneohe Creek) (p. 15). There is reason to suppose that this compatibility will similarly be reduced by the visual effects of the highway and its noise, though not so seriously as the case of the Moanalua Park.

Incidentally the statement that Moanalua "valley was and is closed to the public and, except for the vehicular trail, is virtually impenetrable" (p. 7) is incorrect. The main trail is shown on the State's publication "Trails, Hunting, and Park Areas," and permission to enter the valley has been obtainable from the owners. There are many side trails beside the jeep trail, and the valley is, in fact, if anything less impenetrable than most Hawaiian valleys of similar terrain.

Broader environmental effects

Throughout history, transportation modes and routes have been major determinants of societal development and hence societal impacts on the environment. Initially the controls of transportation routes were natural, for example, rivers and river valleys, mountain passes, and lines of oases in desert areas. With modern technology the strictness of the controls set by natural features has been relaxed. However, it has generally been assumed that the development of transportation would be controlled by a complex of natural features, technology, and economics, and that the societal and environmental effects would continue to be involuntary. Only recently has serious attention been given to the public control of the development of transportation modes and routes as a deliberate means to change or control the change of society and the environment.

The present prescriptions of environmental impact statements call almost exclusively for descriptions of the direct environmental effects of the actions proposed, and it is perhaps unreasonable to expect in such a statement an exhaustive comparison of the direct and immediate environmental effects of the proposed action with the direct and immediate effects of alternative actions to meet the same need, and even more unreasonable to expect examination of the indirect environmental consequences of the societal development that would be made possible or shaped by the proposed and alternative actions. Yet the long term and indirect effects must eventually be estimated and evaluated in addition to the more direct and immediate effects if environmental changes are to be controlled.

In particular, for such a highway scheme as the H-3, a really significant environmental impact statement would have to compare the direct and immediate environmental effects of the highway on the proposed route with not only the equivalent effects of the alternative routes but also the equivalent effects with alternative modes of transport such as mass transit. Beyond this it would have to describe the societal effects of highway development on the proposed route with the equivalent effects of highway development on alternative routes and of alternative transportation modes on various routes, so as to address itself to the environmental consequences of these societal effects. The statement would also have to examine the possibility that the ratio of agricultural to urban land would be lessened and the air pollution problem worsened by the choice of highway construction on the proposed route in place of possibly less effective highway improvement on other routes coupled with the development of an effective mass transit system. Although a really thorough study of the effects of all the alternatives is, under the present circumstances, not expectable, it is regrettable that the H-3 statement under review gives so little evidence that these effects have been considered at all.

The statement does discuss alternative highway corridors (pp. 1-5, 20-22) but not in terms of the differentials in environmental impacts that would result from their development. It does not hint at the differentials in environmental impacts resulting from the development of alternative modes of transit.

This is not to say that a really satisfactory comparison could now be made between the environmental impact of the construction of the proposed H-3 freeway and the environmental impact of not constructing it. Some of the missing environmental information whose absence has been criticized in this review is lacking not only for the proposed H-3 route but for alternative routes as well, and the lacks would affect just as seriously statements of effects of not constructing the H-3 or constructing some alternative as the effects of constructing the H-3. Comparison of the indirect effects of the several alternatives, such as air pollution over the island as a whole and land use patterns with all of their environmental consequences, would be even less satisfactory. Yet the decision to construct or not construct the H-3 on the proposed route should be made only in consideration, as well as possible, of these indirect consequences as well as the direct ones.

The gist of the historical narrative in the impact statement (pp. 1-5) and the discussion of the route location procedure (pp. 20-22) indicate that the choice of that H-3 route was predicated upon transportation planning and design concepts of 1960-65 vintage. The statement also indicates that the corridor selection was finalized two years before the completion of the Oahu Transportation Study in 1967.

The Oahu Transportation Study indicated that the major traffic from the Kailua-Kaneohe area has a destination in the Honolulu core with proportionately less travel destined to Halawa or points to the west. This means that most users of the proposed highway, including those using busses on it, would have to travel out of their way to use the route and implies that later additional capacity in the system between Halawa and downtown Honolulu would have to be developed. If benefits and costs are seriously going to be considered, the total trip relationships must be investigated, not just the trip segment to Halawa.

The OTS study confirmed the advantages of the development of a mass transit system. Considerable progress has since been made in the planning of the components of a mass transit system serving the Honolulu district leeward of the Koolau Range and the fact that this planning would occur to the extent that has already transpired could not have been known at the time H-3 was designed.

There has been little progress to date toward the development of a mass transit system crossing the Range to the windward side, and the impact statement makes much of the utility of the proposed H-3 route in mass transit. It is clear, however, that the utilization of the proposed highway for mass transit by busses was an afterthought. Although the flexibility of mass transit system thus provided would be advantageous, it is not virtually certain (as stated pp. 19-20) that the grades over all Trans-Koolau routes would require rubber tired vehicles on paved rights of way. Many techniques, attitudes, and known facts, particularly those concerned with mass transit, have changed so significantly since 1965 that a reappraisal of the initial planning study may be warranted.

Yours very truly,

Doak C. Cox
Director

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DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

DRAFT - JUNE, 1971

ENVIRONMENTAL IMPACT STATEMENT

FOR

INTERSTATE ROUTE H-3

HALAWA INTERCHANGE TO HALEKOU INTERCHANGE

OAHU, HAWAII

Pursuant to Section 102(2) (C), P.L. 91-190

Prepared By

State Highways Division, Department of Transportation

State of Hawaii

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ENVIRONMENTAL IMPACT STATEMENT

INTERSTATE ROUTE H-3, HALAWA INTERCHANGE TO HALEKOU INTERCHANGE

Oahu, Hawaii

I. HISTORICAL NARRATIVE

With the extension of the National System of Interstate and Defense Highways to Hawaii on July 12, 1960, and the approval of Route H-3 by the Federal Highway Administrator on August 20, 1960, Corridor Studies for an interstate route across Oahu through the Koolau range of mountains began. This would be the third such crossing on Oahu, the others being the Pali Highway, passing through Nuuanu on the leeward side of Oahu, and the Likelike Highway, routed through leeward Kalihi. Both of these are four-lane facilities with uncontrolled access; the new facility will be a controlled access six-lane highway constructed to Interstate standards.

Five corridors were studied, as well as several sub-corridors (see Appendix, Figure 1) and at a public hearing on January 11, 1965, the State presented the five corridors as follows:

North Halawa Corridor. From an interchange with Interstate Route H-1 in the vicinity of Makalapa Crater, it traversed northeasterly through North Halawa Valley and tunneled through the Koolau range, emerging in Haiku Valley. It next proceeded southeasterly and then easterly to an interchange at Halekou on the Kamehameha Highway.

The Moanalua Corridor originated in the vicinity of Honolulu Airport, traversed the Salt Lake complex to Moanalua Highway and then proceeded up Moanalua Valley

through the golf course subdivision to a tunnel at the head of the right branch of the valley. Emerging from the Windward Pali, it included an interchange with the Likelike Highway on the windward side, and then proceeded to the interchange at Halekou.

The Kalihi Corridor superimposed Route H-3 upon the existing Likelike Highway. In effect, it would have widened the four-lane Likelike Highway to six-lanes, terminating at the Halekou Interchange.

The Nuuanu Corridor, which started in the vicinity of the Kapalama Drainage Canal and the Lunalilo Freeway, proceeded northeast, roughly paralleling existing Pali Highway, and then penetrated the Koolau range through a long horseshoe tunnel. It then arced in a reverse curve to the interchange at Halekou.

The Manoa Valley Corridor started near the University of Hawaii, proceeding along the ewa slopes of St. Louis Heights, emerging through the Koolaus at Maunawili Valley and proceeding to the Halekou Interchange.

At the public hearing it was explained that the North Halawa Corridor was not receiving further consideration because it failed to provide the required service.

The Nuuanu Corridor and the Manoa Corridor presented multiple difficulties; displacement of families, additional congestion on connecting highways, and great disruption of existing facilities during construction.

It was indicated by the State that the Kalihi Corridor was the most attractive at that time. However, at the public hearing

there was a preponderance of statements and comments in favor of the Moanalua Corridor. For example, the Chamber of Commerce of Honolulu, in stating its opposition to the Kalihi and Nuuanu Corridors and supporting the Moanalua Corridor, stated "... The Moanalua Corridor would open a completely new scenic area which would be a tremendous asset to the State ..." and the Oahu Development Conference, in supporting the Moanalua Valley route, stated, ..."The ODC believes that the State has a rare opportunity to design and construct through Moanalua Valley a scenic freeway that could be one of the most dramatic in the Nation..."

In accordance with its practice, the State also recorded letters received by it following the hearing. The official transcript of the hearing includes a letter from the Commanding General, Headquarters, United States Army, Hawaii, favoring the Moanalua Valley route and opposing the Kalihi Valley Corridor. The Central Labor Council of Hawaii opposed the Kalihi route and supported the Moanalua Valley route above others. The Outdoor Circle, refraining from making a selection among the corridors presented, wrote asking that the State explore the feasibility of a windward Haiku Valley alternate alignment and opposing any windward alignment through the Nuuanu Pali Cliffs. The Outdoor Circle wrote further as follows: "...The Outdoor Circle stands for the preservation of natural beauty and feels strongly that great care should be given to the design of this highway and to the contours of the land. A great scenic highway through a practically virgin area can be created...."

The Board of Water Supply also wrote opposing the Nuuanu Corridor and Kalihi Corridor and favoring the Moanalua Corridor.

It requested that the Koolau Tunnel be constructed at an elevation of not less then 700 feet to preclude interference with the Oahu Water Supply.

One petition was received by the State. It contained some 242 names and supported the Moanalua Valley route.

Other statements made during the public hearing and received after the hearing opposed a tunnel through Nuuanu Pali and urged consideration of a route through Haiku Valley on the windward side.

In noting the preponderance of opinion in favor of the Moanalua Corridor, the State recognized as well that a housing area was under development at the south portion of the corridor. Therefore, at a subsequent public hearing on May 10, 1965, it presented the Halawa Corridor. This corridor originated at an interchange with Interstate Route H-1 in Halawa near Aiea. Entering South Halawa Valley, it proceeded up the valley parallel to Moanalua Valley until just north of the Red Hill Naval Reservation and past the housing development in Moanalua Valley. Then it crossed Red Hill through a tunnel, entering Moanalua Valley, and thereupon following the alignment of the Moanalua Corridor.

This corridor received substantial support at the May 10 public hearing, but it did not answer the requests of those who suggested that the windward routing be through Haiku Valley. The feasibility of this routing was worked out with the United States Navy during the subsequent planning phase of the project. It was presented as an addendum to the 1967 Planning Report and it was

adopted by the State. At that time the State believed it had satisfied the majority of parties interested in the routing.

On October 22, 1969 and again on November 5, 1969, the Department of Transportation of the State of Hawaii published Notice to the Public of the opportunity for a public hearing on the design of Interstate Route H-3 from the Halawa Interchange to the leeward portals of the Trans-Koolau Tunnels. No requests for public hearings were received, and on January 23, 1970 the State Department of Transportation requested the Federal Highway Administration's approval of the design. Approval under Paragraph 10d(2) of Policy and Procedures Memorandum 20-8 was forwarded by the Federal Highway Administration on February 16, 1970.

On May 7, 1970, a Design Public Hearing was conducted covering Interstate Route H-3 from the leeward portals of the Trans-Koolau Tunnels to the Halekou Interchange. The Design Public Hearing Transcript and Certificate were submitted on July 8, 1970. On August 12, 1970 the Federal Highway Administration approved the design.

II. PROJECT DESCRIPTION:

Interstate Route H-3 between the Halawa Interchange on the leeward side of Oahu and the Halekou Interchange on the windward side is a six-lane facility with limited access, to be constructed to Interstate standards.

Upon leaving the Halawa Interchange by way of a crossing of Moanalua Road the route proceeds 1.4 miles up South Halawa Valley, past the State Department of Agricultural Animal Quarantine Station, the Halawa Jail and the Red Hill Naval Reservation. It passes through Red Hill in a tunnel 0.4 miles long, entering Moanalua

Valley northeast of the present housing development. It then proceeds three miles up the valley, utilizing the left branch of the valley to enter the Koolau mountain range. The Trans-Koolau Tunnel is .9 miles long. The highway emerges in Haiku Valley where it becomes a bifurcated viaduct 1 mile long and adjacent to the Koolau mountain range. The viaduct ends beyond Kaneohe State Hospital, and the highway proceeds in a counter-clockwise arc at the foot of the Koolau range 2.7 miles to its connection to the Halekou Interchange.

The total distance from the Halawa Interchange to the Halekou Interchange is 9.4 miles.

III. ENVIRONMENTAL IMPACT:

A. GENERAL

1. Halawa Interchange to Red Hill Tunnel

This portion of Route H-3 passes through an area in which the possibility of an environmental effect is at a minimum. Facilities in this region consist of the Red Hill Naval Reservation, the Halawa Jail of the City and County of Honolulu, the State Department of Agriculture Animal Quarantine Station, a stone quarry and a grass sod nursery. There are no residences within or near the right-of way; no schools or other public buildings are in the vicinity. Naturally vegetation is minimal and there is no significant wild life.

2. Red Hill Tunnel

Being entirely underground, the Red Hill Tunnel has no effective environmental impact except for

automobile emissions, which will be exhausted through a ventilation structure to be located at the portal at South Halawa Valley. These emissions are expected to be dissipated quickly by the prevailing winds. The area in the vicinity of this portal is unpopulated.

3. Red Hill Tunnel to Trans-Koolau Tunnel

Interstate Route H-3 from the windward portals of the Red Hill Tunnels to the leeward portals of the Trans-Koolau Tunnels lies wholly within Moanalua Valley. The area is administered in its entirety by the Trustees of the Estate of Samuel M. Damon. At the present time, the only facilities in the valley between the portals of the tunnels consist of power transmission lines on towers, owned by the Hawaiian Electric Company on an easement granted by the Trustees of the Estate. A rough vehicular trail has been established to service the transmission facilities. The valley is otherwise occupied only by the Moanalua Stream, wild vegetation, and the rubble remains of a pre-historic agricultural activity, to be discussed below. The valley was and is closed to the public and except for the vehicular trail, is virtually impenetrable.

Upon selection by the State of the Moanalua Valley Corridor, the Trustees of the Estate were notified, and the Trustees were kept informed of progress throughout the planning phase of the project.

The location of a pre-historic petroglyph had been established in the valley some time before, and the State and the Trustees agreed that should the project proceed into the design and construction phases, the petroglyph would be removed, for safe-keeping and perhaps for display, to a suitable location.

Shortly after the State received design approval of the project from the Federal Highway Administration on February 16, 1970, the Trustees notified the State that they had recently discovered the possibility of other items of archaeological interest in Moanalua Valley. With assistance from the Federal government, the State joined the Trustees in financing an archaeological survey of the valley by the Bishop Museum. The report of the Museum was published in September, 1970, and it indicated that in Moanalua Valley there existed remnants of some 57 activity sites. Of these, 50 appear to be pre-historic; 21 have been identified as possible agricultural terraces; 12 may be the remains of house platforms; two are petroglyphs; one is possibly religious or ceremonial, six are mounds; and the remainder are indeterminate in nature. The report recommended preservation of the two petroglyphs by moving them. As for the other sites, the report found that ..."none is of a nature that is unique or is an exceptional example of a particular type of

pre-historic construction. Few sites are of archaeological significance..."

In the meantime, the Damon Estate Trustees had been investigating the vegetation of Moanalua Valley. A February, 1970 report to the Trustees by L. Earl Bishop and Derrel Herbst listed over 150 flora, native to Hawaii in pre-historic times, growing in the valley, as well as numerous other species introduced in more modern times. On March 15, 1970, Paul R. Weissich and James C. Hubbard reported to the Trustees recommending botanical conservation of the valley. On January 7, 1971, Weissich, in a report to the Moanalua Gardens Foundation, proposed the complete redevelopment of Moanalua Valley as a garden. The Moanalua Gardens Foundation, which at that time derived its support from the Trustees of the Estate, had been formed in May of 1970. All three reports were forwarded to the State on January 28, 1971, together with an indication that the Damon Estate intended to pursue the Moanalua Valley redevelopment.

In subsequent meetings between the State and the Trustees, agreement was reached on how the objectives of both parties might be achieved. It was agreed that construction of Route H-3 and the development of Moanalua Valley could be compatible, with some adjustment of plans of both parties. For their part, the Trustees agreed to the eventual surrender of the portions of the valley required

for the construction of the highway, including relocation, where required, of Moanalua Stream. In the meantime, the Trustees granted right-of-entry to the State for the construction of another portion of the highway, I-H3-1(9)6, the Pilot Tunnel for the Trans-Koolau Tunnel. In turn, the Trustees requested that plans for the highway be adjusted as follows:

a. The Trustees requested that final plans for the highway include entrance to and exit from scenic roadside parking areas to be constructed by the State. The Estate, in turn, would construct paths leading from the parking areas to redeveloped portions of the valley, including archaeological sites and natural gardens. Trails for maintenance vehicles, to be constructed by the Estate where required, would be closed to the public.

b. The Trustees requested that final highway plans include provision for visitors to the valley to return to their parked vehicles and then cross over or under the highway, whichever may be practicable, for safe return to their points of origin.

c. Finally, the Trustees requested that the State re-examine its plans to construct a reservoir at the South Branch of Moanalua Stream.

For its part, the State agreed to each of these conditions, subject to their feasibility to the State, and in addition assured the Trustees that planting of cut and fill slopes would be the State's practice in the construction of this highway.

4. Trans-Koolau Tunnel

The Trans-Koolau Tunnel is entirely underground and therefore should have no effective environmental impact except for automobile emissions. These will be exhausted through ventilation structures at each portal. Because of the high elevation of these portals and the steady tradewinds from the Koolau Range exhaust emissions should be dissipated rapidly. The areas in the vicinity of the portals are not populated.

The Trans-Koolau Tunnel is located well above the water level within the Koolau mountain range and the tunnel should have no effect on the Oahu Water Supply.

5. Windward Viaduct

This portion of Interstate Route H-3 is being planned to be as unobtrusive as possible upon the natural vegetation and scenery of Haiku Valley and the Pali Cliffs. In addition, the structure will be designed to be aesthetically pleasing when viewed from the valley below. It is expected that the construction method adopted will involve a minimum

of land clearing and excavation. Heavy planting will be part of the final design and construction.

6. Kaneohe Interchange to Halekou Interchange

Also referred to as the Windward Highway, this portion of Route H-3 has been located in cooperation with the U. S. Army Corps of Engineers, which has plans for a flood control reservoir in the Kaneohe area. The highway has been located well above the flood plain of the proposed reservoir. A recreation park has been proposed in the area surrounding the flood control project; this park will extend from the flood control area across Route H-3 up to the forest boundary.

Where recreation areas will lie on both sides of Route H-3, it is the intention of the Department of Transportation to provide pedestrian access through widening of stream crossings, thus providing interesting and picturesque pathways alongside streams.

B. VISUAL IMPACT AND AESTHETICS

Interstate Route H-3 is being designed as a scenic highway throughout its length. All cut and fill slopes are to be planted both to stabilize these slopes and to provide a pleasing view to the public. Wherever possible, median strips will be heavily planted so that there will be visual bifurcation. It is the intention of the Department of Transportation that in all cases where it is possible the roadway in one direction will be obscured from the roadway in the opposing direction.

The windward viaduct will consist of long curved spans. While the design of the structure has not yet been completed, it is expected to be so proportioned and so colored that it will offer a pleasant view to observers in the valley below and to motorists on the structure.

Portal structures for the tunnels will be underground to the greatest extent possible. Native materials will be used to the fullest in forming the portions of the structure visible to the public. The architectural style will be adopted such that the portal structures will blend with their surroundings and will be aesthetically pleasing.

In addition to the architects to be used by the various section engineers on this project the State has engaged an overall consulting architect who will review architectural plans for all sections of Route H-3. He will be charged with overseeing continuity of architectural style from section to section, and with assuring public acceptability of the project architecture.

C. NOISE

Through the use of heavy planting throughout the project the Department of Transportation ancitipates a substantial reduction in noise from motor vehicles. A special acoustics consultant is being engaged, and it is expected that the State's program of noise minimization will be effective.

D. AIR

The State's handling of automobile emissions within the tunnel structures has been described above. Elsewhere

it is anticipated that tradewinds will dissipate emissions quickly and effectively.

E. DISPLACEMENT OF FAMILIES

No families reside within the right-of-way required for the construction of Interstate Route H-3 from the Halawa Interchange to the Halekou Interchange.

F. BUSINESS AND EMPLOYMENT

The construction of Interstate Route H-3 displaces no businesses and therefore has no detrimental effect on employment.

G. AGRICULTURE

Interstate Route H-3 will use some lands on the windward alignment presently utilized for the cultivation of bananas. Acquisition of these lands will be kept to a minimum. The State will assist the owners of these properties in the relocation of their facilities and will assist them in acquisition of other lands for banana farming if they so desire.

H. SCHOOLS AND RELIGIOUS INSTITUTIONS

No schools or religious institutions are within the highway alignment nor are there any within the vicinity of the highway except for Hawaii Loa College. The windward portion of the highway was located during the planning phase to avoid conflicts with Hawaii Loa College which was also then being planned. Hawaii Loa College has since opened its doors to students, and the construction of Interstate Route H-3 will provide almost direct access to the college from the leeward side of the island.

I. PUBLIC RECREATION FACILITIES

No public recreation facilities exist within or adjacent to the highway alignment at this time. Two such facilities have been announced for development in the future. These have been referred to under the general descriptions above: the development of Moanalua Valley by the Damon Estate, which will be privately owned but open to the public, and the recreational park to be created by the Department of Parks and Recreation of the City and County of Honolulu, surrounding the Kaneohe Creek Flood Control Project. With respect to the Moanalua Valley development, the State is working closely with the planners for the Damon Estate so that the two facilities will compliment each other and be in harmony. In addition, the Damon Estate and the State have agreed to the providing of on and off ramps in the valley so that there will be access from Interstate Route H-3 to parking areas on each side of the highway. From these, the public will be able to take paths and hiking trails to visit the exhibits to be prepared by the Damon Estate. It is also the intention of both parties to make use of the culvert system to be constructed in connection with Interstate Route H-3 to provide pedestrian access to each side of the highway.

This same method of pedestrian access is planned for the recreation park adjacent to the Flood Control Project on the windward side. This will enable the Department of Parks and Recreation eventually to construct additional camping and hiking areas on the Pali side of the highway.

J. VEGETATION AND WILD LIFE

The highway will displace some vegetation in each of its sections. In the section of South Halawa Valley adjacent to the Red Hill Tunnel, the valley floor and slopes are occupied by trees and other vegetation. Some of these will be permanently displaced by the highway. In Moanalua Valley, the portion of the valley to be occupied by the highway is one of repeated disturbance in the past by bulldozing and other clearing operations. Therefore, it does not contain the more valuable botanical specimens, to be found elsewhere in the valley, which are scheduled for preservation. The proposed development plan of the Damon Estate includes eradication of secondary growth, reintroduction of native species and introduction of species from other islands. The highway will generally occupy the area in which secondary growth is proposed to be removed; therefore, although the Damon Estate's program may require some modification in some areas due to the construction of the highway, in the main part the highway will offer no impediment to the Trustees' program, and the proposed archeological and botanical redevelopment of the valley will be achieved.

At the windward viaduct, vegetation will be removed at the location of the viaduct footings. It is the State's intention that elsewhere in the vicinity of the viaduct removal of vegetation will be at a minimum, and where vegetation is removed it will be replaced. In addition,

the State's construction program anticipates additional plantings in the vicinity of the viaduct for aesthetic and acoustic purposes.

The Windward Highway will likewise require the removal of vegetation within the right-of-way. The State's policy will be to restore vegetation and to plant heavily as described earlier in this statement.

There is no designated or known wild life refuge in the vicinity which will be affected by the highway. The undeveloped lands adjacent to the proposed highway are so vast that it is anticipated that the highway will have negligible effect on the land animals and birds. Streams in the vicinity of the highway are generally intermittent, therefore supporting no appreciable acquatic life. All stream flow is to be maintained in any case.

K. HISTORICAL AND NATURAL FEATURES

1. Pre-Historic

Earlier in this statement the joint program of the State and the Damon Estate for preservation of archeological remains in Moanalua Valley has been described.

Of the 57 sites located in the valley all but 4 remain unaffected by the highway. The 4 sites which do lie within the path of the highway will be relocated for preservation.

Several archaeological sites are known to exist in South Halawa Valley. The State is engaging the

Bihop Museum for further exploration in this valley during the summer of 1971, and the same precautions adopted for the Moanalua Valley route will be adopted for the South Halawa portion of the highway. At this time it appears that most archaeological sites in South Halawa Valley will be avoided by the highway alignment. Where it is recommended to the State that relocation of archaeological sites take place, the State will take the proper measures for the preservation of these sites.

2. Historical

In connection with the Bishop Museum Report of 1970 on the archaeological remains in Moanalua Valley, a historical survey of Moanalua was written by Dorothy B. Barrère. Some 12 sites in the Moanalua Ahupua'a which figured in local history were mentioned. None of these sites lie within Moanalua Valley proper and therefore none are affected by the highway. Two additional sites which appear in local legend, a cave of a shark-man adjacent to Moanalua Stream on the ewa side of the ridge that divides the upper waters at the head of the valley and a flat stone in the stream at the confluence of the two source streams, would be affected by the highway if they existed. However, both sites, if they ever existed, have since disappeared.

3. Natural Features

The most prominent natural features upon which the highway will have an effect are the Pali Cliffs on the windward side. As the highway emerges from the Trans-Koolau Tunnels it will be at approximate elevation 700 feet. The Pali peaks in this vicinity vary from elevation 1,900 feet to elevation 2,800 feet. The highway will proceed on viaduct along the escarpment, descending at a grade of approximately 6 percent. The viaduct will be supported on piers which will have a maximum height of approximately 100 feet, so to viewers from the windward side the viaduct will appear to be slightly above the base of the Pali. Through plantings it is the intention of the State to reduce further the apparent height of the viaduct. It is the purpose of the State to make the appearance of the viaduct as unobtrusive as possible with Haiku Valley.

Within Moanalua Valley the natural features are the hills that surround the valley. The highway will not encroach upon these hills.

L. MASS TRANSPORTATION

A primary consideration in any crossing of the Koolau mountain range by any transportation facility is the necessity for being located above the water table in order to avoid disturbing the Oahu Water Supply. The grades which result from such a requirement make it

virtually certain that, in accordance with present and foreseeable technology, mass transportation facilities would consist of rubber-tired vehicles on paved rights-of-way: most likely buses or bus-trains. Route H-3 is the most adaptable of all the Koolau crossings to these mass transportation modes. Apart from being a paved roadway with the required vertical and horizontal clearances, its three lanes in each direction would permit the allocation of a lane each way to exclusive bus use while not disturbing or being affected by other highway travel.

IV. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

The State is aware that some have expressed the view that the proposed construction may in some measure detract from the natural landscape. However, the program of the Department of Transportation encompassing aesthetically pleasing design, revegetation, and additional landscaping, should substantially alleviate any potential adverse environmental effects and, in the case of South Halawa Valley, should result in considerable improvement in the immediate environment. In addition, the construction of the highway in Moanalua Valley will advance the dates for botanical redevelopment of the valley by the Damon Estate and will permit entry into the redeveloped valley by visitors without requiring passage through the South Moanalua Valley residential area.

V. ALTERNATIVES

As described earlier, during its Corridor Studies the

State examined five other corridors: the North Halawa Corridor, the Moanalua Corridor, the Kalihi Corridor, the Nuuanu Corridor, and the Manoa Corridor. Three variations of these corridors were also investigated. Adoption of the Halawa Corridor was based upon the following factors: In addition to providing a network sufficiently adequate to serve the population and defense, it provided the greatest road-user savings to motorists; it required the smallest capital outlay of all the corridors considered; it provided the best opportunity for exploiting the aesthetic advantages of the surrounding areas; it created the least social and economic impact in terms of displacement of family residences and private or industrial buildings; and it provided the best system for mass transportation considerations.

Subsequent planning studies, reported upon in 1967, were confined to the adopted Halawa Corridor. However, preliminary investigation showed that in the case of the Trans-Koolau Tunnels and their approaches, if an alternative Haiku Valley route could be utilized the tunnels could be shortened, resulting in a superior design, significant cost savings, and no sacrifice of any of the other factors which contributed to the Halawa Corridor selection. While both alternatives were developed during the planning studies, a potential conflict with U. S. Navy communications facilities was resolved and the Haiku Valley alternative route was selected.

At the same time, consideration was given to double-decking the windward viaduct. Studies revealed, however,

that the resulting structure would be less pleasing aesthetically than the separated roadways subsequently selected, would be more costly, and would present less desirable geometric features with respect to alignment with the Trans-Koolau Tunnels and Windward Highway. Bifurcated roadways were selected, therefore.

VI. RELATIONSHIP BETWEEN LOCAL SHORT-TERM ENVIRONMENTAL USES AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

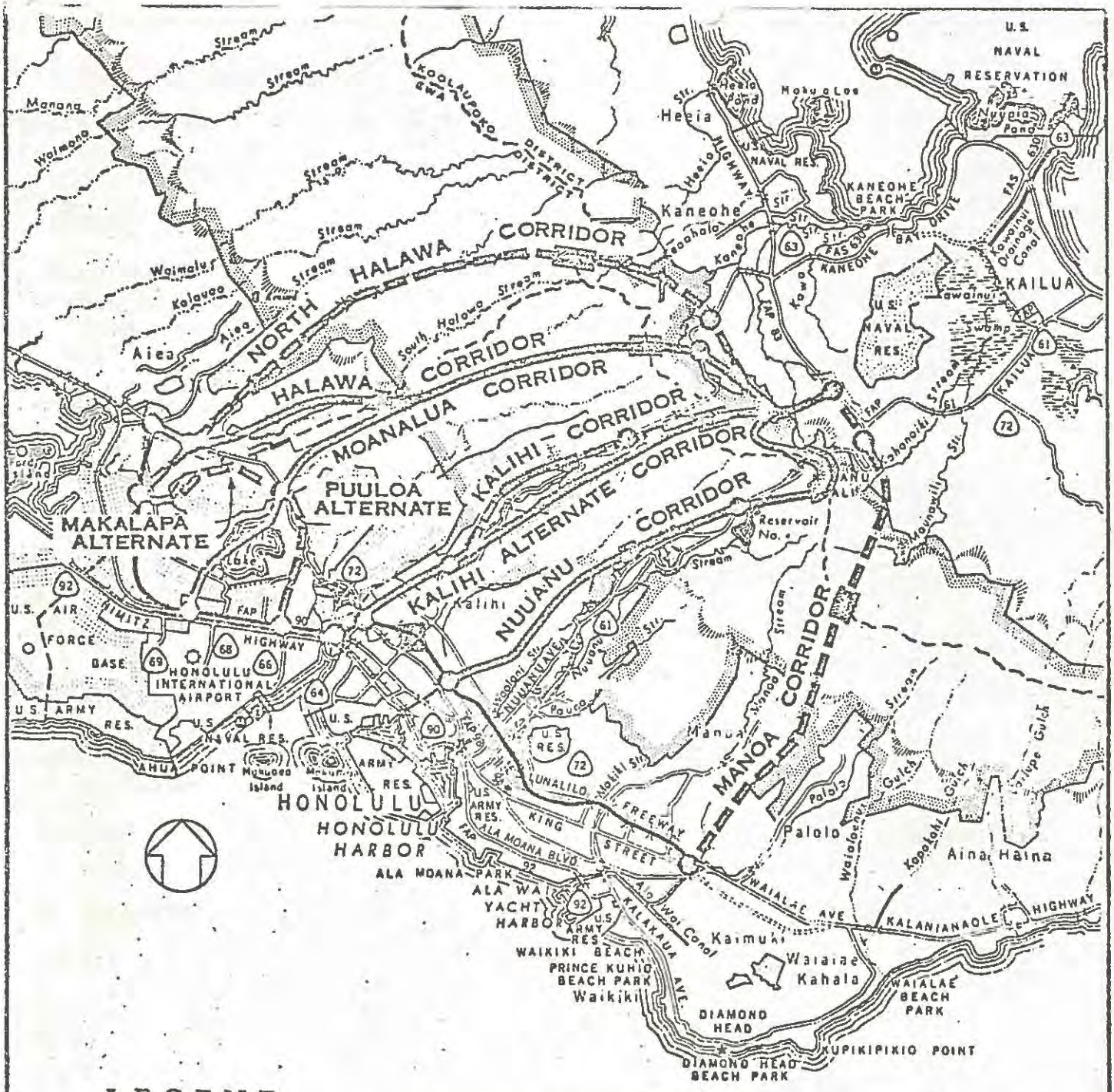
With the construction of Interstate Route H-3, a large step forward will have been taken in the linking of important employment and residential areas; the highway network between defense facilities will have been significantly enhanced; and a large measure of relief will have been provided for traffic on the existing cross-island highways, with consequent reduction in noise and air pollution. The effect on areas presently in use by the public will be minor, requiring a minimum of relocation. At the same time, the highway will be constructed taking fully into account the flood control plans of the Corps of Engineers and the plans for parks and recreational facilities of the City and County of Honolulu and of the Damon Estate.

V. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES.

This highway will require land area which will be continually devoted to highway use. However, all land not occupied by the traveled way will be available for joint recreational and other use by the public.

APPENDIX

1. CORRIDOR STUDY MAP — Copy available at Env. CR if not attached
2. ROUTE MAP
3. DISTRIBUTION LIST — Not reproduced



LEGEND

- Studied Corridors
- Other Alternate Corridors
- Interstate and Defense Highway Route H-1
- Interchanges
- Tunnel

ALTERNATE ROUTE CORRIDORS FOR INTERSTATE AND DEFENSE HIGHWAY ROUTE H-3

BETWEEN INTERSTATE AND DEFENSE HIGHWAY ROUTE H-1 AND HALEKOU INTERCHANGE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

PREPARED BY THE
HIGHWAY PLANNING BRANCH

SCALE IN MILES

JUNE 1965

Figure 2

U. S. Economic Development
Administration
415 First Avenue
North Seattle, Washington 98109

U. S. Department of Agriculture
630 Sansome Street
San Francisco, California 94111

Environmental Protection Agency
1481 South King Street
Honolulu, Hawaii 96814

Mr. John B. Dalhouse
Division Engineer
Federal Highway Administration
P. O. Box 120
Honolulu, Hawaii 96810

LIMIT OF PROJECT
H-3
RED HILL TUNNEL
TRANS-KOOLAU TUNNEL
Aiea
Aiea Heights
AIEA HOMESTEADS
Halawa Heights
Foster Village
Makalapa Crater
ALIAMANU MILITARY RES
Aliamanu Crater
SALT LAKE
EWA DISTRICT
HONOLULU DISTRICT
Red Hill
NAVAL RESERVATION
MOANALUA
Pearl Harbor
Valley
K.M. TOBILL CORPORATION

INTERSTATE ROUTE H-3

FIGURE 2.