RG

University of Hawaii at Manoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawaii 96822
Telephone: (808) 956-7361

September 30, 1992
RG:0111

Mr. Edward Lau
Division of Water and Land Development
Department of Land and Natural Resources
P. O. Box 373
Honolulu, Hawaii 96809

Dear Mr. Lau:

Comments on the Drafts
Ala Wai Canal Improvement Reports:
I. Ala Wai Canal Improvement Project Feasibility Report
II. Toward a Management Plan for the Ala Wai Canal Watershed
III. Maintenance Plan for the Ala Wai Canal

The Ala Wai Canal Technical Committee has reviewed the three draft documents dealing with the Ala Wai Canal Improvement project and offer the following comments for your consideration. In accordance with the original intent of the mission of this committee, we have confined our comments to what we consider technical issues that should be addressed in the final versions of these documents.

I. ALA WAI CANAL IMPROVEMENT PROJECT FEASIBLITY REPORT

Exchange Model and Growth Kinetics of Phytoplankton

Our reviewers were pleased with the recognition in the exchange model of the vertical gradient in the flow and in the water quality characteristics. We noted the attempt to be realistic in the growth kinetics of the phytoplankton population and the adjustment of the model to some of the actual measured parameters of the Canal. This approach has resulted in an evaluation of the dynamics of the Ala Wai Canal that is qualitatively correct. However, we do have some significant quantitative questions regarding both the model of the water exchange and the biological growth kinetics. Since the quantitative aspects of the model affect the recommendations of alternative actions as well as their costs, we believe these questions need to be addressed to assure that the results are as valid as possible.

The exchange model is verified primarily by the dye test as interpreted by the mathematical relationship cited on page 2-14. This relationship is valid for an impulse input to a single constant flow stirred tank reactor (CFSTR). The T value under those conditions is the arithmetic average residence time, and the T 50 value is the median residence time. This relationship is not valid for a plug flow reactor or for a series of CFSTR's. In those cases this relationship underestimates the residence time (more or less by a factor of 2). The actual measurements in the Ala Wai as well as its geometry argue against considering it as a single CFSTR. The lower layer could be considered a series of reactors which include both plug flow and CFSTR elements and the upper layer can be modeled as a series of plug flow reactors with inputs from the lower layers.

In any case, the model used underestimates the residence times in the various areas of the canal. This means that the transport of conservative substances is overestimated. The model itself is constructed mathematically by using horizontal and vertical diffusion (or mixing) parameters which are adjusted to higher or lower values to finally fit the observed condition (which in this case was the dye). The diffusion parameters are not measured directly but are mathematical "adjustment knobs." If the diffusion (or mixing) parameters were measured directly, they would very likely be significantly smaller than those used in the model.

According to the draft document, the mathematical treatment of the growth kinetics of phytoplankton used in the model was developed on the basis of a literature review of the kinetics of all of the pertinent biological, chemical and physical processes that effect the growth rate of phytoplankton. Unfortunately, several significant omissions and some misinterpretations appear to be in the actual model. The following are pertinent:

1. The concentration of phytoplankton is indicated by the measurement of chlorophyll -a (as specified in the State Water Quality Standards). The actual data, however, shows peaks of chlorophyll -a during and after significant run-off events and in general near the bottom. A likely explanation for this temporal and spatial pattern is that much of the chlorophyll -a found under these circumstances is derived from land vegetation washed into the canal and does not represent the concentration of phytoplankton. A way to avoid this difficulty is to evaluate the phytoplankton growth dynamics during periods of low fresh water flow. A glance at the data base shows there are three or four days where the salinity profiles indicate low fresh water flow. The geometric mean (or median) values of chlorophyll -a during these times were much lower (less than 10 micro-grams/l) than those used in the model. Also during these times the residence times are longer and

the water is less turbid - both factors should increase phytoplankton growth- consequently a better application of the model should result. When a growth model is applied under these circumstances and taking into account the actual longer residence time that results from a more correct application of the dye data, a much slower net growth rate of phytoplankton is found to be applicable to the Ala Wai than that used in the model. In other words, the (improved) model should be applied only to the low flow condition for evaluation of phytoplankton growth dynamics. Hydraulic modeling can, of course, be applied at any time and is particularly useful during flood flow conditions.

2. In general, there are two ways to model the growth dynamics of phytoplankton in real world (not chemostat) situations. The most complex is to determine the rate relationships of all of the actors (biological and chemical) in the interdependent food web that constitutes the ecosystem in question and solve the resulting matrix of interactive rate (or kinetic) equations. A second approach is to determine the critical rate controlling parameter(s) and obtain a more direct solution. Judging from the extensive literature review of various kinetic constants, it appeared that an attempt would be made in the model study to solve the more complex matrix of equations. However, this turned out not to be the case and a much simpler set of relationships was modeled. Unfortunately, some inappropriate choices were made in the selection of key parameters and relationships. The primary error was in not taking into account the real-world conditions that affect the growth rate of phytoplankton in an estuarine environment. For example, no adjustments were made to the net phytoplankton growth rate to account for the lack of light at night or for predation or for other stresses in an estuary. The effect of this is a significant overestimation of the net growth rate (by about a factor of 3 to 5). While the net growth rate of phytoplankton in the Ala Wai is quite high (in fact higher than that measured in any other estuary or embayment in Hawaii), it is by no means as high as in a nutrient rich monoculture chemostat with the lights always on. While this overestimation of the net growth rate is in the opposite direction of the underestimation of the residence time discussed earlier the size of the error is greater and the net result is an overestimation of the average (geometric mean) phytoplankton concentration during low stream flow conditions (which occur the large majority of the time).

3. Another problem, in the category of "real world" scenarios, exists in the selection of only the inorganic forms of nutrients in the growth kinetics relationships. Especially in an estuarine environment - the phytoplankton and the water column bacterial

populations form an inseparable symbiotic whole. This means that organic and other forms of nutrients are directly available to this symbiotic couple. While the kinetic constants associated with some of these bacterial groups (eg. Nitrosomonas and Nitrobacter) were included in the literature review their interactions with the phytoplankton (and the fact that they are processing nutrients day and night) were not included in the model. Given this symbiotic relationship the more appropriate forms of nutrients to be used in the critical kinetic relationships are total dissolved nitrogen and phosphorus in the mix of readily available nutrients. In fact, an argument can be made to include some of the suspended particulate forms of nitrogen and phosphorus in the mix of readily available nutrients. This fact has been recognized in the studies and modeling of the Great Lakes, of San Francisco Bay, of Chesapeake Bay, and in virtually every other recent significant sudy of estuarine or limnological eutrophication. This approach is particularly useful in the evaluation and eventual control of mass emission rates of TN and/or TP from various sources. In contrast, the use of the non-conservative inorganic forms of phosphorus or nitrogen does not lend itself to the development of a control strategy of nutrient input from the watershed or other sources. Also it should be recognized that the nitrate, orthophosphate and ammonia values measured for this study do not reflect the actual exposure of the phytoplankton to these nutrients. There is a significant amount of direct exchange of these (and other) materials with the bacterial population in the water column. Recognition of the importance of TN and TP (as well as the initial chlorophyll-a concentration) would further support the location of the intake structure for the ocean water pumping alternative further outside of the mouth of the Ala Wai Harbor and at a 40+ foot depth.

4. The result of adjusting the mathematical exchange model, to more realistically reflect the transport mechanisms in the Ala Wai Canal, as well as adjusting the kinetic analysis to take into account the actual critical rate limiting relationship, is likely to be a smaller pumping requirement and hence a smaller cost than that proposed in the draft report. It is also likley that filling in the deeper portion of the Kapahulu end of the canal will be found to be significantly beneficial to the water quality. Recognition of what the critical water quality parameters are will result in a solid basis for evaluating the water quality characteristics of alternative water sources for the various pumping alternatives.

While the changes suggested here will not alter the basic recommendations of the draft report they will result in quantitative changes and in a more realistic understanding of the dynamics of the Ala Wai Canal. The net result will be a more technically sound document.

Conclusions Relative to Improving Water Quality

The feasibility study concludes that improvement of the water quality in the Ala Wai Canal could best be achieved by the "Injection of 20 to 30 cfs (9000 - 13,500 mgd) seawater inflow into the Kapahulu end of the Ala Wai Canal." Two design options are then proposed. The first is the installation of a submerged pipeline laid the length of the canal with the entrance at the Ala Wai Boat Harbor at the approximate 40 feet water depth. The second design would require the drilling of 5 deep wells, drilled to approximately 250 feet or greater, along the boundary of the Ala Wai Golf Course and Canal.

Use of a Submerged Pipeline

The report examines the feasibility of the installation of a 12,500 foot, 42 inch diameter submerged pipeline laid and partially buried in the Canal with the ocean intake located in the entrance channel of the Ala Wai Boat Harbor. We caution that the intake would need to be at least at the 40 foot depth to assure that the water quality is not jeopardized by nutrient laden waters from the Ala Wai Boat Harbor. It is possible that the diameter of this pipe and the pumping rate could be significantly reduced if the exchange model and growth kinetics of the phytoplankton are modified pursuant to our previous discussions. Hence, the cost of this alternative needs to be reconsidered in light of the new information.

Use of Groundwater (Seawater) from 5 Deep Wells

It is with this second option that our reviewers have expressed concern, particularly over the potential for subsidence in the neighboring areas and the need for additional information. Discussions with Frank Peterson, hydrologist, and Doak Cox, hydro-geologist, have further clarified and supported these concerns. We strongly urge that estimates of the draw-down cone be derived prior to initiation of this alternative. We note that the dewatering of the basement area of the Duty Free Building site in Waikiki during construction a few years ago caused significant and costly cracking and damage to foundations. This subsidence damage was noted as far away as Iolani School, a site several hundred yards mauka of the Canal and was specifically linked to the dewatering operation. We also note that a number of wells near the Canal are shown on the latest (1983?) UIC maps for the Waikiki area. It should be possible to acquire well logs for at least some of these wells and to check with the consultants of the Duty Free project

(Dames and Moore) to obtain background information regarding pumping rates and volumes removed for the Duty Free Project as well as preliminary readings of the subsurface geology relevant to predicting subsidence. We also call your attention to a University of Hawaii Masters Thesis by Chuck Ferrall on the "Subsurface Conditions in Waikiki." This thesis may be obtained from the Hawaii Institute of Geophysics Library.

Yet another potential impact to consider when examining the feasibility of installing deep water wells is their potential effect on any brackish water wells currently being used for irrigation by the Ala Wai Golf Course or other wells in the Waikiki area. It would seem that large scale continuous pumping might jeopardize the water quality in existing wells in the area.

The recommendation to put in one production sized well to test the water quality, aquifer capacity and draw down is reasonable. We suggest that 3 or 4 additional small diameter, unlined, wells be drilled to examine the geological structure of the area. If the area is geologically very heterogenous, then a single production test well may not be sufficient to determine well capacity. In any case, the small diameter test wells will be essential.

The issue of iron in the well water has been raised. Apparently, this has been a problem in some wells in the area in the past. Examination of the existing information on the presence of iron in water wells near Waikiki and possible ways to mitigate the problem to assure the water quality of the waters pumped to the Canal should be discussed.

II. TOWARD A MANAGEMENT PLAN FOR THE ALA WAI CANAL WATERSHED

Perhaps the first suggestion that our committee would make is to change the name of this report. We urge that the title of the report be reduced to: "A Management Plan for the Ala Wai Canal Watershed." As presently titled, the report suggests that this is not a definitive study and, therefore, yet another "watershed management study" may be necessary. We believe the report adequately addresses the issues pertinent to the primary goal of the project...to improve the water quality of the Ala Wai Canal to standards acceptable for water-based recreational activities. The Management Plan identifies the sources of pollutants and actions necessary to eliminate or reduce their presence. These actions include both administrative as well as physical methods. Hence, it is our opinion that the more direct title is appropriate.

The Technical Committee discussed at some length the possible administrative options that might be used to implement the management plan and it was unanimously agreed that a private-public partnership effort would be the preferred administrative organization. For the record, it should be noted that these discussions also included input from the Executive Director of the Waikiki Improvement Association, Ms. Cristina Kemmer, who also expressed support for the private-public partnership plan. Furthermore, it was also concluded that the Final Report for the Watershed Management Plan should include particulars as to funding requirements for implementation of the Plan.

It is also suggested that the draft report could be strengthen by the addition of tables which show the comparative severity of the different pollutants in the watershed. The contaminants might be compared in terms of benefits from clean-up such as visual or health improvements. Contaminants could be listed by rank order of severity and include the name of the responsible agency. Summary tables will facilitate legislative review and thus the merits of funding any programs.

Discussion was also centered around the City and County's responsibilities with regard to enforcement of the grading ordinance. It was generally agreed that enforcement of the grading ordinance was a serious problem and the lack of sufficient inspectors was given as the primary cause. One of the early activities of this public private partnership should be to promote high intensity inspection of the Ala Wai watershed. This would permit both grading violations and litter control to be kept under surveillance. Such an activity would allow for an interagency (DOH and the City) evaluation of the effectiveness of the management plan. The evaluation could determine if tighter inspection seemed to have any impact on the problem, and if improvements in the rules would have any impact.

The draft Management Plan has identified a number of problems and agency responsibilities. The report would be strengthened by placing emphasis on the things that can be done now to reduce pollution, and by noting the specific benefits which would be attained. For example, the report could emphasize the potential enhancement to recreational users and to the visual quality of the canal after rain storms if erosion (through tighter grading controls and enforcement) and litter (through education, tighter enforcement, and more frequent clean-ups) could be reduced.

The report has identified some of the issues related to fishing and crabbing in the Ala Wai and their possible effects on human health. This information could be summarized into an action plan.

The report concludes that some sort of a management entity is required to coordinate and push along the agencies to devote higher priority to watershed management. We believe that the proposed public/private partnership is the answer.

III. MAINTENANCE PLAN FOR THE ALA WAI CANAL

Sediment Control

It is readily apparent that one of the major "maintenance items" is the control of sediments and litter entering the Canal. It must be noted that the presently shoaled condition of the Canal will require maintenance dredging regardless of any water improvement recommendations urged by this study. Periodic dredging is required to assure that the Canal will continue to meet its storm drain/hydraulic flow capacity for flood waters. Reduction in the influx of sediments to the Canal will reduce the frequency of dredging and thus reduce the costs of maintenance of the Canal. The suggested 3-year cycle of maintenance dredging for Manoa-Palolo Stream/Canal would provide a quasi-settling basin and should reduce the input of sediments to the Canal proper. Certainly this recommendation should be adopted along with appropriate monitoring so that the effectiveness of the action can be measured by reduction of sediments to the Canal.

The litter problem, both floating and submerged is yet another maintenance issue. Floating debris traps are suggested particularly under bridges. The Technical Committee was curious if any information exists on the types of floating debris presently recovered in the trap under the Ala Moana bridge? Is there any information to suggest where most of the floating material is coming from, ie. the harbor or the various streams? Some indication of the type of debris presently collected might offer guidance as to where the new debris traps might be located most effectively. Based on the observations of some of our committee, it may be possible to significantly reduce the floating debris in the Canal by installing traps at the stream outlets rather than in the Canal proper.

Submerged litter may be less likely to occur if the water in the canal is clear and littering can be readily seen. Certainly public education programs and appropriate signing along the Canal banks will be essential to reduce the incidence of shopping carts, bottles, cans, etc. entering the Canal.

REPORT FORMAT

We urge that a separately bound, Executive Summary be drafted to accompany the report. This Summary should briefly identify the clean-up problem, discuss alternative solutions and costs, and cite approximate schedules. All three topics of the study should be included in the Summary.

As presently drafted the Feasibility Report is a formidable document. It might be more readable ("user friendly") if the figures and graphs were placed at the end of each of their respective chapters. We would also suggest printing on both sides to reduce bulk.

GENERAL COMMENTS

On the subject of the preparation of the Environmental Assessment, the Technical Committee, with one dissenting opinion, must reiterate our original position and recommendation. On the basis of the nature of the project, its location, and the potential impacts that may accrue as a result of the proposed activity, it is our professional opinion and recommendation that an Environmental Impact Statement be prepared in accordance with the requirements of HRS 343 and the EIS Rules.

The technical committee is pleased with the general content of the three reports and wishes to commend Dr. Noda and his staff and sub-consultants for their efforts.

We hope you will find these comments helpful in preparing the final reports.

Sincerely,

Jacquelin N. Miller

Jacquelin N. Miller
Associate Environmental Coordinator and
Chairperson, Ala Wai Canal Committee

cc: Roger Fujioka
Ala Wai Canal Committee