CORAL REEF
AND
SEDIMENT MONITORING

Copy to Dave, Mike Lee, Robyn Stuber

Engineers
Planners
Economists
Scientists

9 September 1993
BY FAX

PDX30702.MA

Patricia N.N. Young
American Samoa Program Manager
Office of Pacific Islands and Native American Programs
U.S. Environmental Protection Agency
75 Hawthorne Street (E-4)
San Francisco, California 94105

Dear Pat:

Subject: Joint Cannery Outfall NPDES Studies: Status and Action Items

This letter is an informal status report of the various studies being done by CH2M HILL for StarKist Samoa and VCS Samoa Packing. The purposes of the letter are to: [1] list the studies completed and reports forwarded to USEPA and ASEPA, and [2] list the action items needed from USEPA/ASEPA to finalize plans for the second set of field studies.

Completed Studies (February 1993 Field Data)

We have completed the analysis and reporting for the first field sampling period conducted in February 1993. I believe all of the required reports and documentation have been submitted to USEPA and ASEPA. If any additional material is required, or if you have any questions on the reports, please contact me at your convenience. The only remaining item to be delivered is the video record of the coral reef survey. The tapes are being collated and reproduced and copies will be forwarded by the end of September. The reports submitted to date include the following:

- "Sediment Monitoring Study: February 1993 Data Collection". Technical memorandum prepared for StarKist Samoa and VCS Samoa Packing. CH2M HILL, 29 April 1993.

- "Chemical Analysis of Effluent: February 1993 Sampling". Technical memorandum prepared for StarKist Samoa. CH2M HILL, 29 April 1993.

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- "Chemical Analysis of Effluent: February 1993 Sampling". Technical memorandum prepared for VCS Samoa Packing. CH2M HILL, 30 April 1993.

- "Bioassay Testing of Effluent: February 1993 Sampling". Technical Memorandum prepared for StarKist Samoa and VCS Samoa Packing. CH2M HILL, 10 May 1993.

- "Wastewater Treatment System Evaluation for StarKist Samoa, Inc.". Report prepared for StarKist Samoa. CH2M HILL, May 1993

- "Joint Cannery Outfall Dye Study Report: Non-tradewind Season". Report prepared for StarKist Samoa and VCS Samoa Packing. CH2M HILL, July 1993

- "Joint Cannery Outfall Coral Reef Survey Report: February 1993 Survey". Report prepared for StarKist Samoa and VCS Samoa Packing. CH2M HILL, August 1993

Action Items and Questions (October 1993 Field Studies)

We are preparing for the next field data collection period planned for 29 September through 9 October 1993. There are a few unresolved issues that should be addressed. The only critical issue is approval or modification of the Eutrophication Study Plan. Action taken on this plan could effect equipment shipping and staff scheduling in the field. The other items that need to be addressed are not critical to immediate project planning and equipment shipping, but some of them should be resolved prior to project staff travel to Pago Pago. A list of issues is provided below arranged by field activity:

Eutrophication Study. We need approval or comments on modifications of the study plan, in particular the field portion of the study plan, prior to shipping equipment to American Samoa (about 15 Sept 93). Comments on the available data analysis and modeling portions of the study can be addressed after the field work is completed. However, the field portion of the study is planned to be concurrent with the dye study. This will allow a more complete description of physical conditions in the harbor and effluent plume behavior during the field portion of the eutrophication study than would otherwise be possible.

In addition we will need some of the ASG field monitoring data for TN and TP prior to the experiment to determine dosage levels. We can carry out the field experiments without the data but the results may not be as useful for characterizing the response curves used in the subsequent analysis and modeling.

Effluent Chemistry. We propose to eliminate dioxin and asbestos testing from the priority pollutant testing of the effluent. All other constituents will be tested for. We request EPA approval for this modification. There is no identifiable source of dioxin or asbestos in the effluent and the previous test were negative. We note that the second effluent chemistry test is 7 months after the first test, rather than six. This was due to rescheduling the other field work. Although the sampling could have been done earlier we believe it is valuable to maintain consistency in project staff and methodology for the first two tests.

Effluent Bioassays. We propose to use a combined cannery effluent sample as done in the first bioassay test. We also propose to include an immediate dissolved oxygen demand (IDOD) test on the effluent sample as discussed in the report on the first bioassay tests. The bioassay tests will then be run with sufficient aeration to maintain DO sufficient to support the test organism. We request that EPA approve a substitute organism(s) in the event that the juvenile white shrimp specified in the NPDES permit is unavailable. We recommend *Mysidopsis bahia* and/or *Holmesimysis costata*. We will make every reasonable attempt to obtain *Penaeus vannamei* for the test.

As in the case of the chemical testing, the second effluent bioassay test is 7 months after the first test, rather than six because of rescheduling of other field work. As in the case of the chemical testing, the sampling could have been done earlier. However, it was desirable to maintain consistency in project staff and methodology for the first two tests. We note that shipping from American Samoa is difficult and, although we will make every reasonable attempt to meet holding time protocols, some flexibility may be required. We plan to return from American Samoa with the samples carried as excess baggage to minimize shipping time, maintain custody of the samples, and facilitate immediate delivery to the laboratory.

Model Prediction Verification Study. This study plan needs review and approval, but approval is not needed prior to the field work in Pago Pago Harbor in September/October 1993. We will respond to comments and concerns on this study when received. This study is intended to be concur-

rent and associated with the modeling portion of the eutrophication study, and the reviewers should be aware of both study plans.

Sediment Monitoring Study. The revised study plan has been reviewed and approved by EPA.

Dye Study Plan. The revised dye study plan for the tradewind season has been reviewed and approved by EPA.

Coral Reef Survey. No revisions are proposed to the original study plan. The next survey is scheduled for February 1995.

I have prepared a summary of issues which we need resolved in the attached table. The date column in the table indicates the time frame need for project planning. Please let me know if any of the issues or dates are unrealistic so we can make some alternative plans. I realize you are busy and appreciate any time you can provide to review these issues. I am available to discuss any of these issues with you or your staff or reviewers as required.

I have sent the same information to Sheila Wiegman at ASEPA. I will call you later this week to discuss the September/October '93 field data collection. If you have any questions please feel free to call me at your convenience.

Sincerely,

CH2M HILL

Steven L. Costa
Project Manager

cc: Norman Wei, StarKist Seafood Company
James Cox, Van Camp Seafood Company
Maurice Callaghan, StarKist Samoa, Inc.
Michael Macready, VCS Samoa Packing Company
David Wilson/CH2M HILL/SEA

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Summary of Requested Action Items

Item	Action Requested	Date
Review of Eutrophication Study Plan - Field Portion of Study	Review and Comment; Approve/Disapprove	15 Sept 93
Review of Eutrophication Study Plan - Complete Study	Review and Comment	28 Sept 93
Monitoring Data for TN and TP	Data from ASEPA	28 Sept 93
Effluent Chemistry - eliminate dioxin and asbestos from tests	Approve or Disapprove	28 Sept 93
Bioassay Tests - use of combined effluent and aeration during tests	Approve or Disapprove	28 Sept 93
Bioassay Tests - substitute organisms (only as a contingency)	Approve or Disapprove; or specify alternative	28 Sept 93
Model Verification Study Plan	Review and Comment	1 Nov 93

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

August 31, 1993

Steven L. Costa
Project Manager
CH2M Hill
P.O. Box 12681
Oakland, CA 94604-2681

Re: Approval of Draft Joint Cannery Outfall Sediment Study Plan for Second Sampling Period

Dear Steve:

We reviewed the draft study plan for the second period of the sediment monitoring studies required by the canneries' NPDES permits and find that CH2M Hill's response to comments made by our office and American Samoa agencies on the first study plan, adequately addressed our concerns and were incorporated into the first sampling episode where appropriate. The second study plan is hereby approved.

We considered the proposed modification to the monitoring schedule and the advantages to this modified schedule and agree with the changes. Thus the approved schedule for sampling episodes shall be as follows: 2/93, 10/93, 2/95, 2/96 and 2/97.

Please call Pat Young at 415/744-1594 if you have any questions.

Sincerely,

M. T. Lee
for Norman L. Lovelace, Chief
Office of Pacific Island and Native
American Programs (E-4)

cc: Jim Cox, Van Camp Seafood Company
Norman Wei, StarKist Seafood Company
Tony Tausaga, American Samoa EPA
Sheila Wiegman, American Samoa EPA

bc: Robyn Stuber, W-5-1
Dave Stuart, W-7-1
Brian Melzian, W-7-1
Mike Lee, E-4

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

September 2, 1993

Steven L. Costa
Project Manager
CH2M Hill
1111 Broadway
P.O. Box 12681
Oakland, CA 94604-2681

Re: Approval of the Joint Cannery Outfall Dye Study Plan for the Tradewind Season

Dear Steve:

We reviewed the July 1993 Dye Study Report, conducted during the non-tradewind season, as well as the proposed changes to the study plan for the upcoming tradewind season dye study. The proposed revisions, as outlined in your letter of August 16, 1993, are hereby approved. These revisions include: 1) better tracking of the plume near the mixing zone boundary through injecting dye at an initial higher concentration; 2) rescheduling the study from late August/early September to late September/early October; and, 3) other minor modifications.

Should you have any questions, please contact Pat Young at (415) 744-1594.

Sincerely,

Original Signed By

Norman L. Lovelace
Chief, Office of Pacific Island and Native American Programs

cc: Norman Wei, Star-Kist Seafood Company
James Cox, Van Camp Seafood Company
Tony Tausaga, American Samoa EPA
Sheila Wiegman, American Samoa EPA

bc: Mike Lee, E-4
Dave Stuart, W-7-1
Robyn Stuber, W-5-1

Copy to Stuber, Stuart

Engineers
Planners
Economists
Scientists

17 August 1993

PDX30702.SM

Patricia N.N. Young
American Samoa Program Manager
Office of Pacific Islands and Native American Programs
U.S. Environmental Protection Agency
75 Hawthorne Street (E-4)
San Francisco, California 94105

Dear Pat:

Subject: Joint Cannery Outfall Sediment Monitoring Study Plan: **Second Sampling Period**

Attached is a draft study plan for second sampling period of the sediment monitoring studies required by the NPDES permits for the Joint Cannery Outfall in Pago Pago Harbor, American Samoa. This study plan is for review by USEPA and ASEPA and is intended to comply with Part G of NPDES Permit Numbers AS0000019 and AS0000027. A response to comments on the first sampling period study plan is attached as an addendum to this plan.

I believe that the only unresolved issue is the schedule for sampling. We believe the best approach is as previously proposed, with the first two sampling episodes closer together. However, EPA comment number 10 indicated that the resulting extended period between the second and third sampling periods might be too long. If this is the case then the canneries will probably elect to keep the schedule as originally required, at annual intervals, rather than adding an additional sampling period. In such a case we would not collect sediments during the tradewind dye study this year and the second sampling period would be next year. Please review our response to EPA comment number 10 and advise me of your decision on the schedule.

Please provide your comments on the study plan directly to me and to Norman Wei at StarKist and Jim Cox at Van Camp. If you or other reviewers have any questions, please feel free to call me at your convenience.

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As indicated in the study plan, the second sampling period is tentatively scheduled for the end of September/early October, 1993. Therefore, timely review of the study plan would be greatly appreciated.

Thank you for your time and attention to this matter.

Thank you for your time and attention to this matter.

Sincerely,

CH2M HILL

Steven L. Costa
Project Manager

cc: Norman Wei/StarKist Seafood Company
James Cox/Van Camp Seafood Company

AGENCY REVIEW DRAFT

JOINT CANNERY OUTFALL SEDIMENT MONITORING STUDY PLAN
Second Sampling

for

StarKist Samoa, Inc.
and
VCS Samoa Packing Company

to comply with NPDES Permits
AS0000019
AS0000027

August 17, 1993

prepared by
CH2M HILL

AGENCY REVIEW DRAFT
17 August 1993

JOINT CANNERY OUTFALL SEDIMENT STUDY PLAN
Second Sampling

INTRODUCTION

This Sediment Monitoring Study Plan presents a plan for conducting the second in a series of annual field collections and laboratory analyses of the marine sediments at seven sites in the inner and outer regions of Pago Pago Harbor, American Samoa. This sediment study plan is required under the conditions of the United States Environmental Protection Agency (EPA) NPDES Permit No. AS0000019 for Star-Kist Samoa, Inc. and NPDES Permit No. AS0000027 for VCS Samoa Packing Company. This document describes the objectives, approach, and field and laboratory methods for sediment monitoring in the harbor.

Section G of the Star-Kist Samoa and Samoa Packing NPDES permits addresses the Sediment Monitoring as follows:

> *"Sediment monitoring is conducted to determine the character of the sediments in relation to long-term high nutrient discharge by the permittee in the harbor and if harbor recovery will be affected by resuspension of the nutrients.*
>
> *The permittee, cooperatively with {Samoa Packing Co.; Star-Kist Samoa, Inc.} shall undertake a yearly sediment monitoring program in Pago Pago Harbor in order to assess the concentration of nutrient and organic components, the distribution of stored nutrients, the size of the nutrient reservoir, and the rate of accumulation of nutrients. Seven sites shall be located within Pago Pago Harbor and analyzed for total nitrogen, total phosphorus, percent organics, percent solids, bulk density, oxidation-reduction potential, and sulfides. Three sites shall be located in inner Pago Pago Harbor and four sites shall be located in the outer harbor. These sites and monitoring plan shall be submitted within three months of the effective date of the permit for approval by ASEPA and EPA. Thereafter, these sites shall be approved annually by the anniversary date of the effective date of the permit. A report of the sediment monitoring program findings shall be submitted to the ASEPA and EPA 90 days after completion of sampling.*
>
> *After the first two studies have been performed and the results have been assessed, the permit may be reopened for the inclusion of a more frequent or less frequent monitoring schedule."*

This study plan is being submitted to EPA and American Samoa Environmental Protection Agency (ASEPA) to comply with the NPDES permit condition of Section G.

APPROACH

The joint cannery outfall operated by Star-Kist Samoa and Samoa Packing extends a distance of approximately 1.5 miles from the cannery locations on the north shore of the inner harbor into the outer harbor offshore of Anasosopo Point. The outfall consists of a 16-inch HPDE pipe that terminates with a multiport long diffuser section located at a depth of approximately 176 feet below MLLW. The diffuser section has 4 active ports on alternating sides of the pipe at a spacing of 10 feet. The diffuser ports are all 5-inches in diameter and discharge horizontally. The approved zone of mixing zone boundary is defined according to Figure 1 in the NPDES permits.

This study plan, for the second collection and analysis of sediments, is based on the study plan for the initial sediment monitoring in February 1993 as approved by EPA and USEPA. Some elements of this study plan, for the second sampling, have been revised from the initial study plan based on comments and concerns on the initial study plan and the results of the initial monitoring study. The response to the comments on the first study plan are attached as an addendum to this study plan.

OBJECTIVES

The objectives of the Sediment Monitoring Study are: (1) to evaluate the characteristics and nutrient load of the marine sediments in the vicinity of the canneries previous (abandoned) outfalls in the inner harbor; (2) to evaluate the characteristics and nutrient load of the marine sediments in the vicinity of the new joint cannery outfall diffuser in the outer harbor; (3) to provide data for an evaluation of changes in harbor sediments over time. Sediments are to be collected from seven sites, three sites proximate to the historic cannery outfalls in the inner harbor, three sites proximate to the new diffuser, and one site at the Utulei outfall discharge site. The relative location of the seven sediment sampling sites are shown in Figure 1.

SAMPLE SITE LOCATIONS

The location of the sampling sites was established based on the predominant current directions at the outfall areas, bathymetry of the area, limited available information on sediment physical characteristics, and the location of point source discharges of nutrients in consultation with USEPA and ASEPA. The wastewater plume behavior and transport direction will be confirmed through the field dye study measurements. During February 1993 the sampling sites were fixed using MiniRanger coordinates (*Sediment Monitoring Study: February 1993 Data Collections.* Technical Memorandum prepared for StarKist Samoa and VCS Samoa Packing, CH2M HILL, 29 April 1993). The sample sites for the second sampling will be located in the same locations sampled in the first sampling, using a MiniRanger, and are shown in Figure 1. The sites are generally described as follows:

- Inner harbor site IH-1: located within 100 feet of, and between, the two previous cannery outfalls in the inner harbor

- Inner harbor site IH-2: located within 500 feet directly south of, and between, the two previous cannery outfalls in the inner harbor

- Inner harbor site IH-3: located within 250 feet of the mouth of Pago Pago Stream, at the west end of the inner harbor

- Outer harbor site OH-1: located within 400 feet north-northeast of the new outfall diffuser in the outer harbor;

- Outer harbor site OH-2: located within 400 feet south-southwest of the new outfall diffuser

- Outer harbor site OH-3: located directly across the outer harbor from the new outfall diffuser and about 20 feet of the Utulei WWTP outfall

- Outer harbor site OH-4: located in the center of the outer harbor area mid-way between Tulutulu Point and Tafagamanu Point, and north of Whale Rock.

DATA COLLECTION AND ANALYSIS

Five separate samples will be collected at each sampling site and then composited to provide a single representative composite sample for chemical analyses. The second field collections for the sediment studies will be started in late September 1993, after plan approval by EPA and USEPA. The sediment physical characteristics at each sampling site will be described and photographed in the field.

Chemical analyses will include those listed in the NPDES permit, using analytical and QA/QC procedures provided in the Standard Methods for the Examination of Water and Wastewater (1989) and Procedures for Handling and Chemical Analysis of Sediment and Water Samples (U.S. EPA and Army COE, 1981).

Field and laboratory analytical data will be processed and presented in tabular formats in a sediment monitoring study report, and supporting data will be included in the report appendix.

MONITORING SCHEDULE

The NPDES permits specify yearly collections of sediment. CH2M HILL and the canneries have proposed to modify this schedule without decreasing the number of monitoring episodes. The modification provides for the first two sampling episodes to be made during the first year of the study 7 to 8 months apart, the third sampling episode to be during the third year, approximately 16 months after the second, and subsequent collections annually thereafter or as determined after review of initial results.

The advantages to this modification include:

- A compressed time interval when sediment characteristics are expected to change most rapidly near the previous discharge locations in the inner harbor. Changes in sediment nutrient concentration near the previous outfalls can be expected to vary in a fashion similar to a first order decay phenomena. The most rapid change will be soon after the source removal (cannery discharge). With time the rate of change will decrease. Therefore, a sampling schedule with more frequent samples at the beginning will better track the time history of changes of nutrient sediment concentrations.

- A compressed time schedule for the initial collections near the new outfall location will provide a better baseline characterization of the sediment characteristics for the same reasons described above.

- The modified schedule will allow CH2M HILL staff doing the dye studies during year one to be directly involved in the sediment monitoring study and provide an opportunity to train personnel that might do similar collections in the future. This will allow consistency, continuity and enhanced comparability of stations, methods, and results.

- The modified schedule will also result in sediment data acquisition for the initial period during both major seasons.

STUDY METHODS

The sediment monitoring study requires field data and sample collection and subsequent laboratory analysis. The methods to be used for these elements of the study are described below. The field work described in the following sections include the methods and equipment to be used for the field collection of sediments, station positioning, sample handling, and sample shipment. The Laboratory analysis methods listed are compatible with the NPDES permit requirements.

FIELD EQUIPMENT AND SAMPLING VESSEL

Field equipment requirements for the sediment sampling are listed in Table 1. A work vessel with a two-person scientific staff will be aboard to collect sediment samples by hand, since no vessel with hydraulics is available in American Samoa.

STATION LOCATIONS AND FIELD POSITIONING

Sediment samples will be collected from a work vessel using five separate grab samples at each of the seven sites. Vessel navigation will be done by using a Motorola Mini-Ranger III electronic positioning system. Use of a Mini-Ranger III will accurate reoccupation of previous sampling stations and will provide range accuracy of approximately ± 2 meters. A marker buoy will be deployed at the precalculated Mini-Ranger position of the new outfall diffuser prior to collecting sediment samples at the outer harbor outfall sites.

SEDIMENT SAMPLE COLLECTION

Sediment sampling will be conducted in accordance with the Procedures for Handling and Chemical Analysis of Sediment and Water Samples (U.S. EPA and Army COE, 1981). Sediment samples will be collected using a 0.0225 square meter Petite Ponar grab sampler. The Petite Ponar sampler is a weighted sediment grab sampler designed to penetrate and collect undisturbed samples of sediments ranging from silts to coarse gravels. This type of sampler has been used previously to collect sediment samples throughout Pago Pago Harbor. The grab sampler should be able to penetrate and provide a reliable sediment sample of a minimum depth of 4 cm.

Samples will be collected with a minimum of five separate grabs at each of the seven sites. Sufficient sediment materials will be collected at each site to provide adequate material for the sediment chemistry analyses. More than five grabs will be taken if required to collect sufficient material. If bottom the is hard or rocky, has no sediment, or bottom conditions at a site prevent sediment from being recovered, the site will be relocated based on the judgement of experienced scientists on the project staff.

Prior to disturbing the grab samples the following will be recorded in the field logbook: sediment sample penetration depth, color, texture, odor, temperature, pH, and Redox potential. The five (or more) samples from a single site will be composited in a stainless steel bowl, and samples will be taken from the composite for sediment chemistry analyses. The total of seven composite sediment samples for sediment chemistry analysis will be collected.

Samples collected at each site will be labeled with a unique designator to allow sample tracking; each sample designator will consist of a two-letter location code (IH or OH), followed by a numerical station code (1 through 7). Samples for chemical analyses will be immediately iced and/or preserved (as required) and prepared for shipment to the laboratory. The laboratory selection will be finalized prior to field sample collection

LABORATORY ANALYSES

Each composited sediment sample will be analyzed for the chemicals listed in Table 2. All sample collections, storage and analysis will be performed under the guidance of, and in accordance with: the Procedures for Handling and Chemical Analysis of Sediment and Water Samples (U.S. EPA and Army COE, 1981), Evaluation of Dredged Materials Proposed for Ocean Disposal (EPA/COE, 1991), and Quality Assurance/Quality Control (QA/QC) for 301(h) Monitoring Programs: Guidance on Field and Laboratory Methods (EPA, 1986) . Sample containers, sample handling requirements and sample preservation requirements are listed in Table 3. CH2M HILL previously recommended replacing the bulk density analysis with particle size analysis. This was agreed to by USEPA and ASEPA for the initial study and will be continued.

QUALITY ASSURANCE AND QUALITY CONTROL

The quality assurance and quality control objectives for the sediment studies are to collect representative sediments surface samples and provide laboratory chemical and physical measurements that are of known and acceptable quality. The following requirements will be followed to meet the objectives:

- Provide verifiable laboratory chemical analyses with QA to evaluate accuracy and precision targets
- Maintain and document accurate vessel positioning for sample collection
- Provide field equipment redundancy (backup equipment)
- Develop and use a field operations plan
- Examination of samples as collected and subsequent data by experienced scientists

FIELD OPERATIONS PLAN

A field operations plan for conducting the sediment sample collections was developed for the previous sampling activities. This operations plan will be reviewed and modified as needed and will be the basic element of quality assurance and control activities. The operations plan will include field data sheets, chain of custody forms, and a sample matrix collection checklist.

EQUIPMENT CALIBRATION

All equipment will be obtained prior to the beginning of the sediment studies field collections and checked to verify correct operation. Any instrument requiring calibration will be checked and calibrated upon its arrival to confirm that it is in working condition.

The Mini-Ranger will be calibrated to the manufacturer's specifications prior to conducting the dye study. The unit and transponders will be checked against known distances similar to those to be encountered during the study. A calibration range maintained by the National Ocean Service is used for this purpose.

DATA ANALYSIS AND PRESENTATION

Field data will be summarized and vessel positioning data will be processed to calculate and plot the sediment sampling locations. Laboratory chemical and physical data will be reviewed to determine whether analytical accuracy and precision targets were achieved and to assess the laboratory quality assurance. Sediment chemistry results will be presented in tabular formats.

A report of the results will be provided to EPA and USEPA following each monitoring episode (within 90 days of the field sampling). Any proposed future revisions to the study plan will be presented in the monitoring report or in a revised study plan document. Review comments from EPA and ASEPA will be incorporated into the revised study plan as appropriate. The report will provide summary information of previous sediment monitoring data.

Table 1
Field Equipment for Sediment Field Collections

Equipment Item	Purpose	Number of Units	Accuracy Standard
Work Vessel	Field Sampling Platform	1	N/A
0.02 meter^2 Petite Ponar Sediment Grab Sampler	Collect sediment samples at depth	1	Sediment grab acceptability of 4 cm depth
Motorola Mini-Ranger III System	Microwave positioning System with 3 shore-based transponders	1	$\pm$2 meters
ASTM brass sieves	Wet sieve sediments from samples	2	N/A
Orion Redox Potential and pH Instrument	Measure sediment oxidation-reduction potential and pH in the field	1	$\pm$0.5 millivolts
Sample Containers	Collections of sediments for chemical analyses	As required in plan	Pre-cleaned sample containers
Ice Chests	Sample jar holder, cool samples on ice, and sample shipment	As required in plan	Pre-cleaned containers

Table 2
Sediment Chemical Analyses

Parameter	EPA Method (a)	Other Methods (b,c,d)
Total Kjeldahl Nitrogen (TKN)	351.3	EPA/COE 1981; TKN in Sediments
Total Phosphorus (TP)	365.2	EPA/COE 1981; TP in Sediments
Total Sulfides	376.1	EPA/COE 1981; Sulfides in Sediments
Total Volatile Solids (Percent Organics)	160.4	EPA/COE 1981; TVS in Sediments
Total Organic Carbon	415.1	SM 5310B
Percent Solids	160.3	EPA/COE 1981; Solids in Sediments
Particle Size Analyses (Sieve/Hydrometer)	None	ASTM D422

(a) EPA methods are defined in 40 CFR 136.3, Guidelines Establishing Test Procedures for the Analysis of Pollutants.
(b) U.S. EPA and the Army Corps of Engineers. May 1981. Procedures for Handling and Chemical Analysis of Sediment and Water Samples.
(c) American Society for Testing Materials. 1974. Part 19:D422: Standard Method for Particle Size Analysis of Soils.
(d) Standard Methods for the Examination of Water and Wastewater, 17th edition. 1989.

Table 3
Sediment Sample Collection and Handling Requirements

Parameter	Holding Time	Minimum Sample Size	Preservation	Sample Container
Total Kjeldahl Nitrogen	7 days	10 g	Cool, 4°C	250 ml plastic jar
Total Phosphorus	7 days	10 g	Cool, 4°C	250 ml plastic jar
Sulfides	4 days	20 g	Cool, 4°C, add 2 ml ZN-acetate	250 ml plastic jar
Total Volatile Solids (Percent Organics)	7 days	100 g	Cool, 4°C	250 ml plastic jar
Total Organic Carbon	14 days	100g	Cool, 4°C	250 ml plastic jar
Percent Solids	None	50 g	Cool, 4°C	N/A
Particle Size	None	250 g	Cool, 4°C	250 ml plastic jar

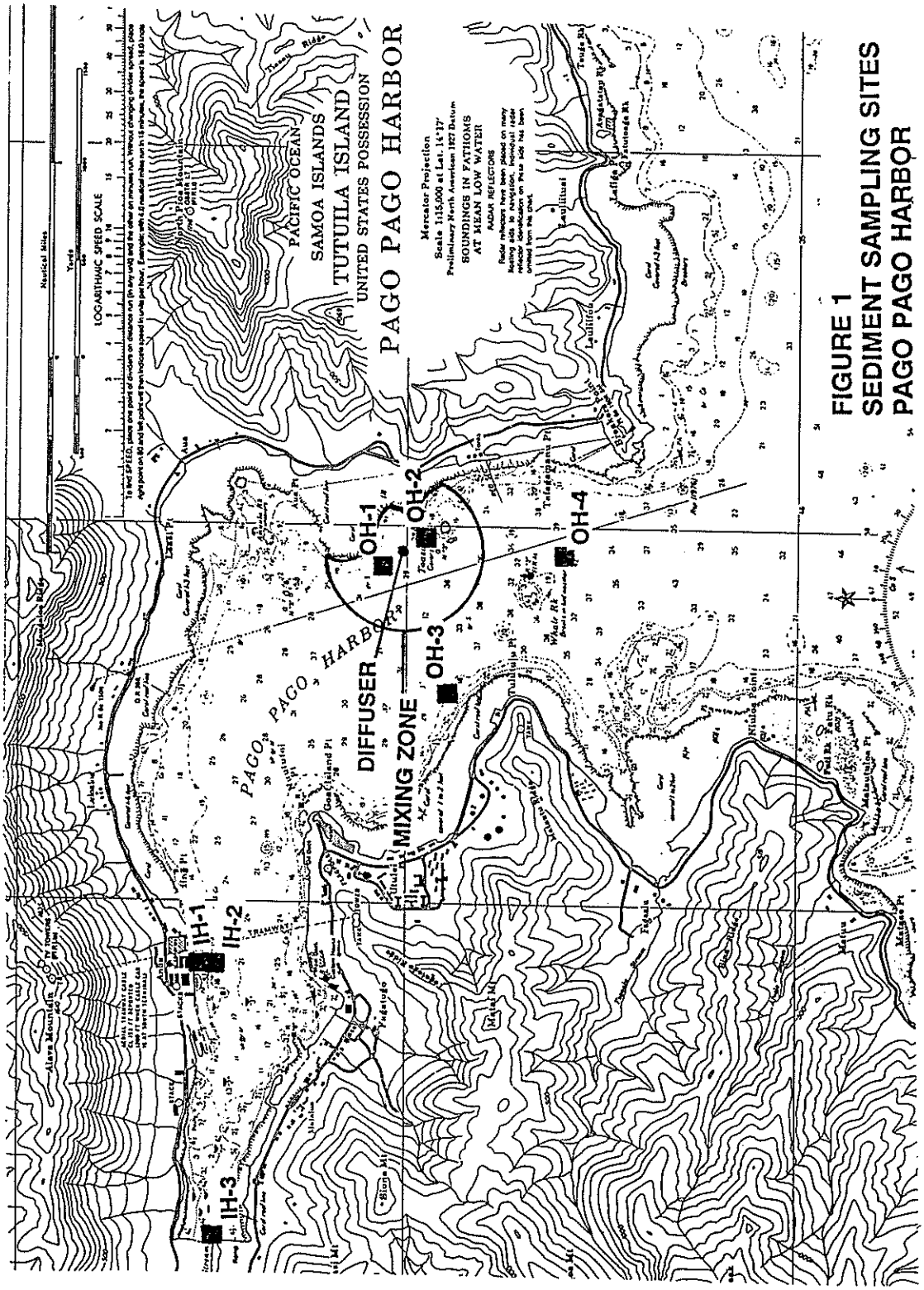

FIGURE 1
SEDIMENT SAMPLING SITES
PAGO PAGO HARBOR

ADDENDUM

RESPONSE TO COMMENTS ON PREVIOUS STUDY PLAN

This addendum provides responses to comments by USEPA, ASEPA, and ASDMWR on the *Joint Cannery Outfall Sediment Monitoring Study Plan* for the first sediment sampling period. The comments were received shortly before the actual field work and a formal response to the comments was not prepared prior to conducting the first sampling for the sediment monitoring study. However, CH2M HILL reviewed and incorporated into the first sampling episode, where appropriate, the comments and concerns. Copies of the comments are attached to this addendum.

RESPONSES TO USEPA COMMENTS (See attached letter of 22 Jan 1993)

Responses to American Samoa Department of Marine and Wildlife Resources comments and concerns are provided separately below. Responses to USEPA comments on the coral reef survey will be provided in a separate document. Responses to USEPA comments on the sediment monitoring plan for the first sediment sampling period are as follows:

Response to Comment 1. Analysis for Total Organic Carbon (TOC) was not proposed in the study plan or specifically required in the permits. TOC is a useful parameter, particularly in assessing and interpreting data on organic compounds. Analysis for specific organic compounds in the sediments is not part of the monitoring requirement. Total Volatile Solids (TVS) is considered adequate for the purposes of the study. However, we have modified the study plan to analyze for TOC for the second sampling period.

Response to Comment 2. We agree that grain size distribution should be included. Grain size distribution was not required in the permit condition and bulk density was a listed requirement. We do not think there is a need for bulk density, nor is there a feasible or appropriate way to measure it under the study conditions. Therefore, we have substituted grain size distribution for bulk density in the study.

Response to Comment 3. CH2M HILL has the documents cited and we routinely reference those documents for studies of this type. They have been added explicitly to the text of the study plan.

Response to Comment 4. Sediment traps were considered. The logistical, technical, and interpretational problems of installation, maintenance, and data evaluation for such studies can be formidable. The requirements and objectives of the study do not require the use of sediment traps, at least initially. If the ongoing sediment monitoring study results indicate no measurable impact of the joint cannery discharge then there is no need for more complex studies.

Sediments traps can, but may not, yield data that characterizes deposition of new and/or resuspended material. It is usually difficult, and sometimes impossible, to relate the trapped sediment to quantitative bottom deposition rates. It can also be difficult to determine the source of trapped material. A sediment trap program in Pago Pago Harbor would require long term deployment of traps installed throughout the harbor, and the collection and analysis of ancillary oceanographic and meteorological data at the same time. The data collected would most likely have to be evaluated on a qualitative/relative basis and would not yield quantitative results.

CH2M HILL's assessment is that sediment traps will not add substantial or significant data to the study at this time. If the sediment monitoring program indicates a problem with sediment chemistry changes in the mixing zone, then more comprehensive studies, such as sediment trap studies, may be justified.

We do not believe there is an advantage in using a van Veen sampler over a ponar sampler. Both obtain the same kinds of sample, both are well accepted samplers in the scientific community, and the small ponar is easier to ship and use by hand line from a vessel without hydraulics. If there is some specific reason to change to a van Veen sampler that we are unaware of (e.g. previous sampling programs) we will accommodate such a request. Otherwise, we prefer to continue using the ponar as we have had good success with it in Pago Pago Harbor during previous studies.

Response to Comment 5. Total sulfides will be measured using the method(s) described in Table 2 (as revised) of the study plan (EPA 376.1). Ammonia was not listed as a required constituent to be determined in the original permit requirements list of constituents. The samples in the outer harbor are well below the photic zone and direct influence on phytoplankton and macroalgae is unlikely. Measurement of total nitrogen and phosphorous appear sufficient for characterizing cannery discharge impacts, at least initially. We do not plan on adding constituents to the analysis unless a specific problem requiring such analysis is detected in the course of the ongoing studies.

Response to Comment 6. We plan to use an Orion Redox Potential probe using the method described in the description enclosed with the USEPA comment letter. The measurements will be done at the 2 cm depth if samples are recovered sufficiently intact. Otherwise measurements will be made within the sediment sample as appears appropriate to the lead scientist in the field. Profiles would require taking core samples. Core samples are not required to meet the objectives of the sediment monitoring study and are not planned. Since we are not collecting the kinds of undisturbed cores required for such measurements, profiles of Eh, pH, or other parameters in the sediment will not be done.

Response to Comment 7. See response to comment 6.

Response to Comment 8. Sea water rinsing and air drying is all that is required since we are not collecting samples for metals or organics analysis.

Response to Comment 9. We are taking grab samples. No cores are being collected. Core samples are not necessary since the concern is changes in the nutrient content of the surficial sediments.

Response to Comment 10. The intent of the change in sampling schedule is described in the study plan. As presently planned the first two sampling periods will be about 7 to 8 months apart, the third sampling period about 16 months after the second, and annually thereafter for a total of five sampling periods. The comment indicates that it is desirable to have the third sampling at the same time of year as the first. We agree for the same reason as stated in the comment: this will provide three samples at alternating seasons. However, if the third sampling period is taken 12 months after the second period, the second and third sampling periods will be during the same season. We recommend the sampling schedule proposed by CH2M HILL be used: 2/93, 10/93, 2/95, 2/96, 2/97. As stated in the permit condition the study can be reassessed for more or less frequent sampling after two sampling periods have been completed.

Response to Comment 11. We intend to take aliquots for sulfide analysis from each of five separate grabs at each station prior to compositing the samples.

Response to Comment 12. Sufficient sample material will be taken so that material will be available to immediately rerun analyses in case of problems (see Table 3). This could be as much as 1.5 liters of material. However, we do not plan on archiving samples after analyses have been successfully completed. Given the relatively straightforward nature of the limited number of tests required, and considering holding time and storage requirements, we see no reason for long term archiving.

Response to Comment 13. The reports are planned to be in a Technical Memorandum format (see the first report dated April 1993) with sections as follows: Introduction, Objectives and Approach, Methods, Results, Summary, and Appendices providing chain of custody and laboratory analysis results. These are functionally identical to the organization suggested in the comment. If after review of our initial report USEPA and ASEPA wish to modify the format we will make any necessary changes to the initial and subsequent reports.

Response to Comment 14. Table 2 was revised.

RESPONSES TO ASEPA COMMENTS (See attached facsimile transmission of 22 Jan 1993)

Responses to American Samoa Department of Marine and Wildlife Resources comments and concerns regarding the sediment monitoring plan are provided below. Responses to American Samoa Department of Marine and Wildlife Resources comments on the dye study are presented

in the revised dye study plan. Responses to ASEPA comments on the sediment monitoring plan for the first sediment sampling period are as follows:

Response to Comments. The location of IH-3 was changed for the first sampling and will remain so for subsequent sampling. The revised location is shown in Figure 1 and described in the study plan for the second sampling. Site OH-3 is near the Utulei STP outfall location and is intended to provide comparative information for that vicinity to assist in data evaluation and interpretation.

RESPONSES TO ASDMWR COMMENTS (See attached memorandum of 15 Jan 1993)

Response to Comments on Origin of Sediments (paragraph 3). The purpose of the sediment monitoring plan is to monitor the nutrient load in the sediments. A comprehensive sediment budget study, including identification of sediment sources, is not required to address this objective. If the sediment monitoring study indicates problems caused by changes in sediment nutrient load, additional studies of sediment origin, transport, and fate may be appropriate in the future. If no problems are observed, then more complex and sophisticated studies are not required.

Response to Comments on Age of Sediments (paragraph 5, item 1). There is no data available to determine the sediment accumulation rates over the past year. The objectives of the monitoring study are to monitor changes in particular aspects of sediment chemistry, and do not include addressing questions of relative age of sediment layers (see the response on origins of sediments above).

Response to Comments on Residence Time and Flushing of Sediments (paragraph 5, item 2). Sediments from all sources, natural and anthropogenic, will accumulate in the harbor over time. This is a natural process that occurs in all bays and estuaries. Sediments deposited, from any source, in deep water will generally remain there indefinitely. Some fraction of sediments will be disturbed and carried out of the harbor. For example, wave suspension in shallow water and bioturbation in deeper water can mobilize sediments.

Response to Comments on Origin of Sediments (paragraph 5, item 3). Please see the responses to the comments above.

Response to Comments on Resuspension of Nutrients (paragraph 6). The objective of the permit requirement is to monitor the impact of the inner harbor sediment nutrient content, which is relatively high, on the water quality of the inner harbor. Specifically, the relocation of the canneries discharge from the inner harbor will result in lower nutrient concentrations in the water column. However, if the nutrients now contained in the inner harbor sediments are released back into the water column the improvement, or recovery, of the inner harbor water

quality may be affected and may not react as predicted in outfall relocation feasibility and design studies. To address this issue we do not need to look at resuspension of sediments (which is unlikely), but rather "resuspension" of the nutrient load in the sediments. This objective is achieved by monitoring the nutrients in the sediments (this sediment monitoring study), monitoring the nutrients in the water column (another permit condition), and reevaluating and verifying the previous model predictions (also a permit requirement).

Response to Comments on Accumulation of Nutrients (paragraph 7). The objective is to monitor the accumulation of nutrients in the sediments, not the total sedimentation rates. Although grab samples would not be adequate for determining sedimentation rates, grab samples of sediments are adequate to provide sediment samples for chemical analysis of nutrients. Thus, the accumulation of nutrients in the sediments, particularly in the outer harbor in the vicinity of the new outfall, can be adequately monitored. If an apparent problem is identified, then some of the more sophisticated studies described in the above comments may be required to better define sources, sinks, and transport paths of sediment and nutrients in the sediments. However, the issues addressed by this permit requirement is to monitor conditions to determine if a problem with sediment nutrient content exists.

Response to Comments on Monitoring Sediment Deposition (paragraph 8). This comment refers to sediment traps. Essentially the same comment was addressed under USEPA comment number 4 above.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

January 22, 1993

Steven L. Costa
Project Manager
CH2M Hill
1111 Broadway
P.O. Box 12681
Oakland, CA 94604-2681

Re: Review of the Joint Cannery Outfall Sediment Monitoring and Coral Reef Draft Study Plans

Dear Steve:

We have reviewed the draft sediment monitoring and coral reef study plans submitted to us on January 6, 1993. Both studies are required by the canneries' NPDES permits. Generally both plans are acceptable, and address the objectives of the studies as outlined in the permits. Both studies appear to be well planned. We find that the use of the Mini-Ranger for locating sampling sites is an excellent idea.

However, we have the following comments and recommendations which we would appreciate being commented upon and/or addressed in the final plan:

Draft Sediment-Monitoring Plan

1. Total Organic Carbon measurements are preferred over Total Volatile Solids (TVS) because it is a better indicator of sediment organic compounds.

2. Total grain size distribution measurements should not be optional as they are an important assessment of solids dispersal in the harbor (i.e., percent silt, clays, sands, etc.).

3. In addition to references mentioned in the plan, other reference documents should be consulted re: collection, storage, analyses, i.e, EPA's 301(h) QA/QC document (EPA 430/9-86-004) and the EPA/COE 1991 Evaluation of Dredged Materials Proposed for Ocean Disposal (EPA-503/8-91/001). If you do not have these documents, feel free to visit our office to review our copies.

4. Have sediment traps been considered? If not, why not? Sediment traps would enable one to determine deposition of new

material over time. Also, a van Veen sediment grab sampler is preferred over a Ponar sampler.

5. Will total and/or water soluble sulfides be measured? What methods will be used? (See 301(h) QA/QC document). Should ammonia also be measured since it is the form of nitrogen that is most readily utilized by phytoplankton and macroalage?

6. How will Eh be measured? (A copy of a suggested procedure is enclosed as Attachment 1.) At what depth will it be measured? If only one measurement will be taken we suggest it be at the 2 cm depth. However, a full vertical profile through the sediments is preferred.

7. Where will temperature and pH be measured? Will they be measured at the surface, 2 cm depth, and at other depths? Please explain the rationale and objectives for measuring pH, Eh and temperature at depth(s) chosen.

8. How will the sediment grab sampler and stainless steel bowls be cleaned between sampling events to minimize cross-contamination between stations?

9. Will only the surface sediments be photographed? If yes, why? We suggest that photographs also be taken of sediment cores as changes in color could then be correlated with other data re: Eh, particle size, hydrogen sulfide, etc.

10. We have no objection to the modification of the monitoring schedule proposed, i.e., having the first two sampling episodes during the first year of the study, six months apart. However, we recommend that the third sampling event occur 12 months after the second episode, versus 18 months as proposed in the study. We feel that the 18-month interval is too long after the second sampling event. Also, a 12-month interval would enable the sampling to take place during the same time as the first event. This should provide information to assist in determining the best season for the annual sampling in the future.

11. Compositing the sediment samples may greatly affect the hydrogen sulfide measurements. Perhaps separate discrete samples should be collected for hydrogen sulfide measurements before compositing.

12. We suggest that a minimum of 2 liters of sediment per station be collected and that excess sediment samples be archived in case there are problems with any of the measurements.

13. The final report on the study results submitted to USEPA and ASEPA should include the following: Introduction, Methods and

Materials, Results, Discussion and Recommendations, and Conclusions.

14. Table 2 on Sediment Chemical Analyses indicates standard methods numbers which are outdated. See 1989 edition of Standard Methods.

Draft Coral Reef Study Plan

The draft plan for the coral reef study is generally good. We especially find noteworthy the use of a Mini-Ranger for siting, use of permanent transects and the adequate number of stations to be surveyed, and the various depths at each station. Our review comments are as follows:

1. Benthic organisms included in the semi-quantitative data sets at each transect should be macroinvertebrates and macroalgae.

2. If possible, water quality sampling should be coordinated with the reef surveys so that any potential correlations between water quality and biological data can be noted. Water quality monitoring should be performed either on the same day or within a week of the coral reef surveys.

3. On page 5, end of the third paragraph, only five representative sites are specified where video records of reef flats will be taken. Where is the sixth representative site?

4. Will the marine ecologist who will be analyzing the videos also be involved in conducting the transects? Please provide a copy of his resume/experience in tropical marine waters.

5. Please describe in detail how the video transect records will be "analyzed and summarized" (see page 2 of the draft plan).

6. We recommend that all sites be visited at least once per year to ensure that the transect marker stakes are still present and/or whether any major changes to each site have occurred.

7. Please describe in detail the video equipment and methods to be used during the videotaping of each transet. This would include information describing:

   a. The camera(s) to be used and "line of resolution" per frame;

   b. Recommended swimming speed for each transect;

   c. Standardized distance from the bottom that will be used during videotaping and the taking of still pictures; and,

d. Any other revelant information.

8. In order to quantitatively document changes within and between the silts over time, we strongly recommend that at least one permanent square-meter quadrant be established along each transect line.

9. For additional guidance in modifying the design of the coral survey plans, please refer to the attached documents entitled: Effects of Sugar Mill Waste Discharge on Reef Coral Community Structure, Hamakua Coast, Island of Hawaii (Attachment 2) and Proposal for Long-Term Monitoring and Management Research on Coral Reefs (Attachment 3).

10. It might be worthwhile to investigate whether a chemical indicator exists in the cannery effluent (e.g., aluminum from the alum added to the wastewater treatment system) which can be measured in the sediment. This would assist in determining transport, dispersion, etc. of the effluent in the harbor.

11. The final report on the study results submitted to USEPA and ASEPA should include the following: Introduction, Methods and Materials, Results, Discussion and Recommendations, and Conclusions.

Also attached are the American Samoa Department of Marine and Wildlife Resources' (DMWR) comments on the sediment monitoring plan and the dye study plan (Attachment 4). We would appreciate your response (in writing) regarding our concerns raised above, and the comments provided by DMWR regarding the draft sediment monitoring plan and the dye study plan. Please call Pat Young at 415/744-1591 if you have any questions.

Sincerely,

James B. Brown

for Norman L. Lovelace, Chief
Office of Pacific Island and Native
American Programs (E-4)

Enclosures (4)

cc: Sheila Wiegman, American Samoa EPA

OFFICE OF THE GOVERNOR
ENVIRONMENTAL PROTECTION AGENCY

January 22, 1993

To: Steve Costa, CH2M Hill

From: Sheila Wiegman, American Samoa EPA

Re: Comments on Sediment and Outfall Dye Studies for American Samoa Canneries.

We have reviewed the draft study plans for the above referenced studies and have the following comments. The AS Department of Marine and Wildlife Resources submitted the attached comments to me.

My only comment on the sediment study is concerning the location of the stations. The inner harbor should probably be sampled near Pago Park. Sites IH-3 or site IH-2 could be moved. Also, site OH-3 is near the Utulei STP outfall and would propbably reflect that discharge rather than the cannery discharge.

Please feel free to contact me if you have any questions on these comments.

January 15, 1993

FROM: John McConnaughey
Fisheries Biologist

TO: Sheila Wiegman, ASEPA
Norman Wei, StarKist Samoa Inc
Jim Cox, VCS Samoa Packing Company

SUBJECT: Comments on "Joint Cannery Outfall Sediment Monitoring Study Plan.

A copy of the Joint Cannery Outfall Sediment Monitoring Study Plan dated January 6, 1992 has been forwarded to our department for review and comments. This study is written to comply with NPDES permits AS0000019 and AS0000027, which allow for the construction and use of the cannery outfall.

In reviewing the study plan I have some questions regarding the usefulness of the studies potential results as far as evaluating the effects of the wastes discharged from the cannery outfall.

My main problem with the sediment sampling program as described is that no mention is made in the methodology as to what criteria will be used to determine the origin of sediments recovered from the harbor.

We know that large volumes of organic wastes were discharged at the cannery sites prior to the construction of the 1.5 mile long discharge pipe. We also know that this pipe is now discharging wastes at a site that is now deeper and further removed from the inner harbor. And we know that there are numerous other sources of wastes and sediments entering the harbor on all sides.

My questions are these:

1) Of the top layer of sediments, how much is new material v.s. old material?

2) What is the resident time of sediments in the harbor? Do they eventually flush out, or do sediments just continue to accumulate?

3) For sediments which have been deposited in the last year, what proportion of them are 1) from wastes discharged from the canneries, 2) from other sources, or 3) sediments which have been resuspended and now just redeposited in their present location?

Section G of the Star-Kist Samoa and Samoa Packing NPDES permit states:

> "Sediment monitoring is conducted"..."and if harbor recovery will be affected by resuspension of the nutrients."

From the study plan, I do not see how the resuspension issue will be addressed. It seems to me that in order to investigate the resuspension issue, that one needs to know what proportion of the observed sediments are new v.s. older resuspended sediments.

Section G also states:

> "The permittee"..."shall undertake a yearly sediment monitoring program in Pago Pago Harbor in order to assess"..."the rate of accumulation of nutrients".

I question whether using grab samples as outlined in the study proposal will address the issue of sediment accumulation rates.

I have only very limited experience working on marine sediment studies, but it seems to me that an alternative procedure which would monitor the sedimentation on a bare surface would provide more useful information on the nature and deposition rates of sediments being currently deposited.

cc: Ray Tulafono, Director DMWR
Peter Craig, Chief Biologist DMWR

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

January 22, 1993

Steven L. Costa
Project Manager
CH2M Hill
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Sincerely,

James B. Brown

for Norman L. Lovelace, Chief
Office of Pacific Island and Native
American Programs (E-4)

Enclosures (4)

cc: Sheila Wiegman, American Samoa EPA
Jim Cox, Van Camp Seaffod Company, Inc.
Norman Wei, Star-Kist Seaffod Company

Attachment 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL RESEARCH LABORATORY
27 TARZWELL DRIVE
NARRAGANSETT, RHODE ISLAND 02882

AUGUST 14, 1992

MEMORANDUM

SUBJECT: PROCEDURE FOR MEASURING REDOX POTENTIAL IN SEDIMENT

FROM: BRIAN D. MELZIAN
EMAP-VP
ERL-N

TO: CHARLIE STROBEL
EMAP-VP QA COORDINATOR
SAIC

ATTACHED IS A COPY OF ERL-N'S NEWPORT LABORATORY'S PROCEDURE FOR MEASURING REDOX POTENTIAL IN SEDIMENTS. DON SCHULTS IS THE AUTHOR OF THIS PROCEDURE AND SHOULD BE ACKNOWLEDGED AND CITED IF EMAP-VP DECIDES TO USE THIS METHOD IN THE FUTURE.

AS YOU CAN SEE, DON'S METHOD FOR MEASURING EH APPEARS TO BE EASY TO DO, AND IT USUALLY TAKES LESS THAN ONE MINUTE TO REACH A STABLE EH READING AT ANY ONE DEPTH IN THE SEDIMENT. IT WOULD PROBABLY COST ABOUT $1,000 TO EQUIP EACH EMAP BOAT SO THAT IT HAS THE CAPABILITY OF MAKING THESE EH MEASUREMENTS.

PLEASE CALL ME OR DON AT (503) 867-4033 IF YOU HAVE ANY QUESTIONS ABOUT THE PROCEDURE DEVELOPED AT ERL-N'S NEWPORT, OREGON LABORATORY.

ATTACHMENT (1)

CC: JOHN PAUL (EMAP)
DICK LATIMER (EMAP)
STEVE SCHIMMEL (EMAP)
NORBERT JAWORSKI
DON PHELPS
JONATHAN GARBER
DON SCHULTS
RICK SWARTZ
DAN REIFSTECK (SAIC)
RAY VALENTE (SAIC)

PROCEDURE FOR MEASURING REDOX POTENTIAL IN SEDIMENT

ONAL FORM 99 (7-90)
FAX TRANSMITTAL # of pages ▶ 2
-ian Melzian | From Don Schults
/Agency PA ERL-N | Phone # (503) 867-4033
(01) 782-3030 | Fax # (503) 867-4049
7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

NEWPORT SOP 4.AA
AUGUST 12, 1992
REVISION #: 1
DATE OF REVISION: AUGUST 12, 1992
PAGE 1 OF 2

U.S. EPA, ERL-N, PEB
TEAM: BET
AUTHOR: DON SCHULTS

INTRODUCTION

The oxidation reduction (redox) potential or Eh is the electromotive force developed by a platinum electrode immersed in water or sediment relative to a standard hydrogen (reference) electrode. In practice the reference electrode is a saturated calomel (KCl) electrode joined by a liquid junction to the test solution. The Eh is calculated by adding the potential of the calomel electrode to the measured voltage. The measurement of Eh in sediment gives a crude estimate of the oxygen (oxic or anoxic) status of the sample.

MATERIALS AND SUPPLIES

Beckman Model 21 pH meter or pH meter that has millivolt (mV) reading capability.

Orion platinum redox electrode Model 96-78-00 (combined Pt and Ag/AgCl reference electrode).

Orion filling solution (4 M KCl saturated with Ag/AgCl) #900011 for use where total ionic strength is >0.2 M (approximately 15‰ salinity).

Check Solution A: 0.1 M potassium ferrocyanide and 0.05 M potassium ferricyanide

Check Solution B: 0.01 M potassium ferrocyanide, 0.05 M potassium ferricyanide, and 0.36 M potassium fluoride

PROCEDURE

Fill the electrode with the filling solution. If the electrode chamber has been dry, unscrew the cap a few turns and push the cap and body together to leak some filling solution past the conical reference junction. Turn on the pH meter to the mV output. Place the electrode solution in Check Solution A and read the mV (should be about 234 mV). Rinse the electrode and place in Check Solution B and read mV (should be 66 mV higher than Solution A or about 300 mV). Rinse the electrode.

The Eh should be done immediately after collecting the sediment sample. Carefully insert the electrode in the test sediment so that air is not trapped in the sediment near the measurement point. Push the end of the electrode to the desired sediment depth. Move the electrode up and down a small distance (½ cm) will allow the electrode to make good contact with the sediment and helps in reaching a stable measurement. Allow the mV reading to stabilize (drift <10 mV/min). It may take 5-20 minutes to reach a stable Eh reading but usually it's less than 1 minute. After a stable reading is obtained, record the value and remove the electrode from the sediment. Wash the electrode with clean seawater and wipe clean. Insert the electrode into the next test sediment and measure the Eh. The technique for measuring sediment Eh is an art and can be operator dependent. Eh values, therefore, are a general measure of redox conditions in the sediment.

The mV readings from the meter is corrected to the standard hydrogen electrode by adding the

potential developed by the calomel electrode relative to the hydrogen electrode. The correction value that need to be added to the meter readings, when using filling solution #900011, are 214 mV (at 10°C), 204 mV (at 20°C), 199 mV (at 25°C) and 194 mV (at 30°C).

Check the electrode instruction manual for electrode cleaning, maintenance and problems. Also the manual describes the procedure for making the Check Solutions and the use of another filling solution if the Eh is to be measured in salinity <15 ‰ (<0.2 M total ionic strength).

INTERPRETATION OF Eh MEASUREMENTS

We have used an Eh value of about +160 mV as the separation between oxic and anoxic conditions (based on the Fe^{+++} - Fe^{++} couple). The relationship between soluble iron and Eh, however, is pH dependent (Gotoh and Patrick, 1974). Patrick and Mahapatra suggest the following redox states at pH 7: oxidized (> +400 mV), moderately reducing (+400 to +100 mV), reducing (+100 to -100 mV), highly reducing (-100 to -300 mV). At pH 7 nitrate-nitrogen is reduced below an Eh of +225 mV, manganic manganese is reduced at about +200 mV, ferric iron at about +120 mV and sulfate is reduced to sulfide at about -150 mV. Plumb (1981) states that a positive Eh indicates the sediment is in an oxidized state or oxygen present and a negative Eh indicates absence of oxygen or reducing conditions.

COST

Beckman pH meter (or any meter that has mV capability)	$400 to $600
Combination Redox electrode	$260
Filling solution	$45
Check solution chemicals	$85

REFERENCES TO Eh INFORMATION

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Attachment 21

EFFECTS OF SUGAR MILL WASTE DISCHARGE ON REEF CORAL COMMUNITY STRUCTURE, HAMAKUA COAST, ISLAND OF HAWAII

Steven Dollar, PhD.
Marine Research Consultants
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Prepared for:

Tetra Tech, Inc.
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Lafayette, CA 94549

Revised

May 1, 1989

INTRODUCTION

The study reported below is part of a comprehensive program designed to define environmental effects caused by ocean discharge of sugar mill waste-water on the northeast (Hamakua) coast of the Island of Hawaii. The specific focus of interest of this portion of the program is to investigate the effects to "stony" corals (Scleractinia) that inhabit the nearshore areas in the vicinity of the mill discharges.

Because physical and chemical characteristics of receiving waters often vary greatly on both temporal and spatial scales owing to changing weather and sea conditions, it is difficult to accurately evaluate degrees of environmental alteration by measuring water column parameters. On the other hand, the cause-and-effect relationships between point-source discharge into the open ocean and environmental impact may be accurately defined by determining the effects to benthic (bottom-dwelling) communities. Components of the benthos are often long-lived, immobile, and intimately affected by exogenous input of potential pollutants (e.g. suspended solids), as well as changes in environmental parameters (e.g. temperature and light). Thus, these organisms must either tolerate the surrounding conditions within the limits of adaptability or die. Benthic assemblages can be viewed as integrators of stress, as they are subjected to the entire spectrum of impacts over long time periods. Patterns of change to the benthos appear to provide a more meaningful interpretation of environmental impact than intermittent measures of water column parameters, at particular points in time.

As members of the benthos, stony corals are of particular importance in nearshore Hawaiian environments. In areas such as the Hamakua coast, coral assemblages can be viewed as "coral communities" rather than true "coral reefs". The distinction is that coral communities are composed of colonies growing on inorganic substrata of basaltic rock, while reefs are comprised of accumulations of calcium carbonate of biotic origin, with an upper layer of living organisms. With both types of assemblages, however, corals contribute a major proportion of the nearshore biomass and their skeletal structures are vital in providing a complex of habitat space, shelter and food for other species. Because corals serve in such a "keystone" function, and because alterations in coral community structure are relatively easy to identify, this assemblage can be considered the most relevant group for evaluating past and potential impacts associated with discharge from land.

The influences of environmental factors on Hawaiian coral community structure and growth has been studied extensively, and many of the cause-and effect relationships between stress and impact are clearly known (Dollar 1975, 1979, 1982, Dollar and Grigg 1981, Grigg 1982, Grigg and Dollar 1980, 1989, Grigg and Maragos 1974, Maragos 1975). With respect to discharges from sugar mills, the major parameter that stresses coral communities

is suspended solids. When sediment deposition is sufficient to bury corals, mortality is complete. At sedimentation levels below "burial level" most reef organisms are capable of removing sediment that settles on living surfaces up to a threshold level of deposition where cleaning mechanisms are overwhelmed. At levels of deposition beyond the threshold, coral colonies may either die or suffer sub-lethal physiological changes. A commonly observed sub-lethal effect is termed "bleaching", where the colony remains alive but loses a fraction of photosynthetic pigment and takes on a white appearance. Planular settling may also be adversely affected in areas of high sediment deposition, as larvae prefer solid surfaces for settlement. Abrasion from sediment suspended by wave and current stirring can also be destructive to adult colonies or settling potential. Decreased light caused by turbidity from suspended solids may also cause decreased growth and survival potential for reef corals.

The intent of this study was to obtain a qualitative and quantitative "snapshot in time" understanding of coral community structure in order to address three questions: 1) what is the present magnitude of impact to coral community structure caused by discharge of the Pepeeekeo and Haina Mills; 2) how does the area of influence relate to the present zones of mixing defined by the Department of Health at each mill site; and 3) what is the difference between the magnitude of influence to coral community structure caused by mill discharge compared to natural stream discharge? By collecting data to answer these questions, it is possible to compare the extent of environmental impacts caused by sugar mill waste with other forms of point source discharge.

Several other past studies have evaluated the extent of environmental impact from Sugar Mill discharge (Kennedy Engineers 1967, Grigg 1972, 1983). It is not the intent of the present work to attempt to verify or invalidated any of the previous surveys. Rather, as stated above, our purpose was to collect a data set capable of rendering unequivocal conclusions as to the present day influences from mill discharge on coral communities.

METHODS

All field work was conducted on February 8, 9, 13, and 14, 1989, from a 26 ft. boat. Benthic survey stations were located directly inshore from buoys set by personnel aboard the Coast Guard patrol boat Cape Cross at pre-determined distances from each mill discharge or stream mouth. Stations were located directly off the mill discharges; at 0.5 mile increments north and south of the Pepeekeo Mill outfall, and at 1 mile increments off the Haina Mill outfall. At each mill sites several additional stations were also located between the regularly spaced intervals. Mill site stations were established up and down-coast until it was determined that the gradient between two successive stations was

near zero, indicating that background conditions (i.e. beyond the zone of influence of mill discharge) had been reached. Stream station buoys were placed at 0.5 mile increments from the stream mouth.

At each buoy station a qualitative reconnaissance survey was conducted. Two diver-scientists descended to the bottom at the 60 ft. depth. The divers then swam toward the shoreline until the shallowest accessible depth was reached (generally 20-30 ft). These reconnaissance surveys were useful in making relative comparisons between depth zones, identifying any unique or unusual biotic resources, and providing a general picture of the physiographic structure and biotic community assemblages occurring throughout the region of study. During the course of the reconnaissance, sediment samples were collected in 250 ml. plastic bottles from approximately 60 and 30 ft. depths.

Following the reconnaissance swim, the divers back-tracked to the depth zone judged to have the greatest coral cover. At all stations this depth was approximately 35-40 ft. In this zone a quantitative photo-quadrat line transect was conducted. The survey technique employed is a modified version of the quadrat method analyzed in Kinsey and Snider (1978), and has been used extensively for reef coral surveys in Hawaii (e.g. Grigg and Maragos 1974, Dollar 1979, Grigg 1982) Transects were executed by stretching a fiberglas surveyors tape 165 ft. in length in a line over the sea floor parallel to the shoreline. An aluminum quadrat frame, with dimensions of 1 m by 0.66 m, was sequentially placed over 10 random marks on the transect tape so that the tape bisected the long axis of the frame. At each quadrat location a color photograph recorded the segment of reef area enclosed by the quadrat frame. A diver knowledgeable of the taxonomy of resident species also visually estimated the percent cover of all stony and soft corals within the quadrat frame. In all, 29 transects were surveyed.

Following the period of field work, quadrat photographs were projected onto a grid and units of bottom cover for each species and bottom type were calculated. This information was combined with the *in-situ* cover estimates and the combined assessment provided the data base for the benthic community structure analysis. Species diversity was calculated using the Shannon-Wiener Index ($H'c = -\Sigma pi \ln pi$, where pi is the proportion of the ith species in the total coral cover for the transect). Species diversity can be equated with the equitability, or dominance, of distribution of the species occurring on each transect.

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Attachment 3

Proposal for

Long-Term Monitoring and Management Research on Coral Reefs

Submitted:
20 March, 1991

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who?

MONITORING AND MANAGEMENT RESEARCH ON HAWAIIAN REEFS

Coral reef experts in Hawaii agree that comprehensive assessment and monitoring studies are necessary and vital to both present understanding and future management of reefs. We are currently supporting a bill before the Hawaii State Legislature which will allocate funding for the initiation of underwater video monitoring of three coral reef sites: Hanauma Bay (Oahu), Honolua Bay (Maui), and Puako Reef (Hawaii). This bill has passed the House Ocean and Marine Resources Committee and the House Finance Committee with budget intact. It is now in the Senate, and we are hopeful of final approval by the end of the legislative session sometime in April. However, this bill addresses an emergency situation and includes funding for only one year.

how much

In light of global climate change as well as rapidly accelerating urbanization pressures, there is an immediate and critical need for baseline information and implementation of monitoring programs on reefs throughout the state. An additional 24 coral reefs on eight Hawaiian islands (see list below) have been identified as economically and ecologically sensitive sites.

X

WORK PLAN

Tasks and Overall Goals

The goals of this program are to provide baseline and continuous long-term monitoring information from permanent transects of economically and anesthetically important coral reefs throughout the Hawaiian Islands. "Long-term" is defined in

reference to the ecology of coral reef systems, on the order of decades. It is also our goal to ensure that data are collated, summarized, and disseminated in a form that will be useful for responsive and responsible planning and management practices.

Literature Survey and Review

Much of the literature and thoughts of individual investigators has been reviewed in the preparation of this proposal. An annotated bibliography and assessment of sampling methodologies will be prepared as a reference document for the proposed study.

where is it?

Development of Standardized Methodology

Standardized methodologies (including procedures, sampling design, scale, frequency, numbers of samples and numbers of replicates) for accurate censusing of coral reefs have been elusive, partly due to past difficulties and constraints of working underwater, but also because we lack the unifying statistical and ecological principles to understand the complexities of physical and biotic processes of coral reefs. However, these inherent difficulties do not absolve us from trying to elucidate these complexities and permanently recording present-day environmental conditions for use by both current researchers and future generations.

New technologies have been developed within the past year which allow high resolution underwater video photography. Underwater video surveys, coupled with rapidly advancing software for data acquisition and analysis, can now not only provide precise,

quantitative estimates of biotic parameters, but also can be used as invaluable "data banks" for future analysis.

Video hardware, lighting systems, and analytical software support for underwater video surveys have been developed and tested by a group of researchers at Northeastern University (Maney, et al. 1990). This system is currently being used to monitor the recovery of effects from Hurricane Hugo on Caribbean reefs. Sony V101 Hi8 video cameras in underwater housings offer 400 lines of resolution per frame and can detect organisms greater than 2 cm^2 from 0.5 m above the substratum; close-up lenses can resolve organisms as small as 1 mm^2 from 0.1 m focal distance (J. Witman, pers. comm.). The general condition of coral tissues (healthy, bleached, necrotic) can also be readily ascertained. Software support (NIH Image, developed as "shareware" with NSF and NIH funding, available at no cost to users) allows digital analysis of individual frames, and includes color image segmentation (keyed to up to 256 colors) and binary object analysis so that the presence of individual species can be identified, mapped and stored for statistical analysis.

NOTE

NOTE

A primary advantage to video survey records is that they may be edited, stored, and backed-up in the same taped medium in which they are recorded. Software is used to identify individual records on each tape. While software for data analysis of individual records may be currently accomplished on desk-top computers, long-term records and comparisons may require greater storage and memory capabilities. Researchers at the Australian Institute of Marine Science (AIMS) are presently developing a

compatible software package for a writable laser disk drive which will hold and analyze many thousands of records (T. Done, pers. comm.).

As stated above, coral reef monitoring methodologies are, at present, largely a matter of personal choice, opinion, and individual questions to be addressed. Studies done to date have therefore been sporadic, geographically scattered, and short-term, lasting only as long as various, temporary research or consulting funding allowed and involving a variety of techniques which were often inconsistent. Video surveys, because they can rapidly and permanently record large amounts of photographic information, can alleviate some of this inconsistency if conducted appropriately by allowing multiple analyses utilizing various statistical approaches and techniques by present and future investigators.

such as

Sampling Procedure and Design

Ecosystem monitoring can provide two important levels of assessment: an a posteriori evaluation of ecosystem responses to natural and anthropogenic environmental changes, and an a priori warning of trends or degradation which may be used to effectively circumvent permanent ecosystem loss. The sensitivity of both of these assessments is largely dependent on the development of methodologies to produce statistically reliable estimates of temporal and spatial variability.

A literature survey of ecological monitoring methodologies as well as numerous discussions with experienced coral reef researchers suggest that the most sensitive, productive, and

such as

statistically satisfying sampling scheme may be a stratified random design with numerous, permanent belt transects at various depths at each reef site. However, adoption of a standardized sampling scheme will await the results of analysis of preliminary video surveys and point-intercept/quadrat validations designed to produce species-area curves for different community types.

Initially, the Hanauma Bay site (because of its ease of access and proximity to research facilities) will be used to "debug" sampling and analytical methods. Step-wise implementation of additional sites will proceed with the establishment of a number (to be determined) of 10 m long permanent transects parallel to the shoreline and/or reef crest at this and subsequent sites. Two techniques will be utilized to estimate algal and invertebrate (including coral) cover within each transect: 1) total cover from digitization of each 10 m^2 belt of three or more randomly chosen transects at each depth, and 2) extrapolation of total cover from projection of random points on randomly selected frames from each transect. These methods will be compared to total coverage data derived from field validation of point-intercept and quadrat methods.

NOTE

Coral Reef Data Collection and Synoptic Sampling

Data collected will include species diversity and percent cover of corals and associated reef organisms, in addition to overall abundance and health of individual coral colonies, which may be used for a myriad of basic biological investigations such as productivity estimates and analyses of ecological interactions. Changes in abundance, diversity, and cover through var-

ious time intervals within and between reef communities will be measured. Precise site locations within each area will be coordinated with on-going water quality and reef fish monitoring stations of state agencies (DLNR, DOH).

Data Summary, Storage and Access

Video records (including back-ups) and data analysis output will be compiled and summarized quarterly, and centrally stored at the Environmental Center on the University of Hawaii, Manoa campus. Summary reports will be distributed both quarterly and annually to the appropriate agencies (EPA, Region 9, Hawaii Department of Health and Department of Land and Natural Resources) and to researchers or other groups by request.

Implementation of Statewide Monitoring Program

Coral reef research has been, until now, the labor, time-, and cost-consumptive work of highly trained professionals. In this program, we propose to enlist the help of members of the recreational and undergraduate diving community in conducting the underwater video surveys. We suggest that a great untapped resource exists among recreational and student divers that can be utilized to conduct surveys and expand our ability to monitor necessarily large numbers of reefs. Organized dive groups in Hawaii have already expressed interest in contributing to scientific investigations in order to enrich their own underwater experience and to help protect their recreational environment. In addition, administrators of the Marine Option Program at the

University of Hawaii (chapters at Manoa, Windward, and Hilo campuses) have expressed interest in having their students participate in such a monitoring program for training as part of their certificate program. A focus of effort will be aimed at training divers in proper survey techniques, recording, and assessment of potential reef problems.

Using the Marine Option Program and commercial dive shops for access and promotion to the community, we will conduct a series of training workshops on each island. Supervisory personnel will be solicited from each group based on their background and leadership capabilities. Survey equipment will be provided to each island team (or teams) to be placed in the custodial care of the team leader under the ultimate joint responsibility of the principal investigators. Logistical support, scheduling, and supervisory responsibility will be sought from UH and Sea Grant Extension agents on each island. Retraining of volunteers will be conducted at least annually, or upon request from island teams. The "mission" of each team will be to conduct quarterly video monitoring of coral reef communities along permanent line transects at each of their assigned sites. As time and interest permit, additional observations and recordings may be made *in situ*.

The video equipment is reasonably low-priced (particularly when compared to the costs incurred by the time required of underwater transecting by professional biologists) and surveys can be readily conducted by non-professionals, thereby greatly decreasing costs and increasing the number of sites or replicates which can be monitored. Because most researchers agree that

direct experience and observation invaluable, the system will also be used, at least initially, under the guidance of professional scientists and in conjunction with standard field survey techniques (quadrats of transects) for supplemental data collection and quality control checks. It is important to note that one of the additional advantages of using video surveys is that data acquisition can be checked immediately (on the camcorder monitor) precluding uncertainty of results or the need to wait for film development.

DELIVERABLES

Measures of success of this program will be many. The data will provide baseline information on coral abundance, health of individual colonies, species diversity, and percent cover of corals and associated reef organisms which may be used for a myriad of basic biological investigations such as productivity estimates and analyses of ecological interactions. Changes in abundance, diversity, and cover through various time intervals within and between reef communities will provide an incomparable database from which to develop vastly improved management options, and provide an early warning system for possible degradation of reef habitats including causes and trends. In addition, the means and procedures of implementing this methodology could be readily transferred to benthic monitoring programs wherever there is a sufficient representation of the recreational diver community and/or educational institutions. Perhaps most importantly, involvement of the community in conducting such a re-

search endeavor will allow the public to "own" the responsibility for fostering reefs and protecting our valuable reef resources for generations to come.

**Critical sites identified in Hawaii: Kailua Bay, Kaneohe Bay, Waikiki, Shark's Cove, and Kahe on Oahu; Honaunau, Haupakahi, Kiholo, Kealakekua Bay, Kapoho, and Blonde Reef on Hawaii; La Perouse Bay, Molokini, and Kahoolawe (Maui district); Manele Bay and Turtle Reef on Lanai; Pahoa, Moanui, and Kaunakakai on Molokai; Haena, Poipu, Nualolo Kai, and Anini Beach on Kauai; Lehua on Niihau; Molokini; and Kahoolawe.

Attachment 4

DEPARTMENT OF MARINE & WILDLIFE RESOURCES

AMERICAN SAMOA GOVERNMENT
P.O. BOX 3730
PAGO PAGO, AMERICAN SAMOA 96799

TEL: (684) 633-4456
FAX: (684) 633-5944

A. P. LUTALI
Governor

TAUESE P. F. SUNIA
Lt. Governor

RAY TULAFONO
Director

PHILIP LANGFORD
Deputy Director

January 15, 1993

FROM: John McConnaughey
Fisheries Biologist

TO: Sheila Wiegman, ASEPA
Norman Wei, StarKist Samoa Inc
Jim Cox, VCS Samoa Packing Company

SUBJECT: Comments on Joint Cannery Outfall Dye Study Plan.

I have just reviewed the "Joint Cannery Outfall Dye Study Plan" which was forwarded to out department for comments.

I am not very familiar with the methodologies used to conduct such outfall plumb studies, so I will not comment on those technical issues. I do have two questions concerning methodology:

1) As the dye (Rhodamine WT) is biodegradable, how long after the dye is subjected to environment is it still detectable? Do the analytical techniques used include a correction factor to account for the decomposition of the dye over time?

2) We are mostly concerned with the fate of the organic materials present in the waste plume. Do the flocculent materials and organic solids in the waste plume behave the same as the aqueous portion of the plume? Will the dye accurately show the movements of these materials?

My major concern for this study is to document the fate of the cannery effluent plume. Does it stay resident in the outer harbor waters for a period of time, or is quickly flushed out of the harbor regions? Or worse, do currents carry it back into the inner harbor regions?

Pago Pago harbor suffers from serious pollution problems, and attempts to eliminate all

sources of waste water entering the harbor need to be taken. The potential problems associated with cannery outfall waste is that it adds large amounts of flocculent material, and organic material to the waters in the harbor. This increases the biological oxygen demand on the system, reduces light for photosynthesis.

The coral reefs in the outer harbor area have been observed to be covered with a fine sediment materials at all times at depths greater than about 15 feet. Most corals appear dead, and very little new recruitment has been observed. Live corals in the inner harbor areas are virtually non-existent.

I feel that the main questions we would be interested in answering with this study are:

1) Resident time of the cannery waste plume.

2) Direction of movements.

I would like to discuss with you the details of the field sampling times and locations, and if possible to join you on a couple trips. Please call me any time so we can discuss this further.

cc: Ray Tulafono, Director DMWR
Peter Craig, Chief Biologist DMWR

January 15, 1993

FROM: John McConnaughey
Fisheries Biologist

TO: Sheila Wiegman, ASEPA
Norman Wei, StarKist Samoa Inc
Jim Cox, VCS Samoa Packing Company

SUBJECT: Comments on "Joint Cannery Outfall Sediment Monitoring Study Plan.

A copy of the Joint Cannery Outfall Sediment Monitoring Study Plan dated January 6, 1992 has been forwarded to our department for review and comments. This study is written to comply with NPDES permits AS0000019 and AS0000027, which allow for the construction and use of the cannery outfall.

In reviewing the study plan I have some questions regarding the usefulness of the studies potential results as far as evaluating the effects of the wastes discharged from the cannery outfall.

My main problem with the sediment sampling program as described is that no mention is made in the methodology as to what criteria will be used to determine the origin of sediments recovered from the harbor.

We know that large volumes of organic wastes were discharged at the cannery sites prior to the construction of the 1.5 mile long discharge pipe. We also know that this pipe is now discharging wastes at a site that is now deeper and further removed from the inner harbor. And we know that there are numerous other sources of wastes and sediments entering the harbor on all sides.

My questions are these:

1) Of the top layer of sediments, how much is new material v.s. old material?

2) What is the resident time of sediments in the harbor? Do they eventually flush out, or do sediments just continue to accumulate?

3) For sediments which have been deposited in the last year, what proportion of them are 1) from wastes discharged from the canneries, 2) from other sources, or 3) sediments which have been resuspended and now just redeposited in their present location?

Section G of the Star-Kist Samoa and Samoa Packing NPDES permit states:

> "Sediment monitoring is conducted"..."and if harbor recovery will be affected by resuspension of the nutrients."

From the study plan, I do not see how the resuspension issue will be addressed. It seems to me that in order to investigate the resuspension issue, that one needs to know what proportion of the observed sediments are new v.s. older resuspended sediments.

Section G also states:

> "The permittee"..."shall undertake a yearly sediment monitoring program in Pago Pago Harbor in order to assess"..."the rate of accumulation of nutrients".

I question whether using grab samples as outlined in the study proposal will address the issue of sediment accumulation rates.

I have only very limited experience working on marine sediment studies, but it seems to me that an alternative procedure which would monitor the sedimentation on a bare surface would provide more useful information on the nature and deposition rates of sediments being currently deposited.

cc: Ray Tulafono, Director DMWR
Peter Craig, Chief Biologist DMWR

ROUTING AND TRANSMITTAL SLIP

Date 1/7

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. Janet 1/7/93 Jane - Pls. make copy for David. Thx.		
2.		
3. David - Brian has copy.	ES	1/13/93
4.		
5.		

	Action		File		Note and Return
	Approval		For Clearance		Per Conversation
	As Requested		For Correction		Prepare Reply
	Circulate		For Your Information		See Me
	Comment		Investigate		Signature
	Coordination		Justify		

REMARKS

Here we go again. Sorry for the short turnaround time but this study was to have occurred later in the year but for reasons outlined in the plan, the consultant feels doing the study in Feb. is better.

Also, a coral reef ~~dra~~ survey draft plan will also be forthcoming this →

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post)	Room No.—Bldg.
Pat Young E-4	Phone No. x1591

5041-102

1990 — 262-080

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206

week for our review. Again, they want to do the study in Feb. rather than later in the year for baseline data.

Call me if there may be problems in reviewing. Thanks.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105-3901

DATE: January 7, 1993

MEMORANDUM

SUBJECT: Request for Review of Sediment Monitoring Plan for Tuna Cannery NPDES Permits

TO: Janet Hashimoto
Chief, Oceans and Estuaries Section

FROM: Pat Young
American Samoa Program Manager (E-4)

Attached please find a copy of the draft plan for sediment monitoring of Pago Pago Harbor, the location of the joint cannery outfall in American Samoa. This study is required by the canneries' reccently-issued NPDES permits. We would greatly appreciate your assistance in having the study plan reviewed. If additional information is needed to assist in the review, please let me know.

Because this study is scheduled for the first week in February, we would greatly appreciate an expedited review of this draft and would appreciate any comments by January 15th (sorry for the short turn around time). Should the reviewer need to discuss the technical aspects of the proposal, he/she should feel free to contact Steve Costa of CH2MHill at (510) 251-2426-2251. Steve can also come into the office to discuss if necessary. Please call me at (415) 744-1591 if you have any questions.

Thanks again for your assistance.

Enclosure

cc: Doug Liden (W-5-1)
Mike Lee (E-4)

Printed on Recycled Paper

Copy to Doug Lide
Janet Hashimoto
Mike Lee

Engineers
Planners
CH2M HILL
Economists
Scientists

FAX No. 510/893-8205

FAX Cover Sheet

INFORMATION TO:

Name: PAT YOUNG

Office No.: 415-744-~~1607~~ 1591

Fax No.: 415-744-1604

Name:

Office No.:

FAX No.:

INFORMATION FROM:

Name: STEVE COSTA

Company: CH2M HILL

Subject: JOINT CANNERY OUTFALL SEDIMENT MONITORING PLAN

Date: 6 JANUARY 93

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REMARKS: PAT -
Here is Sediment Study Plan, I am available to meet with your reviewer if that will help speed things up any
Steve

CH2M HILL 1111 Broadway, Suite 1200 Oakland, CA 94607-4046 510.251.2426 FAX 510.893.8205

AGENCY REVIEW DRAFT

JOINT CANNERY OUTFALL SEDIMENT MONITORING STUDY PLAN

for

StarKist Samoa, Inc.

and

VCS Samoa Packing Company

to comply with NPDES Permits

AS0000019

AS0000027

JANUARY 6, 1992

prepared by

CH2M HILL

AGENCY REVIEW DRAFT
6 January 1993

JOINT CANNERY OUTFALL DILUTION STUDY PLAN

INTRODUCTION

This Sediment Monitoring Study Plan presents a plan for conducting field collections and laboratory analyses of the marine sediments at seven sites in the inner and outer regions of Pago Pago Harbor, American Samoa. This sediment study plan is required under the conditions of the United States Environmental Protection Agency (EPA) NPDES Permit No. AS0000019 for Star-Kist Samoa, Inc. and NPDES Permit No. AS0000027 for VCS Samoa Packing Company. This document describes the objectives, approach, and field and laboratory methods for sediment monitoring in the harbor.

Section G of the Star-Kist Samoa and Samoa Packing NPDES permits addresses the Sediment Monitoring as follows:

> *"Sediment monitoring is conducted to determine the character of the sediments in relation to long-term high nutrient discharge by the permittee in the harbor and if harbor recovery will be affected by resuspension of the nutrients.*
>
> *The permittee, cooperatively with {Samoa Packing Co.; Star-Kist Samoa, Inc.} shall undertake a yearly sediment monitoring program in Pago Pago Harbor in order to assess the concentration of nutrient and organic components, the distribution of stored nutrients, the size of the nutrient reservoir, and the rate of accumulation of nutrients. Seven sites shall be located within Pago Pago Harbor and analyzed for total nitrogen, total phosphorus, percent organics, percent solids, bulk density, oxidation reduction potential, and sulfides. Three sites shall be located in inner Pago Pago Harbor and four sites shall be located in the outer harbor. These sites and monitoring plan shall be submitted within three months of the effective date of the permit for approval by ASEPA and EPA. Thereafter, these sites shall be approved annually by the anniversary date of the effective date of the permit. A report of the sediment monitoring program findings shall be submitted to the ASEPA and EPA 90 days after completion of sampling.*
>
> *After the first two studies have been performed and the results have been assessed, the permit may be reopened for the inclusion of a more frequent or less frequent monitoring schedule."*

TOC?

This study plan is being submitted to EPA and American Samoa Environmental Protection Agency (ASEPA) to comply with the NPDES permit condition of Section G.

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APPROACH

The joint cannery outfall operated by Star-Kist Samoa and Samoa Packing extends a distance of approximately 1.5 miles from the cannery locations on the north shore of the inner harbor into the outer harbor offshore of Anasosopo Point. The outfall consists of a 16-inch HPDE pipe that terminates with a multiport long diffuser section located at a depth of approximately 176 feet below MLLW. The diffuser section has 4 active ports on alternating sides of the pipe at a spacing of 10 feet. The diffuser ports are all 5-inches in diameter and discharge horizontally. The approved zone of mixing zone boundary is defined according to Figure 1 in the NPDES permits.

OBJECTIVES

The objectives of the Sediment Monitoring Study are: (1) to evaluate the characteristics and nutrient load of the marine sediments in the vicinity of the canneries previous (abandoned) outfalls in the inner harbor; (2) to evaluate the characteristics and nutrient load of the marine sediments in the vicinity of the new joint cannery outfall diffuser in the outer harbor; (3) to provide data for an evaluation of changes in harbor sediments over time. Sediments are to be collected from seven sites, three sites proximate to the historic cannery outfalls in the inner harbor, three sites proximate to the new diffuser, and one site at the Utulei outfall discharge site. The relative location of the seven sediment sampling sites are shown in Figure 1.

SAMPLE SITE LOCATIONS

The location of the sampling sites was established based on the predominant current directions at the outfall areas, bathymetry of the area, limited available information on sediment physical characteristics, and the location of point source discharges of nutrients. The wastewater plume behavior and transport direction will be confirmed through the field dye study measurements. The sample sites are shown in Figure 1 and are located as follows:

- Inner harbor site IH-1 will be located within 100 feet of the previous cannery outfalls
- Inner harbor site IH-2 will be located within 500 feet and directly south of the previous cannery outfalls
- Inner harbor site IH-3 will be located at the seaward end of the inner harbor
- Outer harbor site OH-1 will be located about 400 feet NNE of the new outfall diffuser

- Outer harbor site OH-2 will be located about 400 feet SSW of the new outfall diffuser
- Outer harbor site OH-3 will be located directly across the harbor from OH-1 and OH-2
- Outer harbor site OH-4 will be located seaward of the outfall diffuser at the seaward end of the outer harbor

DATA COLLECTION AND ANALYSIS

Five separate samples will be collected at each sampling site and then composited to provide a single representative composite sample for chemical analyses. The field collections for the sediment studies will started in early February 1993, after plan approval by EPA and USEPA. The sediment physical characteristics at each sampling site will be described and photographed in the field.

Chemical analyses will include those listed in the NPDES permit, using analytical and QA/QC procedures provided in the Standard Methods for the Examination of Water and Wastewater (1989) and Procedures for Handling and Chemical Analysis of Sediment and Water Samples (U.S. EPA and Army COE, 1981).

Field and laboratory analytical data will be processed and presented in tabular formats in a sediment monitoring study report, and supporting data will be included in the report appendix.

MONITORING SCHEDULE

The NPDES permits specify yearly collections of sediment. CH2M HILL and the canneries have proposed to modify this schedule without decreasing the number of monitoring episodes. The modification provides for the first two sampling episodes to be made during the first year of the study about six months apart, the third sampling episode to be during the third year, approximately 18 months after the second, and subsequent collections annually thereafter or as determined after review of initial results.

O.K.

The advantages to this modification include:

- A compressed time interval when sediment characteristics are expected to change most rapidly near the previous discharge locations in the inner harbor. Changes in sediment nutrient concentration near the previous outfalls can be expected to vary in a fashion similar to a first order decay phenomena. Most

of the change will be soon after the source removal (cannery discharge). With time the rate of change will probably slow. Therefore, a sampling schedule with more frequent samples at the beginning may better track the changes.

- A compressed time schedule for the initial collections near the new outfall location will provide a better baseline characterization of the sediment characteristics.

- The modified schedule will allow CH2M HILL staff doing the dye studies during year one to be directly involved in the sediment monitoring study and provide an opportunity to train personnel that might do similar collections in the future.

STUDY METHODS

The sediment monitoring study requires field data and sample collection and subsequent laboratory analysis. The methods to be used for these elements of the study are described below. The field work described in the following sections include the methods and equipment to be used for the field collection of sediments, station positioning, sample handling, and sample shipment. The Laboratory analysis methods listed are compatible with the NPDES permit requirements.

FIELD EQUIPMENT AND SAMPLING VESSEL

Field equipment requirements for the sediment sampling are listed in Table 1. A work vessel with a two-person scientific staff will be aboard to collect sediment samples by hand, since no vessel with hydraulics is available in American Samoa.

STATION LOCATIONS AND FIELD POSITIONING

Sediment samples will be collected from a work vessel using five separate grab samples at each of the seven sites. Vessel navigation will be done by using a Motorola Mini-Ranger III electronic positioning system. Use of a Mini-Ranger III will allow maximum flexibility in establishing sampling locations and will provide range accuracy of approximately ±2 meters. A marker buoy will be deployed at the precalculated Mini-Ranger position of the new outfall diffuser prior to collecting sediment samples at the outer harbor outfall sites.

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SEDIMENT SAMPLE COLLECTION

Sediment sampling will be conducted in accordance with the Procedures for Handling and Chemical Analysis of Sediment and Water Samples (U.S. EPA and Army COE, 1981). Sediment samples will be collected using a 0.0225 square meter Petite Ponar grab sampler. The Petite Ponar sampler is a weighted sediment grab sampler designed to penetrate and collect undisturbed samples of sediments ranging from silts to coarse gravels. This type of sampler has been used previously to collect sediment samples throughout Pago Pago Harbor. The grab sampler should be able to penetrate and provide a reliable sediment sample of a minimum depth of 4 cm.

Samples will be collected with a minimum of five separate grabs at each of the seven sites. Sufficient sediment materials will be collected at each site to provide adequate material for the sediment chemistry analyses. More than five grabs will be taken if required to collect sufficient material. If the is hard or rocky, has no sediment, or bottom conditions at a site prevent sediment from being recovered, the site will be relocated based on the judgement of experienced scientists on the project staff.

Prior to disturbing the grab samples the following will be recorded in the field logbook: sediment sample penetration depth, color, texture, odor, temperature, pH, and Redox potential. The five (or more) samples from a single site will be composited in a stainless steel bowl, and samples will be taken from the composite for sediment chemistry analyses. The total of seven composite sediment samples for sediment chemistry analysis will be collected.

Samples collected at each site will be labeled with a unique designator to allow sample tracking; each sample designator will consist of a two-letter location code (IH or OH), followed by a numerical station code (1 through 7). Samples for chemical analyses will be immediately iced and/or preserved (as required) and prepared for shipment to the laboratory. The laboratory selection will be finalized prior to field sample collection

LABORATORY ANALYSES

Each composited sediment sample will be analyzed for the chemicals listed in Table 2. All sample collections will be performed in accordance with the Procedures for Handling and Chemical Analysis of Sediment and Water Samples (U.S. EPA and Army COE, 1981). Sample containers, sample handling requirements and sample preservation requirements are listed in Table 3.

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QUALITY ASSURANCE AND QUALITY CONTROL

The quality assurance and quality control objectives for the sediment studies are to collect representative sediments surface samples and provide laboratory chemical and physical measurements that are of known and acceptable quality. The following requirements will be followed to meet the objectives:

- Provide verifiable laboratory chemical analyses with QA to evaluate accuracy and precision targets
- Maintain and document accurate vessel positioning for sample collection
- Provide field equipment redundancy (backup equipment)
- Develop and use a field operations plan
- Examination of samples as collected and subsequent data by experienced scientists

FIELD OPERATIONS PLAN

A field operations plan for conducting the sediment sample collections will be developed as the basic element of quality assurance and control activities. The operations plan will include field data sheets, chain of custody forms, and a sample matrix collection checklist.

EQUIPMENT CALIBRATION

All equipment will be obtained prior to the beginning of the sediment studies field collections and checked to verify correct operation. Any instrument requiring calibration will be checked and calibrated upon its arrival to confirm that it is in working condition.

The Mini-Ranger will be calibrated to the manufacturer's specifications prior to conducting the dye study. The unit and transponders will be checked against known distances similar to those to be encountered during the study. A calibration range maintained by the National Ocean Service is used for this purpose.

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DATA ANALYSIS AND PRESENTATION

Field data will be summarized and vessel positioning data will be processed to calculate and plot the sediment sampling locations. Laboratory chemical and physical data will be reviewed to determine whether analytical accuracy and precision targets were achieved and to assess the laboratory quality assurance. Sediment chemistry results will be presented in tabular formats.

A report of the results will be provided to EPA and USEPA following each monitoring episode (within 90 days of the field sampling). Any proposed revisions to the study plan will be presented in the monitoring report. Review comments from EPA and ASEPA will be incorporated into the revised study plan as appropriate.

Table 1
Field Equipment for Sediment Field Collections

Equipment Item	Purpose	Number of Units	Accuracy Standard
Work Vessel	Field Sampling Platform	1	N/A
0.02 meter^2 Petite Ponar Sediment Grab Sampler	Collect sediment samples at depth	1	Sediment grab acceptability of 4 cm depth
Motorola Mini-Ranger III System	Microwave positioning System with 3 shore-based transponders	1	±2 meters
ASTM brass sieves	Wet sieve sediments from samples	2	N/A
Orion Redox Potential and pH Instrument	Measure sediment oxidation-reduction potential and pH in the field	1	±0.5 millivolts
Sample Containers	Collections of sediments for chemical analyses	As required in plan	Pre-cleaned sample containers
Ice Chests	Sample jar holder, cool samples on ice, and sample shipment	As required in plan	Pre-cleaned containers

Table 2
Sediment Chemical Analyses

Parameter	EPA Method	Standard Methods No.
Total Kjeldahl Nitrogen	175	437
Total Phosphorus	249	481
Sulfides	284	505
Total Volatile Solids (Percent Organics)	272	95
Percent Solids	270	91
Bulk Density	TBD	TBD
Particle Size (Optional)	None	250 g

TOC preferred over TVS
Total grain size distribution should not be optional.
Selected metals and organic compounds should be analyzed periodically — known or suspected priority pollutants and 6 § 301(h) pesticides until such time concentrations are consistently very low.

Table 3
Sediment Sample Collection and Handling Requirements

Parameter	Holding Time	Minimum Sample Size	Preservation	Sample Container
Total Kjeldahl Nitrogen	7 days	10 g	Cool, 4°C	250 ml plastic jar
Total Phosphorus	7 days	10 g	Cool, 4°C	250 ml plastic jar
Sulfides	7 days	20 g	Cool, 4°C, add 2 ml ZN-acetate	250 ml plastic jar
Total Volatile Solids (Percent Organics)	14 days	100 g	Cool, 4°C	250 ml plastic jar
Percent Solids	None	50 g	Cool, 4°C	N/A
Bulk Density	None	50 g	Cool, 4°C	N/A
Particle Size	None	250 g	Cool, 4°C	250 ml plastic jar

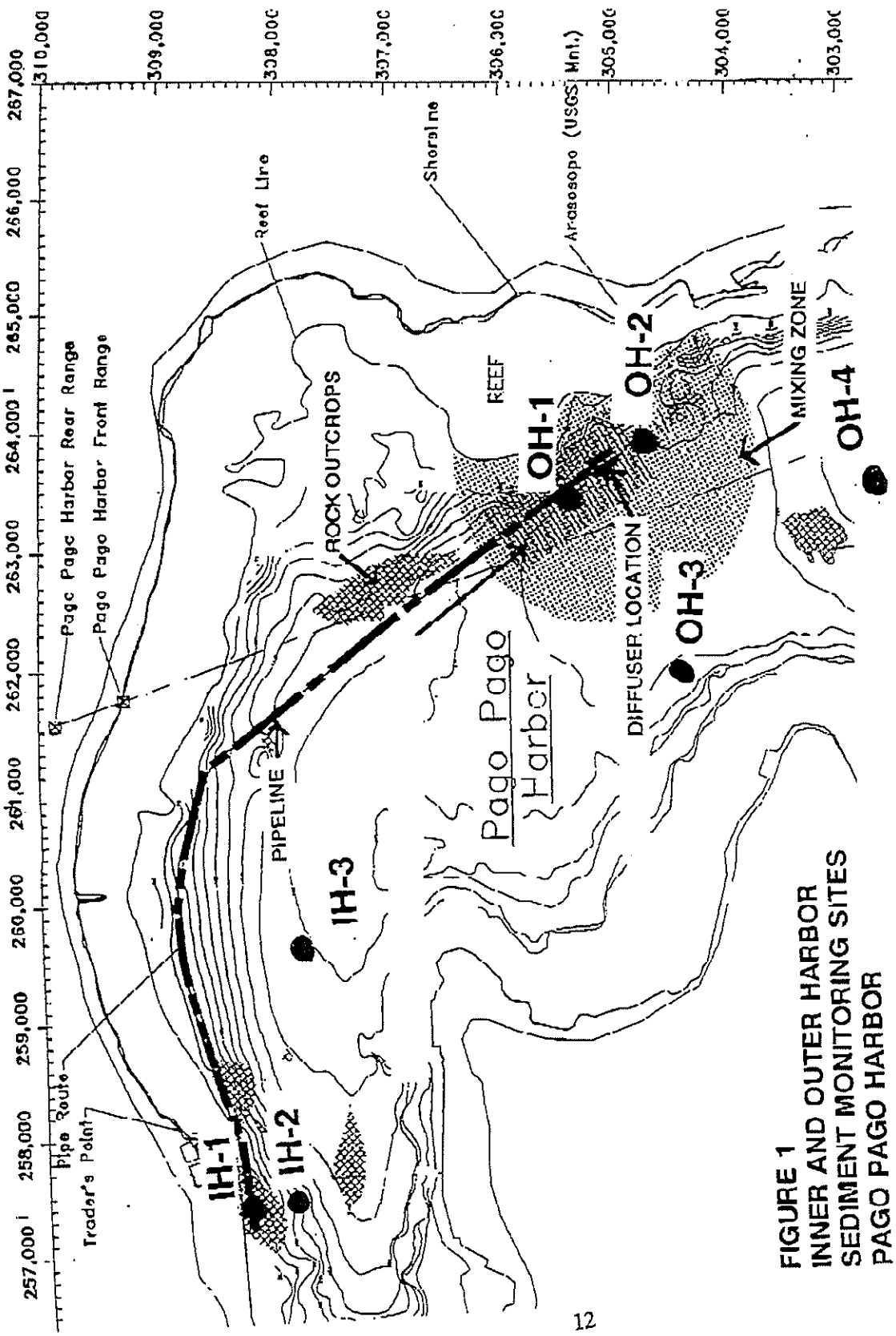

FIGURE 1
INNER AND OUTER HARBOR
SEDIMENT MONITORING SITES
PAGO PAGO HARBOR

MEMORANDUM

SUBJECT: Comments on Sediment Monitoring and Coral Reef Survey Study Plans for Am Samoa Tuna Canneries' NPDES Permits

TO: Pat Young
American Samoa Program Manager (E-4)

FROM: David Stuart
Marine Protection Section (W-7-1)

THRU: Janet Hashimoto
Chief, Marine Protection Section

Generally, both the sediment and the coral reef monitoring plans appear acceptable (especially QA/QC procedures) and meet the requirements of the tuna canneries' NPDES permits. I have a few minor suggested additions and changes to the plans:

Sediment Analyses

- Total Organic Carbon (TOC) is preferred over Total Volatile Solids (TVS) because it is a better indicator of sediment organic compounds.

- Total grain size should not be optional. It is an important assessment of solids dispersal in Pago Pago Harbor.

- Selected metals and organic compounds should be analyzed periodically. Known or suspected priority pollutants and the additional six §301(h) pesticides should be scanned until such time concentrations are consistently low.

Coral Reef Survey

- Benthic organisms to include in the semi-quantitative data sets at each transect should be macroinvertebrates.

- Water quality sampling should be coordinated with the reef surveys so that any potential correlations between water quality and biological data can be noted. Water quality monitoring should be performed either on the same day or within a week of the coral reef surveys.

- Nineteen transects with multiple depths at 16 sites seems a bit too many to do a good job surveying consistently. Perhaps it would be better to have fewer reef stations done annually with more accuracy and consistency?

- On page 5, end of third paragraph, only five representative sites are specified where video records of reef flats will be taken. Where is the sixth representative site?

DAVE, WE WERE THINKING TOTAL ABOUT 2 SURVEYS (1 AFTER 2 YEARS & 2ND AFTER 4) FOR THE ENTIRE HARBOR — NO

WHAT DO YOU THINK?

H. CORAL REEF SURVEY

We see two problems with the coral reef survey as described:

— DOUG

- The time frame requested (annual) is probably not necessary and changes may not be readily observable with respect to the influences of the cannery discharge on that time scale.

X-1921

- The number of transects is too limited to attempt to separate impacts due to specific localized causes.

Suggest 1st after 1 yr of discharge and then every 2 yrs thereafter. RS

We suggest one survey after three to five years be done for transects throughout the harbor. This will provide a better assessment of impacts and a more reasonable chance of isolating the reasons for particular changes. 2 to 4 years Too late? (3-5 years)

I. HARBOR-WIDE CIRCULATION STUDY

lots of local circulation study

To do a circulation study that will add any significant knowledge will be extremely complex and costly. We see no reason to simply gather additional data, which is what the study description indicates is required. As described in the Feasibility Study, the circulation is predominantly wind driven. To significantly increase understanding of the circulation will require an extensive field data collection and modeling effort (costs estimated at $300,000 to $500,000). To simply do a few more drogue releases and put in a few current meters for a short period would not add any significant knowledge about the circulation, flushing, and dispersion in the harbor. Analysis of the results of the monitoring program are more valuable in terms of understanding the circulation in the harbor than a repetition of previous current studies.

Good to do a model of harbor
Goal is to get info to verify model
Need current -

verify. not not.

WLA

Wind & currents are available but are insufficient to describe
Moreover it is not possible
The net results that

\jenpdes\prmtendn.mem

CH2M HILL

FAX TRANSMITTAL FORM

FOR IMMEDIATE DELIVERY

DATE: 1-8-93

PROJECT NUMBER:

FAX OPERATOR:

TIME SENT: ☐ AM ☐ PM

Reviewed 1/22/93 DM

To: Janet Hashimoto

Firm Name: U.S. EPA Region 9 OFFICE

Fax Phone Number: (415) 744-1072 (CITY) (STATE) Verification Phone Number: (415) 744-1156 (COUNTRY IF OUTSIDE THE USA)

Total number of pages, including this page: 8 Return original? ☒ Yes ☐ No

IF YOU DO NOT RECEIVE ALL OF THE PAGES OR THE TRANSMISSION IS UNCLEAR, PLEASE CONTACT OUR FAX OPERATOR AT EXT. 5246

From: David Wilson Office: SEA Employee No.: 3052

RE: Review Draft - Coral Reef Survey Study Plan

Remarks:

Janet -

I have not talked to you since I moved to Seattle in 89! I trust all is well at Region 9.

Please review and provide comments to Steve Costa and myself. If you have any questions please call me directly at (206) 453-5005 (5067).

Regards,

David

Reviewed 1/13/93 DS

Date Fax Sent: Time: ☐ AM ☐ PM

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AGENCY REVIEW DRAFT

JOINT CANNERY OUTFALL CORAL REEF SURVEY STUDY PLAN

for

StarKist Samoa, Inc.

and

VCS Samoa Packing Company

to comply with NPDES Permits

AS0000019

AS0000027

JANUARY 8, 1992

prepared by

CH2M HILL

AGENCY REVIEW DRAFT
January 8, 1993

JOINT CANNERY OUTFALL CORAL REEF SURVEY STUDY PLAN

INTRODUCTION

This Coral Reef Survey Study Plan presents the plan for conducting field surveys of the existing coral reefs around Pago Pago Harbor. This study plan is required under the conditions of the United States Environmental Protection Agency (EPA) NPDES Permit No. AS0000019 for Star-Kist Samoa Inc. and NPDES Permit No. AS0000027 for VCS Samoa Packing Company. This document describes the objectives, approach, field methods, and data analysis procedures for the coral reef surveys.

Section I of the Star-Kist Samoa and Samoa Packing NPDES permits states the following concerning the Coral Reef Surveys:

> *"Within six months of the effective date of this NPDES permit, the permittee, in cooperation with {Samoa Packing Co.; Star-Kist Samoa}, shall submit a field study design for approval by ASEPA and EPA Region 9 to assess the potential impacts of the discharge on the nearby coral reef. The study shall include coral reef transects which shall conform to locations found on Figure 4 in the USE ATTAINABILITY AND SITE-SPECIFIC CRITERIA ANALYSES: PAGO PAGO HARBOR, AMERICAN SAMOA, FINAL REPORT (CH2M HILL, March 15, 1991). The intent of this annual survey is to detect significant differences, if any, from the database information found in the above-cited document. Videos shall be submitted to both the USEPA and ASEPA. Guidance for designing such surveys is provided in the Design of 301(h) Monitoring Programs for Municipal Wastewater Discharges to Marine Waters November 1982, EPA #430/0-82-010 (pages 70-71). In addition, the discharger should consult Ecological Impacts of Sewage Discharges on Coral Reef Communities, September 1983, EPA #430/9-83-010, for further information. The study shall be conducted within one year of the effective date of this permit and every two years thereafter."*

This study plan is being submitted to EPA to comply with the NPDES permit condition of Section I, and to provide for approval of this plan.

APPROACH

The NPDES permit states that coral reef surveys shall be conducted at all of the same sites surveyed during the 1991 Use Attainability Analysis (CH2M HILL, 1991), to detect significant differences, if any, from the 1991 baseline reef survey data. The wastewater discharge locations

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for the canneries and receiving water conditions in the harbor have changed since the 1991 survey. In 1991, when the previous reef survey was conducted, the two canneries operated separate wastewater outfalls in the inner harbor area of Pago Pago Harbor. The 1991 surveys involved recording reef transects at multiple-depths along the reef fronts at 19 sites located around the entire circumference of Pago Pago Harbor. These 1991 coral reef field surveys were designed to provide comparable records of the reef conditions around the entire harbor for use in an evaluation of reef-face habitat conditions in areas of the inner, middle, and outer Pago Pago harbor. These surveys were designed to provide a semi-quantitative summary of reef corals and other benthic species, and reef fish identifications were incidental.

Presently, Star-Kist Samoa and Samoa Packing operate a joint wastewater outfall that extends over 7,000 feet west from the canneries to a deep-water site offshore of Anasosopo Point in the outer harbor. The outfall consists of a 16-inch HPDE pipe that terminates with a diffuser at a depth of 176 feet below MLLW. The diffuser is located north of To'asa Rock and approximately 500 feet west of the reef face near Anasosopo Point.

The approach and methodology for the coral reef survey has been designed to duplicate the 1991 reef video surveys that were conducted at each of the designated sites in Pago Pago Harbor, and to be consistent with available guidance provided in the Design of 301(h) Monitoring Programs for Municipal Wastewater Discharges to Marine Waters (USEPA, November, 1982). To meet the NPDES permit conditions, video transects will be recorded at multiple depths at each of the nineteen established reef transect sites around Pago Pago Harbor (Figure 1).

These coral reef field surveys will be conducted to provide video transect records of the reef conditions around Pago Pago Harbor that can be compared with the 1991 survey and with future surveys at the same locations. These surveys will be used to evaluate the condition of and changes to the reef-face habitat in areas of the inner, middle, and outer Pago Pago harbor. The surveys are limited to providing semi-quantitative data on the type, percent cover of live reef corals and other benthic species. Reef fish identifications will be incidental to the reef habitat evaluation. These video transect records will be analyzed and summarized by a qualified marine ecologist with knowledge of tropical reef taxonomy and several years of experience specifically in American Samoa. Estimates will be developed of live coral coverage and specific benthic genera identifications will be provided, as feasible from the video record. Field survey data will be presented in tabular formats in a coral reef survey report, and supporting data will be included in the report appendix. Copies of the video records will be provided to ASEPA and USEPA along with a report of the survey findings.

The first coral reef survey is presently scheduled for the first week of February 1993, after study plan approval by EPA. Subsequent surveys would take place in February 1995 and 1997.

We should try to coordinate water quality sampling on the same day or within a week of the coral reef monitoring. Correlations among the data would be valuable.

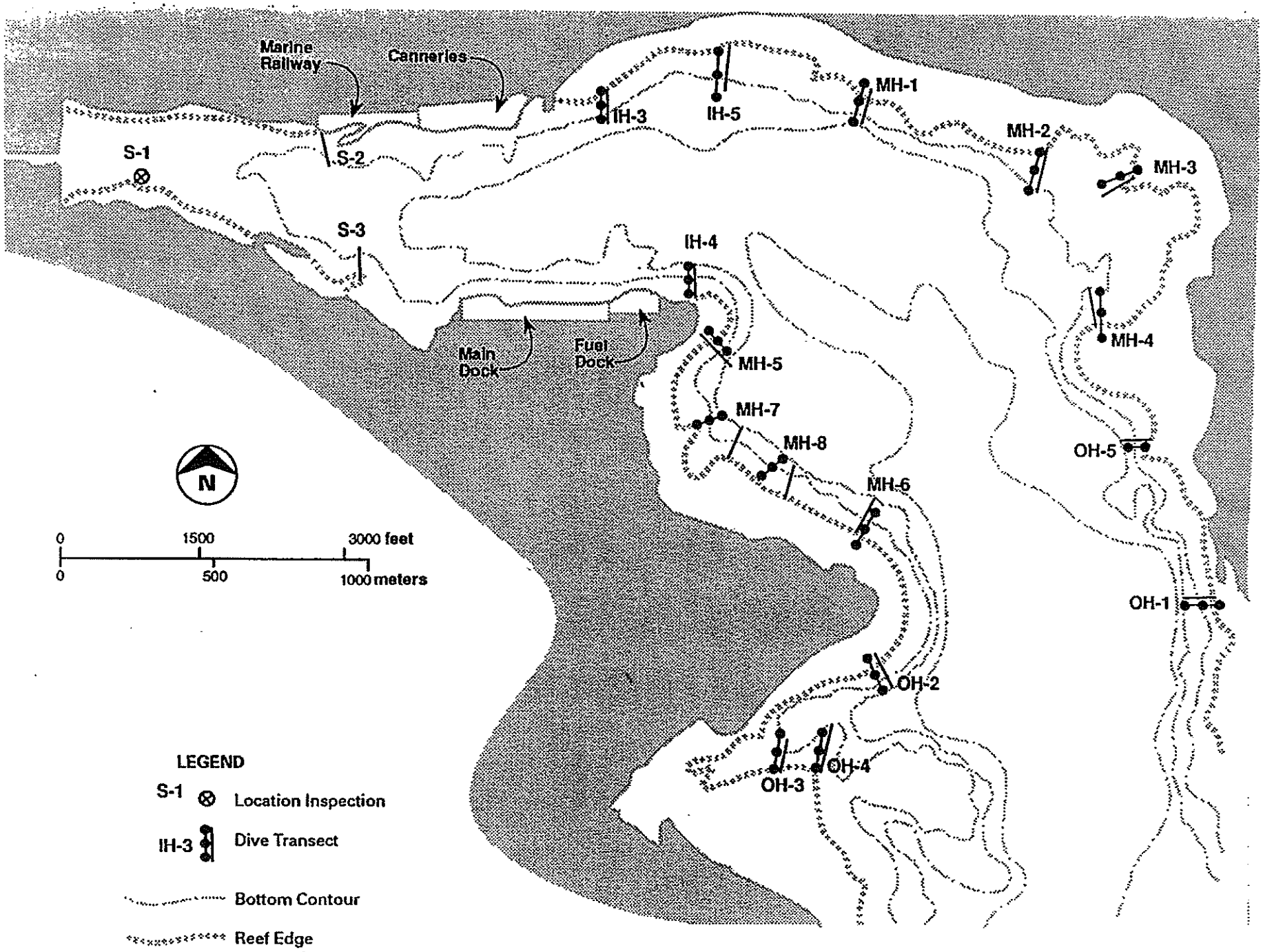

Figure 1

Coral Reef Transects in Pago Pago Harbor

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STUDY METHODS

FIELD SURVEY METHODS

The following section describes the methods and equipment to be used for the coral reef surveys, including horizontal positioning at each reef site, sampling methods, and QA/QC procedures.

Field Equipment and Sampling Vessel

Field equipment requirements for the reef surveys are listed below in Table 1. A small work vessel will be used for the surveys. A three-person staff will be aboard to conduct the reef survey transects.

Table 1
Field Equipment for Coral Reef Surveys

Equipment Item	Purpose	Number of Units
Work Vessel	Field Sampling Platform	1
SCUBA diving equipment and tanks	Underwater surveys	3
ScubaPro Monitor II Dive Computer	Continuous dive logging for each diver's repetitive dives and surface intervals (safety equipment)	2
Sony 8mm Videocamera w/ underwater housing and lights	Underwater videotaping of reef transects	2
Sony 8mm Videotape player	Viewing and verification of videotape records	
Nikonos Camera good	Underwater still photographs	1
30-meter good transect line	Provide reference line for video transects	2
Transect Stakes	Establish start and end point for each transect	100
SeaKing Recording Fathometer	Record reef profile at each site	1
good Motorola Mini-Ranger III System	Microwave positioning System with 3 shore-based transponders	1

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Survey Sites and Field Positioning

Nineteen reef sites will be surveyed, and transects will be conducted at multiple depths at 16 of these sites. The three sites located in the western end of the inner harbor (S-1, S-2, and S-3) will only have a single transect conducted from the top to the base of the reef. The nineteen reef survey sites (Figure 1) will be located based on the descriptions in the 1991 reef survey logbook and photographs of the reef and shoreline at each site. A marker buoy will be set to mark each site. During the first reef survey in 1993, the horizontal position of each site will be recorded using a Motorola Mini-Ranger III electronic positioning system. The Mini-Ranger III will provide positioning accuracy of approximately ±2 meters, to document each site in the harbor. A bathymetric profile of the reef front will also be made using a recording fathometer to document each site.

good

At each of the nineteen sites, transect marker stakes will be driven into the reef at the start and end of each transect. These stakes are designed to provide a long-term reference point for each transect line along the reef-face. In 1995 and 1997, if the transect marker stakes cannot be located by visual positioning, then the Mini-Ranger coordinates will be used to locate a site and a buoy will be deployed for divers to search for the stakes.

good

Reef Transect Methods

Marine biologist-divers will record underwater video transects on the reef fronts at 19 sites in Pago Pago Harbor (Figure 1). At 16 sites (IH-3, 4, 5, MH-1 through 8, and OH-1 through 5), video transects will be recorded along the reef face at three depths. The three sites located in the western end of the inner harbor (S-1, S-2, and S-3) are remnants of reefs with less than 5 percent live coral, and these sites will only have a single transect recorded from the reef flat down to the base of the reef face. Each video transect will be conducted parallel with the reef face (along a depth contour), and along a 30-meter fixed transect line on the reef. The depths for recording the video transects will include; the reef edge (15-20 foot depth), on the reef face (at 30-40 feet depths), and near the base of the reef face (at 55-65 feet depth). The reef front at some sites (e.g. MH-3) does not extend below 45 feet, and only two transects will be conducted at similar sites. Only single continuous transects from the reef top to base, will be recorded at the three inner harbor sites (S-1, -2, and -3). Video records of the reef flat areas will also be recorded at six representative sites (IH-3, MH-3, MH-8, OH-3, and OH-5) to document reef flat conditions.

O/K

O/K

O/K

At each of the nineteen sites, two divers will descend to the three designated transect depths and hammer at 3-foot PVC marker stake into the reef to mark the transect start. These transect marker stakes are to be driven into the reef at the start and end of each transect line to provide a long-term reference point for each transect line along the reef-face. After each marker stake

a

how far from the bottom will the videos and pictures be taken?

has been established then the divers will be at the deepest transect and they will commence the transect surveys at that point. The second diver will payout the 30-meter transect line and hammer the end marker stake into the reef. The 30-meter transect line will have markings every 2.5 meters. The first diver will swim very slowly along the established 30-meter transect line with the video camera and record two passes on the line. The second diver will take still photographs at 5 meter intervals along the transect line using a 35mm camera. At the completion of the transect filming, the transect line will be picked up and moved to the next transect depth and the procedure will be repeated.

A field logbook will be maintained to include; the sampling times, descriptions of the site, transect depths, reef face structure and features, reef biota observations, and weather and sea conditions. The videotape will be viewed at the completion of each day in the field to ensure that the record is complete and to record the location of each trasect record on the video tape.

QUALITY ASSURANCE AND QUALITY CONTROL

The quality assurance and quality control objectives for the coral reef surveys are to record representative reef-front transects at each site and provide scientific interpretations and summaries of these reef transect videos that are of known and acceptable quality. The following requirements will be followed to meet the objectives.

please explain

- Provide verifiable photographic interpretations of the reef transect videos with QA procedures to estimate accuracy and error. Ten percent of all video transects will be reanalyzed without identification to estimate accuracy and error.

OK
- Establish long-term transect markers and document survey site positions (within 2 meters) for repeat surveys.

OK
- Provide field equipment redundancy (backup equipment).

OK
- Develop a field operations and safety plan for conducting the reef surveys to summarize the schedule, survey procedures, field data recording, and safety procedures. This operations and safety plan is a key element of quality assurance and control activities.

OK
- Test all dive and photographic equipment onsite prior to the beginning of the surveys and conduct daily equipment checks.

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DATA ANALYSIS AND PRESENTATION

These surveys will be used to evaluate the condition of and changes to the reef-face habitat in areas of the inner, middle, and outer Pago Pago harbor. These surveys will be limited to providing semi-quantitative data on the type, percent cover of live reef corals and other benthic species. Reef fish identifications will be incidental to the reef habitat evaluation.

The videotape transect records will be analyzed and summarized by a qualified marine ecologist with tropical reef knowledge and several years of experience specifically in American Samoa. The videotape analysis involves repeated slow-frame viewing of the transect video to record estimates of live coral coverage and specific benthic genera. The percent of live coral will be estimated at 5 meter intervals along the transect line, for 2.5 meter segments. The still photographs will provide a secondary source for verification of estimates. Benthic genera identifications will be provided, as feasible from the video record. Field survey data and site positioning data will be summarized in tabular formats in a coral reef survey report, and supporting data will be included in the report appendix. Copies of the video records will be provided to ASEPA and USEPA along with a report of the survey findings.

how will this be quantified?

~~that~~ I

reports should include data, methods + materials, etc.