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A REGIONAL OCEAN MONITORING PLAN

Agencies discharging municipal wastes into the coastal waters of southern California have long been required by state and local regulations to monitor the condition of the water, the bottom, and the animals in the region around their outfalls. To persons involved in that program, monitoring means taking a series of samples and making measurements at specific times and places to collect data which are formally reported to the authorities. The principal objective of such monitoring is to assure compliance with the State of California's Ocean Plan and the requirements of the Regional Water Quality Control Boards. Past programs, some of which have been in existence for over 20 years, have produced a large volume of data, little of which is now of value. One would expect that such data could be used to determine long term trends in ocean conditions, or show environmental changes, or at least indicate the extent of outfall effects. Unfortunately, they can not.

Now that EPA is about to permit the discharge of wastewater not subjected to secondary treatment under the 301h waiver plan, additional monitoring will be required. This seems a good time to consider whether the overall monitoring effort might be coordinated to produce results that are broader in scope, of greater long range value, and more cost effective.

Since the underlying purpose of monitoring is to keep track of the conditions of our coastal environment and to respond to any public concern about it, it would seem logical to produce periodic reports showing the condition of those waters and the extent of outfall effects. Present monitoring data is insufficient for this purpose although it can be done using SCCWRP's data base.

ROMP, the Regional Ocean Monitoring Plan described here, was first suggested by the author in 1980. It was based on the straightforward idea that monitoring could be made more useful and efficient if all the dischargers in this region were to make the same kind of measurements with the same kind of equipment at the same time of year at the same depths and report their findings on the same scale charts using the same units. Data in such a form are easy to collate, compare, and convert to statements about regional conditions.

The ideas and suggestions put forward here are the work of an *ad hoc* group of some 30 technical persons representing the dischargers, the Regional Water Quality Control Boards, and inter-

ested government agencies. This author served as chairman of the group; Greg Pamson headed the subcommittee on Benthic Monitoring; Dr. Terry Hendricks led the subcommittee on Data Management. The third revision of the plan, dated January 1982, noted that the plan would not be considered complete until it fully met the requirements of the responsible authorities (including EPA and the State and Regional Water Quality Boards) and has the approval of other interested agencies including NOAA, California Fish and Game, and perhaps others.

We began by defining monitoring as "A continuing series of specific measurements (either *in situ* or on samples) intended to determine the condition of the marine environment–especially with respect to the effect of ocean outfalls."

Monitoring should be accompanied by research on monitoring, defined as "Scientific investigations of measurements that might be used in future monitoring programs." The objective of such research would be to determine which measurements are most useful and how they can be made most efficiently. Before a new measurement can be added to a general monitoring program it must be standardized, tested, and the variability determined to demonstrate that useful results can be obtained. When new monitoring techniques are developed that are deemed suitable for general use, they can replace, or be added to the existing monitoring requirements.

This planning effort is directed towards improving man's knowledge of coastal conditions without increasing the cost of information gathering and can be accomplished by applying modern thinking.

SITUATION IN MID 1981

An examination of the present ocean monitoring programs of the five largest dischargers in southern California shows that each of them measures different aspects of the environment. The kind of samples taken, the methods of sampling, the spacing of samples, and the time between samples vary considerably. This is surprising, considering that all are responding to the same state and federal laws and regulations. Except for satisfying the immediate requirements of the law, it might be hard to demonstrate that anything substantial has been achieved by past monitoring programs. It would be better if a fund of reliable data had resulted from the considerable expenditures.

This is partly because the present programs were devised by different people to fit different situations. Over 10 years ago when no one was confident about what should be measured at what intervals of time and space, the monitoring programs were considered to be experimental. The various dischargers used different sampling equipment; the personnel involved had different levels of interest and skill; the locations of repeat samples varied because of inaccurate navigation. Few of the subsampling, preparation, or analysis techniques were standardized. One result of this unduly wide variation in the data was that myths arose about rapid change and great variability. In some areas this led to an unwarranted requirement for multiple replicates.

Now, with a decade of experience and research behind us, we have an array of new equipment and tested techniques; we are able to navigate precisely, take similar samples time after time, and process them so that there are relatively minor variations between them. Now we are no longer groping for clues about the extent of the area affected by each outfall; we have charts showing the extent of various effects and can lay out a monitoring program that will show how each of these is changing. Today we know which animals are the best indicators of change and which chemicals are most important. We know which diseases are natural and which are related to the discharges. We know where suitable control or background conditions can be found and that there is substantial natural variation in chemical and biological conditions in these undisturbed regions. Recently obtained control data gives us a better basis for defining normalcy.

Until now monitoring data has not produced a generally usable long-term data base and it has not contributed significantly to scientific research. The dischargers feel that the costs (totaling several million dollars a year) have been unnecessarily high relative to the benefits received and that future monitoring programs should at least produce data that are usable in long-term environmental studies. Many of the questions asked in EPA's 301h waiver requirements could not be answered by reference to past monitoring data. There has never been a complete reconsideration of monitoring activities in the light of the scientific findings of the last decade and analysis of past data. Technical people believe the entire ocean monitoring program should be re-evaluated. It is apparent that the disconnected "puddles of data" around the end of each outfall do not give an adequate picture of the effects of outfalls on our coastal waters. Many samples are taken close to the discharge where the effects are obvious, but few are taken where the affected area is changing. A new program is needed that will give a more useful and understandable picture of the conditions along those parts of our coast that are at greatest risk.

OBJECTIVES

The objectives of an ocean monitoring program should be to: Develop data that document both natural conditions and the effects of outfalls on the ocean environment. These data will be used to: (1) determine compliance or noncompliance with applicable water quality objectives, (2) provide data that can be used to respond to actual and perceived concerns, (3) build a long term data base, and (4) contribute to a better understanding of coastal ecology.

The objective of ROMP is to propose specific ways in which monitoring can be made more valuable and cost-effective. The intention is to obtain a consensus of all interested parties on a plan that will meet the objectives stated above. We suggest that the techniques used for sampling, measuring, analysis, etc., be the best that are reasonably achievable.

Standardization of data gathering is the key to this plan, but enough flexibility is incorporated to take into account differences in discharge depths and the extent of effects of various dischargers. Any participants who wish to do so are free to make any additional measurements they deem necessary.

THIS REGIONAL OCEAN MONITORING PLAN PROPOSES:

1. Sampling stations that are more evenly distributed; that are positioned along contour lines; and that better document the extent of outfall effects. Where practical, they should coincide with previously used stations.

2. Measurements at multiple control stations to obtain background data on ocean variability that will be usable by all.

3. Bridging stations between the outfall-affected areas so that the data are continuous and productive of an overall coastal picture.

4. Standardized equipment for navigation, sampling, and measuring, both at sea and in the laboratory.

5. Standardized forms, charts, and scales; standardized processing, archiving, and data storage; and standardized analysis techniques and reporting procedures.

6. Computer storage of data by each contributor and the ability to obtain comparisons of data and computer-made charts of various effects.

7. Ways of training monitoring personnel to insure consistent results.

8. Quality control procedures that involve intercalibration of certain biological and chemical measurements.

9. Discontinuation of measurements that experience has shown to be of little value in favor of others that will be of greater value for long-term environmental assessment.

10. Measurement of the actual toxicity of all effluents after normal dilution.

We call attention to the fact that this proposal does **not** deal with monitoring in sewage treatment plants, or anywhere ashore, or with bacterial sampling along the beach.

THE MONITORING RESEARCH PROGRAM

The monitoring program proposed requires samples and measurements be taken at specific times and places, under specified conditions. However, the ROMP group recognizes that there may be better ways to detect the effects of wastewaters on the biota or to forecast changes in coastal waters. We feel that research on ideas that can contribute to future monitoring should proceed concurrently with the monitoring proposed. Then, as improved techniques are developed, they can replace the methods presently proposed.

The objective of the research would be to develop better techniques for:

1. Measuring and evaluating sub-lethal effects on marine plants and animals. The questions of which species should be used, whether measurements are best made in the sea or in the laboratory, and exactly what should be measured all need to be investigated. The most promising possibilities should be experimentally tested.

2. Predicting changes in the biota and bottom that would result if certain changes were made in the discharges. Predictive capabilities are improving as more variables are added to the mathematical models. These variables must then be confirmed by actual measurements in the sea. Many important questions relating to the chemical/bacterial transformations in the sediments, the effects of large episodic marine disturbances, and the relation between possible pollutants and animals remain to be explored.

3. Determining if new chemicals entering the environment (detected by measurements made in treatment plants) are present in marine animals and defining the extent of their toxicity.

4. Analyzing the data obtained by the regional monitoring program from a long term point of view so that useful generalizations can be drawn and the overall program can be combined with other scientific measurements.

5. Continuing development of taxonomic identification procedures for both invertebrates and vertebrates will be needed.

6. Counting small animals more accurately and rapidly, making *in situ* chemical determinations, and measuring/sampling various aspects of the environment.

7. Measuring subsurface currents so that it is possible to understand anomalous monitoring results or the onset of seasonal changes.

THE MONITORING PLAN

This plan builds on and makes use of existing monitoring plans and past research on monitoring done by SCCWRP. Any changes from the past are intended to bring uniformity to the sampling methods, and regional logic to the spacing of sample stations. The best available technology will be used and it will be improved as the research program shows better ways to conduct monitoring. We believe that the best course is to begin by following this plan, acknowledging that it will be altered in accordance with findings, future needs and better measurement techniques.

In the version of ROMP that was distributed for consideration, actual sampling and measuring techniques were specified. They are those ordinarily used by this Project and some of the dischargers and need not be repeated here. We also specified the suite of equipment that has been used by this Project, emphasizing the need for LORAN C navigation, the Van Veen chain-rigged grab, and the Willis 10 m trawl.

Sampling stations were selected in accordance with the depth of the outfalls (mostly 60 meters) and experience in observing outfall effects. Since currents which generally flow parallel to contours distribute the falling organic particles, the effects of outfalls usually follow depth contours. Marine animal populations also tend to be distributed by depth. Therefore, the sampling stations were located mainly at depths of 30, 45, 60,and 150 meters. Exceptions were made at the shallower Ventura outfall where 15 and 20 meter depth stations were added and at the LA County outfall which needs to be monitored along the 300 meter contour.

Stations at the above depths were organized along transects which are orthogonal to the coast and spaced about three kilometers apart. Additional stations at outfall depth were located immediately adjacent to the outfall, at distances of 500 m, and at the distance where "normal" conditions (based on an Infaunal Index of 60) had been observed. Numbers of stations and numbers of replicates to be taken in each time of year were specified. In the main, these station locations coincided with those used in the past so that the data would form a continuum and comparisons could be made.

The stations described above were appropriately spaced to detect important changes in the bottom and the sea life. They blanketed the shelf from Malibu to Newport, a distance of about 80 km. Included within that grid were two groups of "bridging" stations whose data would fill the measurement gaps between the Los Angeles City and County outfalls and between Los Angeles County and Orange County. The purpose was, of course, to provide information so a continuous picture of the region could be made.

Outside the above region, where man's effects were most probable, there were three other groups of stations. One, off Point Loma in the San Diego region, was intended to monitor the effects of that outfall. The other two were groups of control stations.

Ecology is a relative science. One must compare any area thought to be changed or damaged by man with a similar area that is believed to be unchanged. Many allegations of environmental damage have been made by persons who were unaware of normal conditions. In our judgment the controls used in past monitoring were inadequate. Therefore, we laid out four transects, with stations at the same depths as those near the outfalls, two in western Santa Monica Bay and two west of Pt. Dume, where Infaunal Index values of 90 or more had been found. These were called "west controls" and "south controls." They would be used as a basis for determining changes not caused by man and as a basis for judging contamination or damage resulting from the outfalls.

All the station locations were presented on a coded chart that is not presented here. There was some redistribution of monitoring effort in accordance with need; under this plan some agencies would take more samples and others would take less than at present. Overall, the total number of yearly grabs was reduced to 451 (relative to 760) and the number of trawls increased from 92 to 103. These changes were not presented in a rigid manner, but as an example of the principles involved.

Other parts of the plan described how the data from 5 monitoring agencies and SCCWRP would be handled, stored, and processed. There were discussions of a mutual teaching program to improve data gathering techniques and of analysis programs that would benefit all participants.

Although there was a very high percentage of agreement about the value of this plan among the technical people involved, a few of the regulatory personnel objected to some points and, at this writing, have not agreed to implement it entirely.

This plan is presented here to demonstrate that more useful data can be obtained at less cost if monitoring programs are modified in accordance with scientific findings. Few, if any, monitoring programs have given adequate attention to establishing clear objectives in advance. Instead of deciding what is needed to show specific levels of change and why these happened, there has been a tendency to require more stations, replicates, and metals measurements, without much thought as to how these will be used. A thoughtful reading of the other papers in this report may be helpful to those planning monitoring work.