DREDGINGS DISPOSAL IN THE HAURAKI GULF

SECOND REPORT OF THE TECHNICAL REVIEW PANEL

Office of the
PARLIAMENTARY COMMISSIONER FOR THE ENVIRONMENT
Te Kaitiaki Taiao a Whare Pāremata

REVIEW PANEL

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ACKNOWLEDGEMENTS

The Commissioner wishes to thank the staff of Ports of Auckland Ltd and their consultants, staff of Auckland Regional Council and members of the New Zealand Underwater Association for their assistance.

ISBN 0-908804-48-2

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1. INTRODUCTION

The Parliamentary Commissioner for the Environment established a Technical Review Panel in late 1992 to assist the Auckland Regional Council (ARC) and Ports of Auckland Ltd (POAL) to review the monitoring programme established as part of the water right granted for the disposal of dredgings from the Port of Auckland to a site in the Hauraki Gulf.

The Panel met in February 1993 and a report of that meeting is contained in its first report (Parliamentary Commissioner for the Environment, August 1993).

The second meeting of the Panel was held in August 1993 and this report summarises that meeting.

2. PURPOSE OF SECOND MEETING

The purpose of the second meeting was to review the monitoring carried out between February and August 1993 and to make recommendations to ARC and POAL for any changes to Condition 11 (as allowed for in the granted water right).

The monitoring programme includes physical, biological and chemical monitoring at sites located up to 750 metres upcurrent and downcurrent from the disposal site as well as biological and water quality monitoring at The Noises Islands and at a control site. The full programme is outlined in Appendix 1.

Survey Three was conducted in April 1993 and included: a biological survey including a bioaccumulation survey and a survey of benthic biota; a sediment chemistry survey and a physical survey including bathymetry and particle size analysis of sediment. Biological surveys Five and Six at The Noises and Tiritiri Matangi Island were conducted by January 1993 and by March 1993 respectively. The report on Survey Five was made available to the Panel and a briefing on the results from Survey Six was given to the Panel members at the meeting.

3. REVIEW OF MONITORING PROGRAMME

The Panel's findings on the monitoring programme are as follows:

- There have been no obviously damaging effects on the benthic community surrounding the disposal site.
- A loss of fine sediment from the disposal mound has been indicated but the amount or extent is not clear. Results have been within the errors of the measurements making their interpretation difficult and uncertain.
- The decreased concentrations of copper, lead and zinc in the surrounding sediments do not seem to be significant.

- The results of the analysis of the DDT components in the sediments indicate a problem of contamination has arisen during sampling or analysis.

3.1 Monitoring in the Vicinity of the Disposal Site

The Panel considers the programme of benthic biological monitoring undertaken in the vicinity of the disposal site has progressed satisfactorily. Results of the core sampling around the disposal site indicate that to date there have been no obviously damaging effects on the benthic community.

Similarly, whilst the monitoring of sublittoral rocky epibenthos and (predominantly) sandy gravel infauna at The Noises Islands and Tiritiri Matangi Island has revealed changes in species diversity and abundance, these appear to be consistent with an expected degree of natural variability.

The purpose of studying the sediments from the disposal mound is to determine that the material actually deposited at the site has a chemical composition similar to the average composition of the dredged material. This has been established in Survey Three. The chemical surveys outside the disposal site have not identified any significant changes.

3.2 Monitoring on the Disposal Mound

Chemical Analysis

Chemical analysis shows reduced concentrations of some of the components that are enriched in the Port sediments. Although this might point to a loss of fine material, the picture is not consistent across all of the components. Pollutants such as the trace metals and trace organics are commonly supposed to be present largely in the fine (i.e. mud) fraction of harbour sediments but this has not been demonstrated for the sediments from the Port of Auckland.

Copper, lead and zinc all show concentrations towards the lower end of the range found in Port sediments. For both copper and zinc there have been problems of consistency in the analytical results from different surveys possibly as a consequence of the effects of sample handling and processing. This is a very common problem in sediment analysis for trace metals and is neither unique to this monitoring programme nor an adverse reflection on the quality of work conducted. It is therefore difficult to attach any significance to the decreased concentrations of copper, lead and zinc. The results could indicate a loss of up to 30% of dredged material if the fine material was enriched in these elements. However, without information on the actual concentrations of copper, lead and zinc in both the sand and mud fractions of the fine material, this estimate of loss remains imprecise.

For mercury (and lead), fewer problems with consistency were observed in previous work. The mercury results of Survey Three are essentially the same as the dredged sediments. This is not consistent with a major loss of fine material if it was enriched in mercury.

The organic components are, by and large, more sensitive tracers. Polynuclear aromatic hydrocarbons (PAH) are enriched in the Port sediments by a factor of about 13 relative to the disposal site (pre-disposal), while the factors for PCB and DDT are 32 and 100 respectively. For both PAH and PCB, the disposal site concentrations are essentially the same as those of the Port sediments. DDT is the most sensitive tracer. However, the results presented in the Appendix (to the Draft Survey Three Report) indicate that a problem of contamination has arisen during processing and analysis of the samples.

In conclusion, the most sensitive tracers (organics, mercury) suggest that the dumped sediment has the expected composition based on studies of the Port sediments before disposal. There are unexplained features with the results for the other trace metals that probably arise from analytical variations.

Bathymetric Analysis

The bathymetric surveys indicate that the initial spoil volumes of 262,000 m^3 may have reduced to 202,000 m^3 and 176,000 m^3 in two subsequent surveys. However, the process of consolidation of the spoil and errors in the survey accuracy make these estimates unreliable. Some loss of fine material is obviously to be expected either during the disposal operation or as winnowing off the mound from the top layers of spoil but the extent of the loss is difficult to demonstrate.

Textural Analysis

Textural analysis of sediment on the mound has been carried out on a limited number of samples. Because only the top approximately 6 cm of a sample was analysed, it cannot be assumed that these samples are fully representative of the texture of the mound overall. The results give a sediment composition of 57 $\pm$ 14% mud and 42% $\pm$ 13% sand in the disposal zone. The draft of Report 24 (Survey Three results) describes this as lower than expected, as the average mud content of sediment in the port is 81% to 84%. The reduction in the percentage mud in the spoil at the disposal site could indicate a loss of sediment from the disposal mound of up to 31%, if the sample results applied to the whole mound and if it is assumed that only mud is lost by dispersion and winnowing.

4. REFINEMENTS TO MONITORING PROGRAMME

As a result of evaluating the results of the monitoring programme, the Panel considered possible amendments to the programme.

4.1 Benthic Community Monitoring

The second post-disposal monitoring survey of macrobenthos outside the disposal site, which is due to be carried out in October 1993, 12 months after the completion of the disposal of dredged material, could be deleted.

Differences in species diversity, total abundance, brittlestar abundance, and biomass for samples collected around the disposal site appear to be consistent with expected natural variability and, in particular, sedimentary gradients. The period of greatest potential physical disturbance to the benthos, the disposal operation, occurred without obvious impacts on benthic community structure in areas adjacent to the disposal site.

It is unlikely that significant changes in benthic community structure due to dredgings disposal will become evident around the disposal site during the second post-disposal monitoring survey unless there is a sudden and major movement of sediment off the disposal site, or there is some chronic sublethal effect of disposal on adjacent sediment benthos which begins to manifest itself. These possibilities are not likely because of:

- the local hydrodynamic and sedimentary environment is well characterised,
- the deposited sediment is likely to have increased in stability, and
- there has already been rapid recolonisation at the disposal site .

4.2 Benthic biomass

Determining biomass of sediment macrobenthos would seem to be of limited value and could be deleted from future surveys.

Biomass is sometimes used for monitoring, probably most effectively by employing the Abundance Biomass Comparison method which takes account of the distribution of biomass among species. The rationale for this approach is that sediment benthic communities in early successional stages of recovery tend to be characterised by a few small short-lived species which can reach high population densities. By contrast, the mature community is typically more diverse and contains more longer lived species that attain larger body size but at smaller population densities. Consequently at early successional stages biomass is distributed among a large number of individuals of few species, but as the community recovers biomass becomes distributed among more species of higher individual body weight. To use biomass data in this way, however, would entail a considerable increase in laboratory time.

The monitoring programme specifies that biomass is to be determined for benthic macrofauna to at least the level of class. In the reports on physical and biological monitoring of the dredgings disposal site, biomass data are given for species (in the case of the abundant echinoderms, the heart urchin *Echinocardium cordatum* and the brittlestar *Amphiura rosea*), and for the trophic group (in the case of the major annelid and molluscan classes). This degree of resolution may provide some indication if the community had been knocked back to an early successional stage. One would, for instance, expect to see an abundance of small surface deposit-feeding polychaetes and few of the dominant sub-surface echinoderms. But such changes would be revealed in the abundance data, and it appears doubtful if the biomass data in the form specified in the water right conditions provide useful monitoring information. The results from the biological monitoring indicate that the distribution of the biomass can be strongly influenced by large individuals.

4.3 Chemical Analysis

There seems to be little point in repeating the on-site chemical analysis. It has been established that the deposited sediment has the expected chemical composition. Little would be served by repeating the measurements. The variations in results for copper and zinc are probably a result of procedural factors and only confuse the essential issues. However, the problem of the DDT results must be resolved as DDT is the most sensitive tracer. If it is shown that the present set of samples are themselves contaminated, it may then be necessary to resample for DDT analysis.

The off-site chemical measurements could be usefully simplified by focusing on a more restricted range of tracers. Taking into account the nature and costs of the analytical methods used, reductions in the measurements could be made without significant loss of information quality. The PCB and PAH analyses could be deleted from the next off-site programme. Although the trace metals copper, lead and zinc are less sensitive tracers than the organics, the analytical methods involved are much simpler and less prone to contamination artifacts. Moreover, removing one or two of the metals from the list would not result in a significant cost reduction given the common sample preparation needed for each analysis. Thus it does not seem useful to change the trace metal component of the measurement programme.

5. ADDITIONAL MEASUREMENTS

The issue of whether the disposal site is a containment site which was raised at the Panel's first meeting in February 1993 has been a subject of discussion among Panel members and staff and consultants of ARC and POAL. The Planning Tribunal was presented with a considerable body of evidence on the issue of containment. The monitoring programme focused on the effects of the dredging disposal on the surrounding environment.

Even if it has been determined, on the basis of evidence available before disposal, that a site has the physical properties that will ensure containment of most of the disposed material, the Panel considers it is sensible, prudent and reasonable to include in the monitoring programme an investigation of possible sediment transport into areas surrounding that site.

The purpose of undertaking additional measurements suggested by the Panel is to assist in more clearly defining the sediment movement, within the spoil ground, which has been suggested by the latest results.

5.1 Cores Within the Disposal Mound

The existing programme could be replaced with two sets of measurements. In the first, cores could be collected within the disposal site. The cores should extend through the dumped sediments into the original sea bed and analysed to provide:

(i) information about the volume of spoil remaining on site;

(ii) the overburden pressure causing consolidation of the spoil and compression of the existing sea bed under the weight of the new sediments;

(iii) the grain size composition through the core to examine any changes in sediment particle size of the deposited sediment. This could assist in providing evidence of any recent loss of fines from the disposal site.

The aims of the work will be achieved by recording:

- thickness (and calculated volume) of the spoil
- bulk density
- percentage mud.

Thus a series of sub-samples would need to be taken from each core at least at the surface, mid-depth and above the bottom interface. The bottom interface may be visually obvious. However, it may be necessary to undertake chemical analyses, presumably looking for one common, easily-measured chemical, which exists in significantly different concentrations in disposal mound sediments and original Gulf sediments, to identify the bottom interface. The REMOTS camera should aid this process in the locations where the dredge spoil was thinly spread. Extreme care will have to be taken to ensure that the core is not altered during sampling.

Secondly, the coring should include some adjacent sites on the edge of the disposal site. At least 20 cores would be recommended in a spatial arrangement suitable for the calculation of volumes. Sediment on the disposal site may be moving to the east and so some cores should also be taken from the east of the main area of dumping.

5.2 Recolonisation by Benthic Fauna

Although not specified under the water right conditions, some macrobenthic sampling has been carried out within the disposal site during the first post-disposal survey. Samples taken from the central portion of the disposal site, seven months after completion of disposal, indicate rapid recolonisation to a community stage very similar to that occurring around the disposal site.

There is very little information on the rate, pattern and methods of recolonisation for this type of infaunal community in New Zealand and there is an opportunity here to obtain useful information on the response of infaunal macrobenthos to disposal of dredge material and mode of recolonisation. In particular, examination of cores taken from the disposal site (penetrating to below the original sediment surface) and from adjacent control sites, could also indicate if the burrowing fauna at the disposal site had been able to keep pace with the deposition of dredged material and ultimately regain the new sediment surface. If this had not occurred, one could expect to find a stratum rich in skeletal remains (notably from the dominant echinoderms) as evidence of recent catastrophic burial.

5.3 Fate of Fine Sediment

The indications from the results of Survey Three are that some fine sediment may have been lost from the mound of disposed dredgings either during the dredging disposal operation or subsequently as storms occurred in the vicinity. There are presently two means of identifying to what extent the sediment may have moved. One is to use those chemical components that are enriched in the sediments dredged from the Port relative to the original disposal site sediments as tracers for post-disposal movement of sediment off the site.

The other means is the bathymetric measurements taken over the disposal site. One of the difficulties with the present monitoring programme is the inherent lack of accuracy in the bathymetric surveys notwithstanding the care taken in conducting these surveys. While these surveys are indicating a net loss of sediment from the site, errors in the depths make volume calculations unreliable. As such, a datum and a more direct measure of bed levels is needed. In particular, the direct measure should account for consolidation, if it is still occurring. There are some highly technical instruments, including bottom mounted depth sounders and bed level sensors, which would give an accurate measure of the sediment levels. The cheapest option may be "stakes hammered into the sea bed". A diver would measure bed level changes on the stakes but it should be noted that this technique will provide a limited data set.

5.4 Sediment Deposition at The Noises

A photographic transect of the rocky sublittoral benthos at water depths of 18-22 m off The Noises has been surveyed by New Zealand Underwater Association (NZUA) divers, once before disposal (June 1992), and (to date) on five post-disposal occasions (from August 1992 to August 1993). Results show that on the pre-disposal sampling date the transect was relatively free of deposited material whereas on the subsequent sampling occasions a significantly greater amount of deposited material was evident. The New Zealand Underwater Association divers have, however, surveyed only this one transect, and there appear to be no measurements available to indicate natural spatial and temporal variability of deposition episodes to be expected at these water depths within the Hauraki Gulf. Thus it is difficult to judge to what extent these results might be regarded as abnormal.

There is a need for meteorological records to be examined for possible relationships between weather events and sediment resuspension and deposition. It would also be helpful, if opportunities arose, to examine other rocky sublittoral areas at similar water depths in this part of the Gulf to see if there is more widespread evidence of sediment deposition. The monitoring programme specified in the water right has used transects at 8 m and 12 m at The Noises Islands.

The Panel considers that it is important that representative samples of the material deposited on The Noises are obtained for chemical and physical characterisation. Chemical analysis should determine whether the material is primarily organic or inorganic in nature, and, if inorganic, whether it originates from the disposal zone.

5.5 Identification of Other Techniques

The Panel has indicated that other, more expensive, techniques are available to track sediment movement and these techniques may be suitable for consideration for any future monitoring programmes. These include the use of fluorescent tracers to identify the location of dredged material. The tracer could be placed on the sea bed at the disposal site and tracked through Hauraki Gulf. Other methods are:

- Long-term underwater video observations (placed on the sea bed adjacent to a wave recording current meter) would show when and if the sediment is being moved;

- Long-term measurements of waves, currents and turbidity on the spoil ground would quantify the sediment movement and the conditions when transportation takes place;

- Electromagnetic and acoustic devices which show the bed levels over several months are available with automated logging systems.

SUMMARY

The Panel reviewed the results of Survey Three carried out in April/May 1993 and concluded that monitoring the disposal site surroundings has to date not identified any adverse effects.

The Panel considered the monitoring programme could be modified where the water right conditions allow change, and could include additional measurements on the disposal site to help resolve questions that have arisen since the granting of the water right.

Suggestions have been made to POAL and ARC to refine parts of the present monitoring programme by deleting some measurements. Additional measurements to enable a better assessment of the fate of fine sediments at the disposal site to be identified have also been suggested.

The Panel will meet again at the conclusion of the monitoring programme.

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APPENDIX 1 Special Conditions of the Water Right Relating to the Monitoring Programme

Appendix C

Programme to Monitor the Effects of the Disposal of Dredged Material at the Hauraki Gulf Disposal Site.

1. Sample Sites

i Standard Sampling Locations

- 2 pairs of sites located in the upcurrent and downcurrent boundary zone (a 250 m zone around the disposal site) respectively.
- 2 pairs of sites located 300 m beyond the boundary zone upcurrent and downcurrent respectively of the sites specified above.
- 4 control sites located in areas comparable to the vicinity of the disposal site.

ii Additional Sampling Locations

- 2 pairs of sites located 750 m beyond the boundary zone, upcurrent and downcurrent respectively of the sites specified above.
- 4 further control sites, to ensure balance of design.

Minimum replicate number per site for i and ii = 4.

Where a statistically significant difference between pre- and post-disposal mean values at the standard sites for any parameter is detected, then sampling from the additional sites for this parameter will be carried out.

iii Bioaccumulation Sampling Locations

- between the disposal site and The Noises
- north of the disposal site;
- 2 control sites located in areas comparable to the vicinity of the disposal site

Minimum replicate number per site for iii - 3 (pooled)

2. Physical Monitoring

i A bathymetric survey of the disposal site and surrounding seabed.

ii Sediment samples collected from the standard sites analysed for particle size characteristics and the presence of anthropogenic materials. Precision of particle size analyses = 15%.

iii Samples collected and analysed in conjunction with the chemical monitoring of 4(iii) below.

3. Biological Monitoring

a Benthic biota:

i Samples collected from the standard sites analysed for the following: total abundance and biomass of all macrofauna separated to at least the level of class; abundances of the 5 major macrofaunal species. Precision for Amphiura sampling = 30%.

b Bioaccumulation:

i Scallops collected from the bioaccumulation sites analysed for copper, lead, zinc, mercury, the DDT group, chlordane, PCBs and PNAs. Precision has yet to be established by baseline monitoring.

4. Chemical Monitoring:

i Samples collected from the standard sites analysed for copper, lead, zinc, mercury, organic carbon content, PCBs PAHs and chlordane. Analyses will be carried out on the <63 um fraction. Precision = 20% for copper, lead and zinc.

ii four replicate samples collected from each of half the cells used for disposal since the previous monitoring or baseline survey, analysed as above.

A comparison will be made between the pre-disposal chemical characteristics of the dredged material and the material at the disposal site. If the new analytical data show exceedances of a guideline concentration of the dredged material average, plus three standard deviations about that average, then supplementary analysis of the collected samples will be carried out. The new data will be compared to protocol screening guidelines, and if necessary the discharged sediment will be reanalysed and tested by bioassay and bioaccumulation procedures, and remedial action carried out.

A comparison will also be made between the pre-disposal chemical characteristics of the disposal site and post-disposal concentrations at the standard site. If the new data exceed a guideline concentration of the pre-disposal sediment average, plus three standard deviations about the average then a gridded sampling programme will be instigated around the site.

APPENDIX D

Programme to Monitor the Effects of the Disposal of Dredged Material on Water Quality at The Noises Islands.

1. Sampling Locations

a) i) 3 stations located not more than 1 kilometre north of The Noises Islands.
ii) 3 control stations.

b) Depths

i) 5 metres away beneath the surface of the water.
ii) 5 metres above the seabed.
iii) mid-way between the depths specified in 1(i) and (ii) above.

2. Pilot Survey

a) Prior to the commencement of disposal, water samples shall be collected from all stations at each depth specified in (1) above on at least 12 occasions during a representative range of weather conditions. The samples collected shall be analysed for non-filtrable residue and turbidity.

b) The Grantee shall then establish:

i) a statistical relationship between levels of non-filtrable residue at The Noises stations and at the control stations, and
ii) a sampling regime.

which are sufficient to permit the detection, during the period of disposal, of an increase in non-filtrable residue of 20 g/m^3 or greater at The Noises stations, above any increase which may also occur at the control stations.

3. Impact Survey following commencement of Discharge

a) Following the commencement of discharge the Grantee shall carry out sampling as determined in accordance with (2b) above, except that this survey shall include:

i) sampling at all sites and depths on at least 7 occasions during disposal of the first 150,000 m^3 of dredged material, and then sampling at least once per week until the completion of the disposal operation.
ii) Sampling following disposal on each day when winds in excess of an average of 17 knots and from a northerly direction as measured at the Whangaparaoa Meteorological Station (between NW and NE) have prevailed for at least 6 hours prior to disposal.

b) The timing of sampling shall relate to disposal events as follows:

i) disposal during ebb tide or the first 3 hours of flood tide - samples shall be collected within one hour of the next high tide.

ii) disposal during the second three hours of flood tide - samples shall be collected within one hour either side of the second high tide following this disposal event. Provided that if monitoring is required during the official hours of darkness it may be delayed until the next succeeding high tide.

c) The samples collected shall be analysed for non-filtrable residue and turbidity. Wind and sea state conditions prevailing during the 24 hours preceding each sampling occasion shall be recorded.

APPENDIX E

1. Sampling Locations

a) Sites:

i) 3 vertical transects located on the rocky substrate of The Noises Islands, 2-3 sites on each transect.
ii) 3 vertical transects at a control location, 2-3 sites on each transect.

2. Survey Parameters

Each survey shall consist of photographs of the biota occurring within permanent guadrats established at each site. Digitising techniques will be used to quantitatively assess any changes in biota recorded by the photographs.

3. Survey Timing

The surveys will be carried out in accordance with the following programme:

i) three times prior to the commencement of disposal.
ii) during disposal, one survey, prior to the completion of dumping.
iii) 3, 6 and 12 months after the completion of the disposal operation.