
**REPORT TO CORE AREA LIQUID WASTE MANAGEMENT COMMITTEE
MEETING OF WEDNESDAY, 28 NOVEMBER 2007**

SUBJECT **MACAULAY AND CLOVER POINT WASTEWATER AND MARINE ENVIRONMENT
PROGRAM – 2006 ANNUAL REPORT**

PURPOSE

To present the results of the Macaulay and Clover Point 2006 Wastewater and Marine Environment program (WMEP) and the comments and recommendations of the Marine Monitoring Advisory group (MMAG).

BACKGROUND

The Core Area Liquid Waste Management Plan (LWMP) commits to reporting on the WMEP annually to the Capital Regional District (CRD) Board and the Ministry of Environment (MOE). The report, *Macaulay and Clover Point Wastewater and Marine Environment Program – 2006 Annual Report*, by CRD Scientific Programs, has been reviewed by the MMAG and is now completed. The report's executive summary is attached as Appendix A and a summary brochure for distribution to the public is attached as Appendix B. The complete report is available on request from the CRD Environmental Services department. The 2006 annual report presents monitoring results (parameters monitored are listed in Appendix C) and additional investigations for the Macaulay and Clover Point outfalls. This staff report also presents the MMAG's report to the MOE that reviews the 2006 program (Appendix D).

1. 2006 ANNUAL REPORT

Wastewater Quality

The Macaulay and Clover Point wastewater discharges met receiving water quality guidelines for the protection of aquatic life well within the 100m initial dilution zone (IDZ) around each outfall. This is based on minimum dilutions of effluent concentrations in the marine environment.

Surface Water Quality

Surface water above the Macaulay and Clover Point outfalls showed fecal coliform levels generally well below the value of 200 CFU/100mL, indicating that health effects from primary contact recreational activities are not expected. The data indicate that the effluent plume was trapped below the surface during monitoring events, as predicted by the hydrodynamic model.

Seafloor Monitoring

Macaulay Point Outfall

Sediment Chemistry

Sediment chemistry data were compared to various sediment quality guidelines (SQGs), including guidelines from the MOE. Data comparisons indicate that areas above SQGs are primarily limited to within 200m southeast of the diffuser. It is important to note that values above the SQGs are only an indication of potential effects on the receiving environment. If potential effects are indicated by SQGs, a

complete assessment then follows to determine if effects are present. This assessment would evaluate the health of biological communities living on or in the sediments.

Sediment chemistry data were also analysed to determine if there were any changes in chemical concentrations in the sediments from 1990 to 2006. Concentrations in sediments have gone down over this time for a number of substances. These include nickel, zinc, lead, several polycyclic aromatic hydrocarbons (PAH) and 1,4-dichlorobenzene.

A few parameters showed increases over time (e.g., cadmium, silver and phenol). The CRD Regional Source Control program (RSCP) is proposing to implement a new program component – priority contaminants management – to specifically target these components and reverse this trend.

The 2006 sediment chemistry results are generally consistent with previous years and the recent review conducted by the Society of Environmental Toxicology and Chemistry (SETAC) panel that concluded the sediment chemistry findings do not indicate a negative change over time.

Seafloor Communities

In 2006, there were more animals at all the outfall stations than at the reference area. The number of types of animals was also generally higher at outfall stations. These results are consistent with the SETAC panel report findings. The indicators used for the seafloor community showed an area of effect confined to within 200m away from the outfall terminus, and to the southeast, similar to previous years.

Clover Point Outfall

Sediment Chemistry

Sediment chemistry data were compared to the same SQGs as for Macaulay Point. Data comparisons indicate that areas above SQGs are primarily limited to within 100 to 200m east-southeast of the diffuser. Similar to Macaulay Point, it is important to note that values above the SQGs are only an indication of potential effects on the receiving environment and a complete assessment is required to determine if effects are present.

Sediment chemistry data were also analysed to determine if there were any changes in chemical concentrations in the sediments from 1990 to 2006. A number of substances in sediments have gone down over this time, including phenol, total phenols and several PAHs. Several substances showed increases including some metals, such as arsenic, chromium, iron and manganese. Again, these increasing trends can be addressed through the proposed RSCP priority contaminants management program.

Mussel Communities

The 2006 results indicated no negative effects on mussel communities living on the seafloor around the Clover Point outfall. Mussels closer to the outfall were fatter and longer than those at the reference area. These results are consistent with the SETAC panel report findings.

Analysis of chemicals in the tissues of mussels showed that most metal concentrations were lower near the outfall than at the reference area. Most organic compounds were not detected in mussel samples.

Additional Investigations

Additional investigations are important elements of the WMEP. These investigations are conducted to address issues that pertain to the WMEP, clarifying certain aspects of the regular program and providing data for the assessment of environmental effects. Investigations undertaken or underway in 2006 and planned for 2007 are summarized in the attached executive summary (Appendix A). Planned investigations include collaborative studies with Environment Canada and the University of Victoria on pharmaceuticals and personal care products.

2. MMAG REPORT TO MOE

The MMAG was established to advise on, provide an independent assessment of, and provide recommendations on the marine environment programs to the CRD. The group consists of scientists and experts from government and academia.

In the LWMP approval letter of 26 March 2003, the minister of environment required the annual submission of an independent report by the MMAG with comments on the Macaulay and Clover Point WMEP. This report has been completed by the MMAG and forwarded by the MMAG chair to the MOE. The letter report is attached as Appendix D.

The MMAG report indicates a general level of support for the current program. Minor suggestions for improvement were made and a pilot study to investigate the use of a different indicator of potential health effects was recommended. The group suggested that a clear link to the summary brochure (Appendix B) should be publicized to allow for wider public distribution.

All MMAG members applauded the efforts and successes of the CRD RSCP. They advocated continued support for the program. Members recommended that the CRD provide more publicity for the program and increased recognition of participating industry and/or businesses.

Three of the MMAG members provided some specific comments to the MOE. These included concern that the MacDonal report and the SETAC review, which led to the decision to require treatment, may not have been adequately peer-reviewed from a scientific perspective. Concern was also expressed that misinformation about the impacts and benefits of treatment is being provided to the public through the press, and that the CRD is not responding with enough factual information. These same members believe that the present plan for wastewater treatment should have included the current scenario as an option in the CRD's triple-bottom-line comparison of different treatment options, and that the money that will be spent on treatment could have better returns for the environment and human health if used for other projects.

ALTERNATIVES

Not applicable.

FINANCIAL IMPLICATIONS

Funding for this work is included in the annual budgets for the northeast trunk (Clover) and northwest trunk (Macaulay) systems.

SUMMARY/CONCLUSIONS

The SETAC panel report found that the CRD WMEP is one of the most comprehensive programs for assessing the effects of sewage discharges in marine environments. Results of the 2006 monitoring showed that predicted wastewater concentrations in the marine environment met receiving water quality guidelines for the protection of aquatic life, and that surface waters off the outfalls were not at levels of concern for human health. The seafloor monitoring component showed some effects on seafloor organisms (higher numbers of animals and types of animals) and deep-water mussels (longer and fatter mussels), restricted to within 100 to 200m at Clover Point and within approximately 200m southeast of the Macaulay Point outfall diffuser. Additional investigations to provide data for the assessment of environmental effects are an important component of the WMEP.

The MMAG reviewed the 2006 WMEP and indicated it generally supported the current program. Recommendations that will be incorporated into the WMEP were made in the MMAG letter report.

RECOMMENDATIONS

That the Core Area Liquid Waste Management committee recommend to the Board that:

1. the executive summary and the summary brochure of the report, *Macaulay and Clover Point Wastewater and Marine Environment Program – 2006 Annual Report*, be received for information;
2. the Marine Monitoring Advisory group letter report, *Review of the 2006 Macaulay and Clover Point Wastewater and Marine Environment Program*, be received for information; and
3. the report, *Macaulay and Clover Point Wastewater and Marine Environment Program – 2006 Annual Report*, be forwarded to the Ministry of Environment.

Laura A. Taylor, M.Sc.
Senior Manager, Scientific Programs

Dwayne Kalynchuk, PEng
General Manager, Environmental Services
Concurrence

Kelly Daniels
CAO Concurrence

COMMENTS

CL:cam
Attachments: 4

**MACAULAY AND CLOVER POINT WASTEWATER AND
MARINE ENVIRONMENT PROGRAM
2006 ANNUAL REPORT**

Executive Summary

Monitoring of wastewater discharges, surface waters and the seafloor environment in the vicinity of the Macaulay and Clover Point outfalls has been conducted as part of the Wastewater and Marine Environment program (WMEP) on a regular basis since the late 1980s. In addition, additional investigations have been undertaken to more clearly define the effects of the outfalls on the receiving environment. The program has undergone a number of changes over the years.

In March 2003, the CRD Core Area Liquid Waste Management Plan (LWMP) was approved. This LWMP outlined the plans of the Capital Regional District (CRD) to manage liquid wastes for the next 25 years. Commitments made in this plan were designed to protect public health and the environment from the impacts of liquid waste discharges. The plan committed to a number of actions pertaining to the WMEP. On July 21, 2006, the CRD received a letter from the minister of environment requesting that an amendment to the Core Area LWMP, detailing a schedule for the provision of sewage treatment, be provided to him by June 30, 2007. In his letter, the minister also requested that the CRD continue the current monitoring program.

The Society of Environmental Toxicology and Chemistry (SETAC) completed a review of the CRD core area liquid waste management programs in 2006. A number of recommendations were made for the Macaulay and Clover Point WMEP. However, these recommendations were made before a decision to move to advanced treatment was made. With the level of treatment proposed, some of these recommendations may no longer apply. Once a decision on the location and types of treatment facilities for the core area has been reached, the WMEP will be reviewed in collaboration with the Marine Monitoring Advisory group (MMAG). This review will include a determination of the objectives of the program, in light of the development of treatment, and an assessment of the monitoring and assessment studies that should be conducted to fulfill these objectives.

The 2006 WMEP consisted of:

- wastewater monitoring and analysis for a list of substances, including conventional parameters, metals and other priority substances (conducted monthly for each outfall)
- surface water monitoring and analysis for potential risk to public health, using fecal coliforms as indicators (conducted monthly at each outfall)
- seafloor monitoring for chemical (sediment and mussel tissue contaminant concentrations) and biological parameters (health of seafloor communities – benthic organisms and mussels) on a yearly basis
- additional investigations (that address specific questions about wastewater, water column and seafloor monitoring components and that look into emerging scientific issues regarding wastewater discharges and environmental effects)

The 2006 annual report presents results and updates for the different elements of the Macaulay and Clover Point WMEP, including the monitoring components and the additional investigations.

WASTEWATER MONITORING

Wastewater monitoring results for conventional parameters (i.e., pH, biochemical oxygen demand, total suspended solids and nutrients) indicated that the quality of the effluents from both Macaulay and Clover Point outfalls in 2006 were similar to 2004 and 2005 results. Concentrations of all conventional parameters were within the expected range for fine-screened wastewater and the estimated receiving environment concentrations, based on the minimum initial dilution, did not exceed BC Water Quality Guidelines (WQG).

Priority substances frequently detected in wastewater in 2006 were similar to previous years. Substances detected greater than or equal to 50% of the time included conventionals, total and dissolved metals, phenolic compounds, some polycyclic aromatic hydrocarbons (PAHs), phthalates, a few miscellaneous volatile organics and terpenes. For those substances that were frequently detected, a minimum initial dilution factor was applied to predict concentrations in the receiving environment [within the initial dilution zone (IDZ)]. Results were compared to available WQGs. In 2006 (similar to previous years), all predicted receiving environment concentrations were well below these guidelines within the IDZ, with most being below guidelines in effluent even before discharge to the marine environment.

SURFACE WATER MONITORING

Macaulay Point

Results of the monthly surface fecal coliform monitoring for Macaulay Point indicated that the effluent plume behaved according to modelling predictions. Recent hydrodynamic modelling work has confirmed that, during slack tide in winter, there is less than a 5% chance that the Macaulay Point effluent may be reaching the surface. Although the plume is highly diluted by the time it reaches the surface on these occasions (average dilution of 1580:1), fecal coliform concentrations above 200 CFU/100mL could sometimes be detected. Overall, the data indicate that the Macaulay Point effluent plume was trapped below the surface. Fecal coliforms stations' geometric means were all below 200 CFU/100mL, indicating that health effects from primary contact recreational activities are not expected. Only 12 individual measurements out of 456 (representing 2.6% of surface water samples) were above the value of 200 CFU/100mL. The highest value measured was 2,000 CFU/100mL and all 12 results occurred in the winter months.

A recent trend analysis of 1990 to 2005 data showed statistically significant seasonal variability in fecal coliform data. Concentrations consistently decreased in the spring, were lowest from May to September, and increased again towards the winter. This pattern is attributed to the higher effluent flows in winter (due to rain storms and the related inflow and infiltration into the sewer system), coupled with the oceanographic conditions (i.e., stratification) that result in a small percentage of diluted plume surfacing events in winter. The trend analysis showed some variations between years but these were not statistically significant. Overall, there are no apparent increasing or decreasing temporal trends on an annual scale during the last 16-year monitoring period.

Clover Point

Fecal coliforms stations' geometric means were all below 200 CFU/100mL in 2006, indicating that health effects from primary contact recreational activities are not expected at Clover Point. There were 16 individual measurements out of 456 (representing 3.5% of surface water samples) above the value of 200 CFU/100mL. The highest value measured was 3,600 CFU/100mL and all of the 16 measurements occurred in the winter months. Results were within the expected concentrations predicted by the hydrodynamic modelling. Recent modelling work has confirmed that, during slack tide in winter, there is less than a 2% chance that the Clover Point effluent plume may be reaching the surface. Although the plume is highly diluted by the time it reaches the surface (average dilution of 1500:1), fecal coliform concentrations above 200 CFU/100mL could sometimes be detected. Overall, the data indicate that the Clover Point effluent plume was trapped below the surface.

A recent trend analysis of 1990 to 2005 data showed statistically significant seasonal variability in fecal coliform data. Concentrations have been consistently lower in the spring and highest in winter for the past 16-year monitoring period. Similar to Macaulay Point, this pattern is attributed to the higher effluent flows in winter, coupled with the oceanography of this particular area. The inter-annual trend analysis for Clover Point showed some variations between years but these were not statistically significant (i.e., no apparent increasing or decreasing temporal trends over the 16-year monitoring).

SEAFLOOR MONITORING

Macaulay Point

Sediment Chemistry

A total of 151 substances were analysed in sediments at the outfall station (M0) and the reference station (PB1) in 2006. For the remaining stations at Macaulay Point, 78 substances were analysed. An evaluation of the reliability of marine sediment quality guidelines (SQG) in predicting biological effects near the Clover and Macaulay Point wastewater outfalls was conducted in 2007. Each set of SQGs was compared to the data for each sample to identify which samples were predicted to show an effect by that set of SQGs. Then the predictions of effect at these stations were compared with the biological data to determine if the samples actually showed an effect or not. The percentage of correct results (termed overall reliability), false negatives and false positives were determined for each set of SQGs and compared to determine which SQGs best predict environmental conditions near the Clover and Macaulay Point outfalls, if any.

The SQGs that had the highest reliability were the BC Typical Contaminated Sites Criteria, Canadian Council of the Ministers of the Environment (CCME) parameter effects level (PEL) and Washington State Department of Ecology (WSDOE) 2nd Lowest Apparent Effects Threshold (2LAET). Sediment chemistry data were, therefore, compared to these SQGs, as well as the CRD SQG. Metals, phthalates and 1,4-dichlorobenzene (1,4-DCB) showed concentrations above SQGs mostly within 100m of the outfall. The only exception to this was lead at M4SE. Most of the PAH SQG exceedences were within 200m of the outfall. The only substance for which concentrations were above SQGs beyond 200m was phenol. The sediment chemistry data indicate that effects are primarily limited to within 200m southeast of the diffuser. It is important to note that values above the SQGs are only an indication of potential effects on the receiving environment. A complete assessment requires additional measures, such as assessing the health of the biological communities living within the sediments.

Analytical laboratories are working on developing methodologies that will reduce common phthalate contamination of samples, a potential source of the elevated results. The CRD Regional Source Control program has been, and will continue to be, actively promoting the use of alternative products to those containing 1,4-DCB by providing educational materials aimed at the business sectors and large organizations that use deodorizer tablets (i.e., the main product and sources containing 1,4-DCB).

A detailed statistical analysis was performed for the 1990 to 2006 sediment chemistry data to determine spatial and temporal trends, as well as identify potential substances of interest. The majority of sediment chemistry parameters significantly decreased with distance from the outfall and the strongest decreasing correlations were for cadmium, silver and 1,4-DCB. Iron and manganese exhibited statistically significant, but relatively weak, increasing distance gradients. The spatial analysis also found that only some of the 100m and 200m stations were different from the reference area (i.e., all other stations were similar to the reference area), indicating that the spatial extent of outfall effects is limited to a small area within 200m of the outfall and is related to both distance and direction. The predominant direction of outfall effect is to the east and southeast, which is consistent with the general water circulation and current patterns in the region.

Approximately half of the frequently detected substances exhibited a significant decrease over time with near-field stations exhibiting stronger decreasing trends than far-field stations. Substances that showed decreases over time included nickel, zinc, lead, several PAHs and 1,4-DCB. Seven parameters showed increases over time (although the statistical significance was weak), including aluminum, beryllium, cadmium, magnesium, selenium, silver and phenol. Using a weight-of-evidence approach incorporating the above SQG, spatial and temporal trends, seven parameters were identified as substances of interest (i.e., those that should be more closely monitored) for the Macaulay Point outfall. These include cadmium, mercury, silver, 1,4-DCB, benzo(g,h,i)perylene, fluoranthene and indeno(1,2,3-c,d)pyrene.

The 2006 results are generally consistent with previous years and the recent review conducted by the SETAC panel that concluded the sediment chemistry findings do not indicate a negative change over time.

Benthic Communities

The 2006 results were qualitatively similar to the 2002 to 2005 results. As for these years, a spatial trend of declining total abundance (TA) with distance from the outfall terminus was observed in 2006, with the highest abundance at the outfall terminus. However, the magnitude of the difference at M0 relative to other exposed stations was not as great (i.e., no longer a several-fold increase) as previous years. Although a significant trend of decreasing abundance with distance was also observed for the remaining stations, the mean abundances for the remaining distance groups were all very similar. This trend in TA is attributable in large part to abundances of a few taxa, particularly sedentary polychaetes of the species complex *Capitella capitata* and, to a lesser extent, amphipods. These species have responded to the organic concentrations of the near-field stations due to their opportunistic nature. Relative to 2004 and 2005, the most notable spatial difference in 2006 was the relatively low abundance of amphipods and other crustaceans at M0.

Taxonomic richness (TR) did not exhibit a significant spatial gradient over the study area. Richness values for most stations were only slightly higher than the reference range. The general consistency in taxonomic richness across the study area indicates that biodiversity is not significantly affected by the outfall discharge beyond the IDZ, further supporting the observed decreases in distance gradients of other benthic parameters since the 1990s.

Infaunal trophic index (ITI) values were generally lower near the outfall relative to the reference area and these differences indicate that there is a shift in the dominance of organisms from those that feed on deposited material (i.e., where ITI is relatively low closer to the outfall) to those that feed on suspended material (i.e., where ITI is relatively high away from the outfall). ITI is an index that has not previously been calculated for Macaulay Point benthic community results.

Spatial trends were evident in the analysis of major taxonomic groups. Similar to recent years, several taxa groups exhibited trends of decreased abundance with distance from the outfall terminus, consistent with the pattern of organic concentrations, including capitellid polychaetes. Gastropod, echinoderm and non-*Capitella* polychaete abundance (PA) had relatively flat gradients with distance from the outfall. Individual taxa assessments followed similar patterns.

Multivariate ordination showed that the benthic community structure exhibited a spatial pattern that was related to both distance and direction, similar to 2005 and past investigations. Stations M0, M1E, M1S, M1W, M1SW, M1SE, M2E, M2SE and M4SE exhibited similar community structures, consistent with the direction of prevalent currents in this region. Although benthic community assemblages were different adjacent to the outfall, there was little or no evidence of impairment of the communities in terms of the summary biological metrics evaluated in this study. For example, taxonomic richness was unaffected by distance from the outfall discharges relative to the reference area, indicating that biodiversity of seafloor organisms was not reduced as a result of the discharge. When all the available indicators were considered, the effects of the outfall on benthic communities were observed to be limited primarily to within 200m southeast of the diffuser. Far-field stations were qualitatively similar to reference conditions.

A definitive evaluation of temporal trends was difficult due to the pronounced inter-annual variability. However, results were similar to recent sampling years and indicate that relative abundances of polychaetes, echinoderms and miscellaneous taxa have decreased since the 1990s. In addition, taxonomic richness has increased over the same time period. Overall, the temporal analyses suggest that the benthic communities have either remained stable or have improved with respect to community health.

Clover Point

Sediment Chemistry

A total of 151 substances were analysed in sediments at the outfall station (C0) and the reference station (CB) in 2006. For the remaining stations at Clover Point, 78 substances were analysed. Sediment chemistry data were compared to the same SQGs as for Macaulay Point. As observed in previous years, a few substances were above the CRD, BC Typical Contaminated Sites Criteria, CCME PEL and WSDOE 2LAET SQGs in 2006. The substances that had levels above SQGs within the 100m IDZ included: copper, mercury and some PAHs, with all of the PAH exceedences at station C1E. The only substances that had concentrations above SQGs outside the 100m IDZ were benzyl butyl phthalate and bis(2-ethylhexyl) phthalate at stations C2NW and C4SW respectively. The sediment chemistry data indicate that outfall effects are primarily limited to within 100 to 200m, east-southeast of the diffuser. It is important to note that values above SQGs are only an indication of potential effects on the receiving environment. A complete assessment requires additional measures, such as assessing the health of the biological communities living within the sediments.

Similar to Macaulay Point, a detailed statistical analysis was performed for the 1990 to 2006 Clover Point sediment chemistry data to determine spatial and temporal trends, as well as identify substances of interest. The majority of sediment chemistry parameters decreased significantly with distance from the outfall with the strongest correlations for copper, silver, mercury, pyrene and fluoranthene. Beryllium and potassium exhibited increasing distance gradients; however, although correlations were statistically significant, they were relatively weak. Similar to Macaulay Point, the spatial analysis also found that only some of the 100m and 200m stations were different from the reference area (i.e., all other stations were similar to the reference area) indicating that the spatial extent of outfall effects is limited to a small area within 200m of the outfall and is related to both distance and direction. The predominant direction of outfall effect is to the east and southeast, which is consistent with the general water circulation and current patterns in the region. Overall, the footprint of outfall effects is smaller for Clover Point than Macaulay Point.

Seven of the frequently detected substances exhibited decreases over time, including phenol, total phenols and several PAHs. Nine parameters showed increases over time, although the statistical significance was weak, including aluminum, antimony, arsenic, chromium, iron, magnesium, manganese, selenium and 2-methylnaphthalene. Temporal trends among distance groups were also observed, with C0 having a higher frequency of increasing temporal correlations than the other distance groups. Using a weight-of-evidence approach incorporating all of the above SQGs, spatial and temporal trends, eight parameters were identified as substances of interest for the Clover Point outfall. These include antimony, cadmium, mercury, silver, benzo(a)anthracene, fluoranthene, phenanthrene and pyrene.

The 2006 results are generally consistent with previous years and the recent review conducted by the SETAC panel that concluded the sediment chemistry findings do not indicate a negative change over time.

Mussel Communities

Mussel mean lengths and weights for 2006 were greater at most locations than at the reference stations (i.e., growth enhancement or stimulation occurred around the outfall). The qualitative temporal trend assessments revealed no apparent patterns over time for mussel length or weight when comparing 2006 results to 1998 to 2005 data indicating that, in general, mean mussel sizes have not changed over this time period. In previous years, mussels near the outfall have been either older or younger than the reference mussels; in 2006, ages at all stations were similar to those at the reference stations. The gonad index was negatively correlated with distance from the outfall, with the 100m and 200m stations being significantly different than the reference stations. However, reproductive timing index and sex ratio were unrelated with distance from the outfall. Overall, the 2006 biological data do not provide any indication of adverse effects to the resident mussel communities.

Tissue Chemistry

A total of 17 metals and 31 organic substances were analysed in mussel tissue in 2006. Copper and lead were qualitatively higher near the outfall as compared to the reference area. Arsenic, cadmium, magnesium, nickel and selenium concentrations exhibited reverse gradients (i.e., higher concentrations further away from the outfall). These results are similar to previous years and may be partly attributed to growth dilution (when tissue weight increases more rapidly than the rate of uptake of a particular substance and is usually the result of enhanced food availability). Other factors (e.g., physiological or seasonal) could also be contributing to the concentrations of substances in mussels. Mussel tissue metal concentrations were lower than recognized tissue benchmarks for the protection of wildlife and consumers of mussels. Qualitative temporal assessments of metal concentrations over the period 1995 to 2006 showed little change.

The majority of the 2006 high resolution PAH concentrations were substantially lower than lethal or sublethal effect threshold concentrations. The only exception to this was some total high molecular weight PAH sum concentrations above the most conservative tissue residue value. High resolution PAH concentrations at C1NE were also anomalous (i.e., they were elevated as compared to other stations and previous years). Results of the PAH fingerprinting analysis may help to determine the cause of these anomalous results. Eight of the 11 frequently detected high resolution PAHs and the sum of high-molecular weight PAHs showed statistically significant decreasing patterns with distance from outfall. Lipid content also significantly decreased with distance from the outfall, indicating that mussels had higher lipid content near the outfall supporting the assumption of a continuous source of food near the outfall. When PAH concentrations were corrected for lipid content, the magnitudes of the correlations were much reduced. PAHs naturally partition to fat and this analysis showed that correcting for lipid content is necessary to obtain a more accurate measure of distance gradients for PAHs.

Overall, the 2006 mussel tissue chemistry data do not provide any indication of adverse effects to the resident mussel communities, or to higher trophic level organisms as a result of bioaccumulation/biomagnification of contaminants. In addition, discussions are ongoing with the analytical laboratories to determine how the frequency and severity of data quality objectives failures can be minimized in the future.

ADDITIONAL INVESTIGATIONS

Additional investigations are important elements of the WMEP and are conducted to address issues that pertain to the WMEP, to clarify aspects of the program and provide concurrent data for the assessment of environmental effects. Studies undertaken as part of the additional investigations component of the WMEP are recommended and reviewed by the MMAG. Additional investigations underway and/or completed in 2006 included the following:

- completion of high resolution chemical analyses and assessment of results in 2007
- continuation of the collaborative study on the presence of pharmaceuticals and personal care products (PPCPs) in wastewater and potential environmental effects on biological communities with the University of Victoria (UVic)
- continuation of the collaborative project on potential toxicogenomic effects of municipal wastewater with Environment Canada
- collection and analysis of sediment core samples in collaboration with Fisheries and Oceans Canada
- detailed fingerprinting analysis of PAHs in sediment near Macaulay Point

Macaulay and Clover Point Additional Investigations – High Resolution Chemical Analyses

As part of the additional investigations identified by the MMAG, and to fulfil requirements under the LWMP approval, high resolution analyses for several analytes in wastewater, sediment or mussel tissue samples from the Macaulay Point and Clover Point outfalls were conducted from 2003 to 2007. High resolution substances analysed included polychlorinated biphenyls (PCBs), polybrominated diphenyl ether (PBDEs), nonylphenols, chlorobenzenes, and organochlorine pesticides. Wastewater samples

were collected and analysed for PBDEs in collaboration with Environment Canada as part of the Georgia Basin Action Plan initiative. Data collected for sediments at the Macaulay and Clover Point outfalls included nonylphenols, PBDEs and PCBs; while parameters analysed in Clover Point mussel tissue included PBDEs, PCBs, PAHs and phthalates.

The analysis of the 2006 wastewater, sediment and mussel tissue data and the January 2007 wastewater chemistry data was not completed in time to be included in this report. These data will be included in the 2007 annual report.

Collaborative Study on PPCPs in Wastewater and Effects on Biological Communities in the Marine Environment

A collaborative research project between the CRD WMEP and the UVic was initiated in 2005. This type of investigation was included in the requirements of the LWMP approval. The project consists of two components.

1. Assessment of PPCPs in wastewater and determination of potential correlation with prescription rates and demographic data

Wastewater samples from Macaulay and Clover Point were collected from 2004 to 2006. Samples were analysed for a select group of PPCPs. Concentrations will be compared to demographic and prescription data from the CRD outfall catchment areas to determine whether they can be used together as predictors of future PPCP concentrations. The environmental relevance of any observed pharmaceuticals relative to concentrations or effects data presented in the literature will also be assessed. Data are currently being analysed and were, therefore, not available for presentation in this report. Results are expected in 2007/2008 and will be presented in an upcoming report.

2. Analysis of potential toxicogenomic effects on mussels

The proposed phase one of the toxicogenomics project includes the isolation of the sequences from *Modiolus* genes that present possible gene expression biomarkers for this species. Phase two of this study will include the analysis of gene expression on various tissues from mussels of different ages and sex collected from the reference and outfall sites. Preliminary results will be available in 2007/2008 and included in an upcoming annual report.

Collaborative Program on Potential Effects of Emerging Chemicals from Municipal Wastewaters

A collaborative study between the CRD's WMEP and Environment Canada's Pacific Environmental Science Centre was initiated in 2004 to determine the potential toxicogenomic effects of wastewater on marine fish. This type of investigation was included as part of the requirements of the LWMP approval. As part of this study, effluent samples from the Macaulay and Clover Point outfalls were collected on a regular basis from 2004 to 2006 and marine fish species were exposed to different environmentally relevant concentrations. The overall objective of the study is to determine if these exposures cause changes in gene expression using a gene chip array and other toxicogenomic tools. There are no results to date to include in this report as the study is still underway.

Sediment Core Analyses

Over the years, sediment chemistry data collected as part of the WMEP have shown some variations from year to year. Variations in the measured surface concentration of a contaminant may not only reflect variations in the source. The local rates of sedimentation and mixing also affect the observed surface concentration. As a result, collecting only surface sediment can be misleading. A sediment core study was recommended as part of the additional investigations prioritized by the MMAG and undertaken in September 2006 in collaboration with Fisheries and Oceans Canada, Institute of Ocean Sciences. Three sediment cores were collected from Macaulay Point and the reference stations at Parry Bay. These cores

will be analysed for various substances. Results will be available for analysis in 2007/2008 and included in the 2007 WMEP annual report.

Fingerprinting Analyses

High variability in PAH analyses has been an issue with Macaulay Point sediment samples for a number of years. The observed presence of coal particles in collected sediments may lead to this variability. The suspected source of these coal particles is the collier SS San Pedro that ran aground at Brotchie Ledge in 1891. To confirm the coal source, the CRD has initiated PAH fingerprinting analyses using coal collected from the wreck site, Macaulay Point and Clover Point sediment and effluent samples. Results will be available in 2008 and included in the 2007 WMEP annual report.

Investigations Planned for 2007

- continuation of the collaborative study on the presence of PPCPs in wastewater and potential environmental effects on biological communities with UVic
- continuation of the collaborative project on potential toxicogenomic effects of municipal wastewater with Environment Canada
- analysis of sediment core samples in collaboration with Fisheries and Oceans Canada
- detailed fingerprinting analysis of PAHs in sediment near Macaulay Point
- assemble a database of emerging chemicals/substances of potential interest or concern

Additional details on these investigations and preliminary results will be presented in future WMEP annual reports as they become available.



Making a difference...together

2006 Annual Report Summary

Macaulay and Clover Point Wastewater and Marine Environment Program

CRD Marine Programs: Who we are

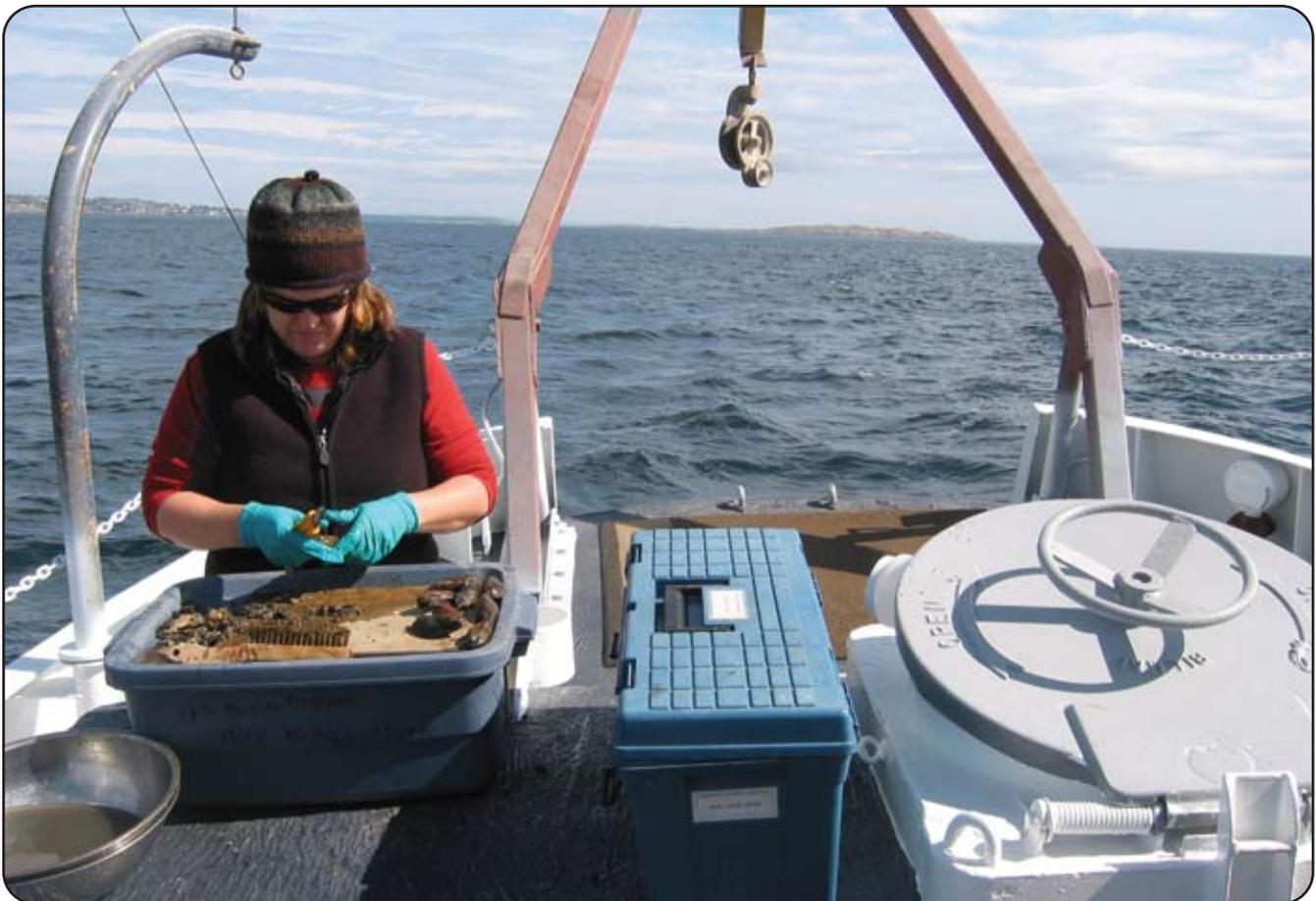
About 30 scientists and technical staff work for the CRD's Scientific Program. They include five staff in Marine Programs with a range of field and research experience. These scientists study the effects of discharges from CRD sewer systems to ensure the ocean environment and public health are safe today and into the future.

Marine Programs scientists analyze the wastewater discharged from the Macaulay and Clover Point outfalls, and both the seawater and seafloor near each outfall. Since 2000, they have added more detail to their monitoring and data analysis following recommendations made by the Marine Monitoring Advisory Group.

Since 1987, this voluntary advisory group of established scientists from government and academia, with expertise in marine sciences, has provided an independent review of the CRD's Marine Programs.

The Macaulay and Clover Point Wastewater and Marine Environment Program Annual Report presents the monitoring results and scientific investigations conducted each year. This allows CRD staff to make decisions based on the latest scientific data.

The 2006 annual report can be found online at <http://www.crd.bc.ca/wastewater/marine/reports.htm>



Macaulay & Clover Point Wastewater and Marine Environment Program

Scientific standards

Marine Programs scientists have studied the Macaulay and Clover Point outfalls since the late 1980s. Their monitoring and analysis follows a rigorous quality assurance and quality control regime both in the field and in the laboratory. For example, they use accredited laboratories and follow established scientific protocols for sampling, such as taking duplicate and triplicate samples, to confirm accuracy. Their work meets guidelines established by the BC and Canadian governments and the US Environmental Protection Agency.

The Marine Monitoring Advisory Group reviews all of the conclusions, and independent experts are often invited to conduct their own detailed analyses or to review the CRD data. In some cases, CRD scientists publish their findings in peer-reviewed journals.

"The CRD's marine monitoring program is one of the more comprehensive programs being implemented to evaluate the effects of sewage in marine environments."

Society of Environmental Toxicology and Chemistry (SETAC) Panel Report

Moving Ahead with Advanced Treatment

In July 2006, the CRD received a letter from the BC Minister of Environment requesting that a detailed schedule for the provision of sewage treatment be provided to him by June 2007. The minister also requested that the CRD continue the current monitoring program. The monitoring program will be reviewed in collaboration with the Marine Monitoring Advisory Group, once a decision on the location and types of treatment facilities has been reached.



Guidelines



Environment
Canada

Environnement
Canada



Ministry of
Environment

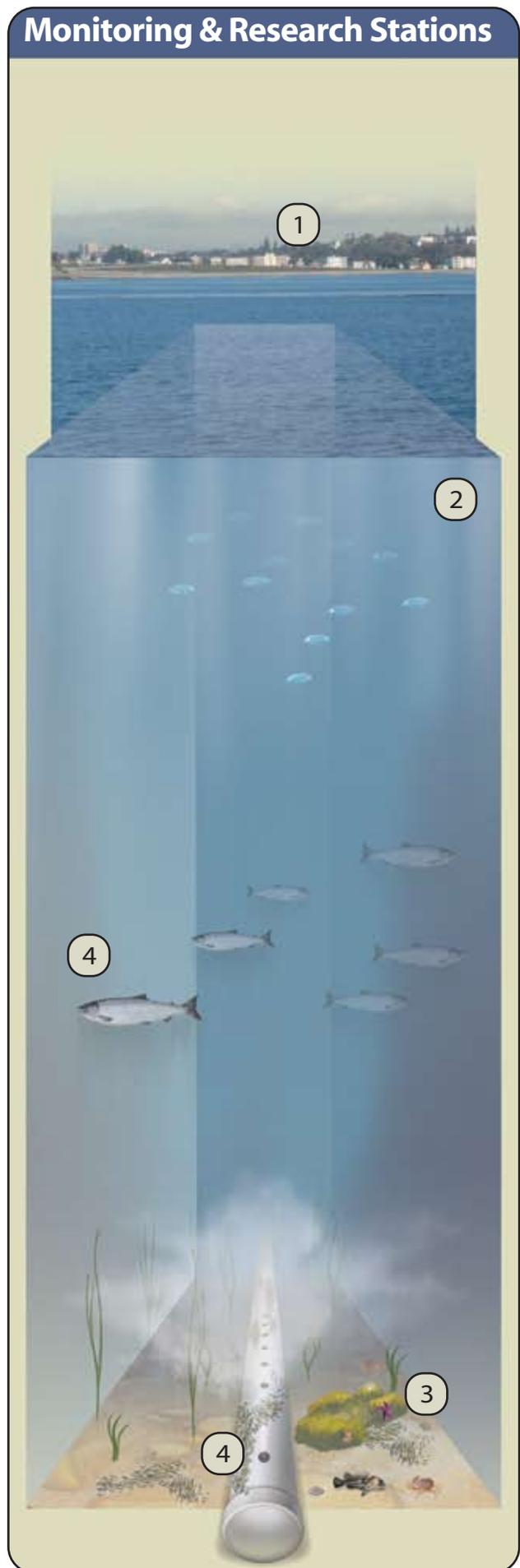
The CRD uses accredited laboratories and follows established scientific protocols for sampling including taking duplicate and triplicate samples to confirm accuracy. Their work meets guidelines established by the BC and Canadian governments and the U.S. Environmental Protection Agency.

What We Do

Monitoring and Research for the Macaulay and Clover Point outfalls includes:

- 1 Monitoring wastewater** for many priority substances every month before discharge into the marine environment and measuring flows every few minutes to make sure they do not exceed permitted amounts.
- 2 Monitoring surface water** for fecal coliforms (an indicator of potential public health concerns) every month near the outfalls.
- 3 Monitoring the seafloor** and organisms living near each outfall every year.
- 4 Conducting collaborative research projects** such as assessing the potential environmental effects from pharmaceuticals and personal care products.

As well as assessing potential environmental and public health effects, this detailed scientific monitoring and analysis provides information to the CRD Regional Source Control Program (RSCP), and scientific guidance to managers involved in the disposal of municipal wastewater.



Monitoring wastewater

What was monitored?

In 2006, Marine Programs monitored for over 180 priority substances. These included measures of general water quality, referred to as conventionals, such as fats, oil and grease, biochemical oxygen demand (BOD) and total suspended solids (TSS), as well as selected priority substances such as metals and organic chemicals.

“CRD wastewater contains fewer chemicals than many other urban areas because there is little industrial activity and the regional district has source control codes of practice and permits that require industries and businesses to treat wastewater before it enters the sewers.”

While Marine Programs scientists monitor for all the substances on a priority list, they only expect to find a small percentage of them. Some substances that are detected may occur naturally and others, such as DDT and PCBs, remain in the environment long after they have been banned because they do not readily break down. Many of the substances detected are generally found in wastewater from any treatment plant, including those with secondary or tertiary treatment.

Substances that were detected frequently in 2006 included conventionals, metals, some PAHs, phthalates, phenolic compounds, and a few substances used in solvents. Concentrations of these substances were compared to BC Water Quality Guidelines, which were developed to help protect aquatic life.

“All predicted receiving environment concentrations for 2006 were below these guidelines in the marine environment, indicating that effects on the receiving environment are not expected.”

A detailed statistical analysis of findings from 1990 to 2005 showed a significant decrease in concentrations of metals such as cadmium, chromium, copper, lead, mercury, nickel, zinc and a few organic substances. Many of these decreases are in large part the result of the continued efforts of the CRD RSCP.

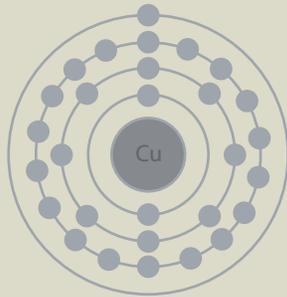
Some substances such as certain PAHs showed some increases over the past 10 years at Macaulay Point. Marine Programs, in cooperation with the CRD RSCP, is investigating the reason for increases in contaminants.



General results for the six main categories of priority substances measured in wastewater

Metals

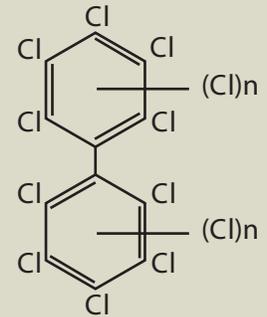
Tests have found that the concentrations of most metals of environmental concern have decreased over time in the Macaulay and Clover wastewaters.



Copper

PCBs (Polychlorinated Biphenyls)

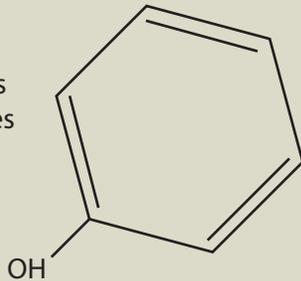
PCBs have been banned in North America since 1985. However, similar to organochlorine pesticides, they are still found at very low levels in the environment in water, wastewater, air and soil.



PCBs

Phenolic Substances

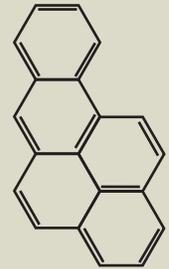
In general, there have been no observed increases or decreases of phenolic substances since 1990.



Phenol

PAHs (Polycyclic Aromatic Hydrocarbons)

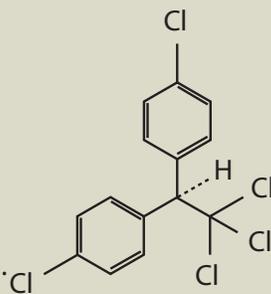
Concentrations of most PAHs have remained constant since 1990. Increases were only observed for a few of the PAHs. These substances have been targeted by the CRD RSCP to help reduce them at their source.



Benzo-a-pyrene

Organochlorine Pesticides

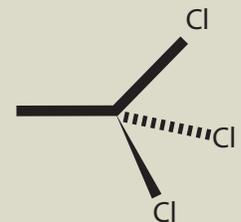
Organochlorine pesticides, such as DDT, are substances that are no longer used. However, they are still found at very low levels in the environment in water, wastewater, air and soil.



DDT

VOCs (Volatile and Semi-volatile Organics)

This category contains a wide range of compounds. While the majority of these were not detected in 2005 and 2006, there have been slight increases and decreases for a few VOCs since 1990.



Trichloroethane

More details about these compounds can be found in the glossary at the end of this brochure and in the Marine Programs annual report available online.

Some Facts

The Macaulay and Clover Point long outfalls, in use since the early 1970s, discharge in deep water offshore.

At both outfalls, the wastewater currently passes through screens that **remove solid objects larger than a thumbtack**. These solids are taken to the Hurland Landfill. The remaining wastewater is jettied out through specially designed outfalls at least 60 metres below the surface. It mixes quickly with seawater and is dispersed by the strong tidal currents in Juan de Fuca Strait. Plans are currently underway to provide treatment for Greater Victoria.

The Macaulay Point Outfall

Average flow rate in 2006 30,182 m³/day
Distance from shoreline 1.7 km
Depth 60 m
Pipe diameter 0.91 m
Diffuser length 135 m
Number of operating diffuser ports 28

The Clover Point Outfall

Average flow rate in 2006 62,700 m³/day
Distance from shoreline 1.1 km
Depth 65 m
Pipe diameter 1.067 m
Diffuser length 196 m
Number of operating diffuser ports 37

About the Reference Stations

The CRD monitors areas immediately around the outfalls as well as reference stations further away.

The reference stations, situated well outside the areas of influence of the outfalls, have similar physical characteristics (e.g. depth, type of sea floor, sea life) to the outfall sampling stations and provide areas to compare observations and assess effects.

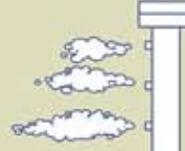
Reference stations for the Macaulay Point outfall are situated in Parry Bay.

Reference stations for the Clover Point outfall are situated in Constance Bank.



What is a Diffuser?

At the end of each outfall is a section of pipe (diffuser) that contains a number of ports spread along its length. Wastewater is discharged through all of the ports so that it is diffused or spread more efficiently throughout the water. It's a common misconception that the end is left open. It is, in fact, capped off.



Key

- Outfall (represented by a green line)
- Diffuser (represented by an orange line)
- Seafloor Sampling Stations (represented by blue dots)



Monitoring surface waters

Overview

As well as monitoring wastewater, Marine Programs collects samples of surface water and evaluates them to ensure levels are protective of people involved in recreational activities near beaches. The samples are collected by rapidly submerging sterile bottles to a depth of one metre, and testing for fecal coliform levels.

Findings in 2006

A detailed statistical analysis of findings from 1990 to 2005 showed little change in the fecal coliform concentrations in surface waters near the outfalls over the 16 years.

“The 2006 surface water fecal coliform results did not indicate expected health effects from recreational activities.”

As part of their overall program assessment, the SETAC panel recommended a review of this monitoring component. Monitoring frequency, station location, as well as the best indicator to assess public health effects, will be reviewed as part of the overall Wastewater and Marine Environment program review. This review, in conjunction with the Marine Monitoring Advisory Group, will take place once a formal decision on treatment locations and types is made.

Monitoring the seafloor

Overview

Wastewater from Macaulay and Clover Point is jetted through multi-port outfalls where it mixes quickly with seawater and is dispersed by strong tidal currents. However, some material may settle to the bottom, so Marine Programs scientists monitor sediment quality within one kilometre of both outfalls and at reference stations five to 12 kilometres away to provide a comparison.

In addition, there is a regular assessment of the health of organisms such as deep-sea horse mussels at Clover Point (where the seafloor is rocky) and benthic organisms such as shrimp, molluscs and sea worms in the sediment at Macaulay Point (where the seafloor is sandy or muddy).

What was monitored?

Researchers use an apparatus called a Van Veen grab to collect sediment and organism samples from the seafloor near the outfalls as well as from the reference stations.

Sediment samples are analyzed for priority substances that have the potential to be present in seafloor particles (based on what is measured in wastewater). They include many of the metals, phenolic compounds and PAHs. The results are compared with sediment quality guidelines that have been developed by government agencies (such as BC Ministry of Environment, Canadian Council of Ministers of the Environment, and Washington State) to help protect marine seafloor organisms.

Monitoring the Seafloor (Continued)

Findings in 2006

Few substances exceeded sediment quality guidelines. Concentrations above guidelines were generally restricted to within 200 metres of Macaulay Point and 100 metres of Clover Point, mostly in a south-southeast direction from the outfalls. A statistical analysis of 1990 to 2006 results showed that many substances in the seafloor sediments, including many metals and PAHs, have decreased over this time period. Only a few substances, mainly a few metals, have shown an increase close to the outfalls over time. While these results indicate there could be potential for effects on seafloor organisms within these areas, the best indicators of effects are the biological organisms that are living at or near the outfalls.

There has been little change in seafloor organisms (benthic communities) around the Macaulay Point outfall. There are more organisms closer to the outfall due to an abundant food source in the form of organic matter (total organic carbon) in the discharge.

“Overall, the number of different types of organisms found across the area was consistent, indicating that the communities were not significantly affected by the discharge.”

Some of the communities closer to the outfall had a slightly different makeup of organisms, although their function and health were the same as communities further away. Communities at stations 400 metres and 800 metres from the outfall were the similar to those at the reference stations.

At Clover Point, mussels near the outfall were bigger and longer than those further away or in the reference areas. Measures of age and reproductive status, as well as tissue chemistry showed no harmful effects.

These findings are consistent with the conclusions of the SETAC panel, which completed an independent report in 2006.

The SETAC report can be found online at <http://www.crd.bc.ca/wastewater/reviewpanel.htm>



Science and Research - Additional Investigations

Marine Programs scientists are also involved in additional research investigations, often in collaboration with universities and government agencies, to address issues related to wastewater and marine environment monitoring and assessment.

Five investigations were underway, initiated or completed in 2006:

High-resolution analyses conducted in 2005 and 2006 for several persistent organic pollutants (POPs), such as DDT and PCBs, found very low levels of these substances in wastewater, sediment and/or mussel tissue. This was not surprising as POPs are found in many places in the environment such as water, air, soil and biological tissues. Concentrations measured as part of this investigation were below levels of concern for the environment. The SETAC panel reviewed these results and agreed with the conclusions. In most cases, concentrations in the sediment were orders of magnitude lower than other areas in Puget Sound and the BC Lower Mainland. POPs detected in the wastewater discharges were often at levels similar to those found in the environment related to the transport of pollutants by global air or ocean currents. One exception was the measured concentration of nonylphenols near the outfalls. Nonylphenols are

CRD Collaborations

University
of Victoria



Department
of Biology

“Studies, with the University of Victoria and Environment Canada, are measuring pharmaceuticals and personal care products in wastewater to determine potential environmental effects.”

used in laundry detergents and can potentially have an effect on the marine environment. A good way to reduce nonylphenols is to remove them at the source, which is why the CRD RSCP is promoting reductions in the use of detergents. Additional samples were collected in 2006 to complete this three year study, but results were still being analyzed when this report was completed. Results will be presented in the 2007 annual report.



A collaborative research project between the CRD and the University of Victoria was initiated in 2005. This project includes the analysis of pharmaceuticals and personal care products in wastewater and the determination of potential links between measured concentrations, prescription rates and the area where they were dispensed. A second component of this project will include the analysis of potential genetic effects on mussels exposed to the Clover Point wastewater outfall.

A sediment core study was undertaken in September 2006 in collaboration with Fisheries and Oceans Canada. Seafloor samples were collected near the Macaulay Point outfall, and at a reference site, with a core cylinder that is pushed into the seafloor and collects material to a depth of approximately 30 cm. These samples will be analyzed for various chemicals to assess historical contamination and determine a rate of deposition for seafloor particles.

A research project was initiated in 2006 to analyze the different types of PAH substances found near the Macaulay and Clover Point outfalls and identify their sources. Scientists have observed coal particles (a potential source of PAH substances) in seafloor samples from the vicinity of the outfalls. However, the suspected source of these coal particles is the collier SS San Pedro, that ran aground at Brotchie Ledge in 1891, rather than the outfalls. A fingerprinting analysis using coal collected from the collier wreck site and seafloor samples from Macaulay Point and Clover Point was initiated to identify the presence of coal particles and differentiate the potential PAH sources. Results will be presented in the 2007 annual report.



Find out what you can do to help protect our oceans.

<http://www.crd.bc.ca/wastewater/sourcecontrol/residential.htm>

Glossary

BOD (Biochemical Oxygen Demand)

The amount of oxygen used by microorganisms in the breakdown or decay of organic matter in a water body.

Fecal coliform

A type of bacteria that comes from the intestines of warm-blooded animals, including humans and ducks. It is used as an indicator of potential human health effects.

Metals

Includes total and dissolved metals such as aluminum, mercury, silver and zinc that occur naturally, or come from human sources (e.g. mercury from dental uses).

Nutrients

Any inorganic or organic substance needed by plants and animals for nutrition and growth (e.g. nitrogen, phosphorus).

Organic chemicals

Chemicals consisting primarily of carbon that are found in many household products such as cleaning, disinfecting, cosmetic, degreasing and hobby products.

Organochlorine Pesticides

Pesticide such as DDT and mirex that can remain in the environment long after application. Many have been banned because of concerns about environmental impact and human health.

Phenolic Compounds

Compounds that occur naturally from the decomposition of aquatic vegetation or that are manufactured and used in disinfectants, biocides, preservatives, dyes, pesticides and medical and industrial chemicals.

PCBs (Polychlorinated Biphenyls)

Industrial chemicals once widely used, and now banned in Canada, the US and Europe, in electrical equipment, heat exchangers, hydraulic systems and several other specialized applications.

PAHs (Polycyclic Aromatic Hydrocarbons)

Substances that occur through incomplete burning of organic substances such as wood, tobacco or charbroiled meats, and are also manufactured and used in medicines, dyes, plastics and pesticides.

Priority substances

Substances, such as metals and organic chemicals, that were selected for monitoring based on numerous governmental agency lists of substances of potential concern.

TSS (Total Suspended Solids)

Solids in water that can be trapped by a filter. TSS can include a wide variety of organic and inorganic material, such as silt, decaying plant and animal matter.

VOCs (Semi Volatile and Volatile Organic Compounds)

Emitted as gasses from a wide array of products, including paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, glues and adhesives. This group includes compounds such as benzenes, phthalates and others.

Visit us online!

For more information about these substances and other compounds please visit the online glossary. As well you will find the entire 2006 Clover Point and Macaulay Point annual report.

<http://www.crd.bc.ca/wastewater/marine/index.htm>

**MONITORING COMPONENTS OF THE MACAULAY AND CLOVER POINT
WASTEWATER AND MARINE ENVIRONMENT PROGRAM**

MACAULAY POINT OUTFALL	PARAMETER	MONITORING FREQUENCY
Wastewater	flow	daily
	conventionals ¹ and priority substances ¹	monthly
	priority substances ¹	quarterly (January, April, July and October)
Surface Water	indicator bacteria (fecal coliform)	monthly
Seafloor	particle size analysis, TOC ² , AVS ² and sediment chemistry ¹ benthic community structure	annually (September)
CLOVER POINT OUTFALL	PARAMETER	MONITORING FREQUENCY
Wastewater	flow	daily
	conventionals ¹ and priority substances ¹	monthly
	priority substances ¹	quarterly (January, April, July and October)
Surface Water	indicator bacteria (fecal coliform)	monthly
Seafloor	particle size analysis, TOC ² , AVS ² and sediment chemistry ¹	annually (September) at C0 and CB, every three years at additional stations
	deep-sea mussel (<i>Modiolus modiolus</i>) - tissue weight, shell length, age structure, reproductive state tissue chemistry ¹	annually (September)
Notes:		
¹ See <i>Macaulay and Clover Point Wastewater and Marine Environment Program, 2006 Annual Report</i> – Appendix A for list of substances		
² TOC – total organic carbon, AVS – acid volatile sulphide		

MARINE MONITORING ADVISORY GROUP
**REVIEW OF THE 2006 MACAULAY AND CLOVER POINT WASTEWATER AND
MARINE ENVIRONMENT PROGRAM**

November 6, 2007

Prepared by Dr. Teresa Michelsen, Mediation Solutions

1.0 INTRODUCTION

The Marine Monitoring Advisory Group (MMAG) was established to advise on, provide an independent assessment of, and provide recommendations on the Wastewater and Marine Environment Program (WMEP) to the Capital Regional District (CRD) (see Attachment A for the MMAG Terms of Reference). When requested by the CRD, the MMAG reviews program data and reports, and provides recommendations. The MMAG consists of independent scientists and experts associated with Environment Canada, BC Ministry of the Environment (MoE), Vancouver Island Health Authority, University of Victoria, Simon Fraser University, and Fisheries and Oceans Canada (up until October 2007). The representative from Fisheries and Oceans Canada no longer works for this agency but will remain on the committee as a representative of Dalhousie University.

In a letter dated March 26, 2003, the Minister of the Environment (then Water, Land, and Air Protection) required the continuing involvement of the MMAG in this manner as part of her approval of CRD's Core Area Liquid Waste Management Plan. The letter also stated that the MMAG should complete an independent report on an annual basis with comments on the Wastewater and Marine Environment program (WMEP). The MMAG members agreed to complete such a report. The first MMAG report was submitted in 2004, and provided the group's review of the 2003 WMEP for the Macaulay and Clover Point Outfalls. This report reviews the 2006 WMEP, and as such does not include comments on any of the recent events pertaining to the Macaulay and Clover Point outfalls (including the report by the Society of Environmental Toxicology and Chemistry and the letter from the Minister of Environment requiring the CRD to prepare and submit a plan for treatment).

Initial comments on WMEP program components were provided to CRD Scientific Programs at MMAG meetings on May 30, 2007 and June 19, 2007, which were recorded by an independent consultant, Dr. Teresa Michelsen of Mediation Solutions. The consultant compiled the comments from the meeting and provided them to the chair of the MMAG for member review and additional contributions. CRD Scientific Programs then provided the MMAG members with the 2006 annual report on September 7, 2007. The MMAG reviewed the annual report and provided additional comments on the WMEP to CRD Scientific Programs at the MMAG meeting on October 2, 2007 and subsequently in writing by October 22, 2007. These comments were forwarded to the consultant, who integrated the comments from both meetings and provided them to the chair of the MMAG for review and finalization.

2.0 MARINE MONITORING ADVISORY GROUP COMMENTS BY PROGRAM COMPONENT

The following consensus comments were provided by the MMAG on the WMEP, organized below by program component (see the WMEP 2006 annual report for a detailed description of these components). Any dissenting comments are also recorded below.

MMAG members attending the May 30, 2007 meeting included Chris Kennedy, John Chamberlain, Deanna Lee, Diana Varela, Chris Garrett, and Les Swain. MMAG members attending the June 19, 2007 meeting included Chris Kennedy, John Chamberlain, Deanna Lee, Diana Varela, Chris Garrett, and Les Swain. MMAG members attending the October 2, 2007 meeting included Chris Kennedy, John Chamberlain, Deanna Lee, Diana Varela, Chris Garrett, John Deniseger. Céline Larose and Laura Taylor also attended each meeting as CRD representatives, to provide information and support and to receive suggestions and comments.

2.1 Wastewater Monitoring

Comments

There was general support for how this monitoring component is being conducted, including the monitoring parameters and frequency.

Suggestions

There were no specific suggestions on this monitoring component in terms of annual monitoring prior to implementation of the treatment program. The following suggestion was provided to support design of the treatment plant:

- As an additional investigation for engineering design purposes, conduct more frequent (daily/weekly) sampling for conventionals, especially for wet weather flows. CRD will conduct a detailed characterization of the Macaulay and Clover Point effluent for wet weather and storm event flows.

2.2 Surface Water Monitoring

Comments:

The MMAG was divided on whether to continue with the existing monitoring program prior to implementation of treatment, or whether to modify the timing and frequency of sampling. Two points of view were expressed by the members, and consensus was not reached:

- The majority of the MMAG favored retaining the existing monitoring program until the location and type of treatment facilities for the CRD are determined, and until a monitoring program for the new wastewater treatment facilities is developed. This approach would provide consistency with historical data, avoid making changes before the future configuration of the outfalls is known, contributes to testing the water quality

model, and allows for more frequent sampling events, which can identify maintenance issues with the outfalls.

- Les Swain (BC Ministry of the Environment) and Deanna Lee (Environment Canada) favored modifying the surface water sampling program to twice annually, conducting two sets of five sampling events within 30 days. This approach would provide consistency with recreational guidelines for the receiving environment, and could be targeted to coincide with times when exposure to wastewater effluent and/or recreational water uses are highest to capture the range of exposures and risk scenarios.

One member expressed interest in conducting before and after sampling to demonstrate the efficacy of treatment. However, it is not yet known whether future outfalls will be located in the same receiving environment as is the case currently.

Suggestions:

There was one specific suggestion for this monitoring component:

- The MMAG recommended that CRD continue with plans for the enterococci pilot project. There was some discussion about the intended goals of the monitoring and how that might affect the best location and design of the pilot project; for example, whether the study should be in areas off the Macaulay and Clover Point outfalls (potentially higher fecal coliform) or offshore of the Saanich Peninsula secondary treatment plant to better represent levels that will be present following construction of the new treatment facilities. CRD will develop a proposed monitoring design in collaboration with the MMAG.

2.3 Seafloor Monitoring – Sediment Chemistry

Comments:

There was general support for how this monitoring component is being conducted.

Suggestions:

There were no specific suggestions on this monitoring component.

2.4 Seafloor Monitoring – Benthic Communities

Comments:

There was general support for how this monitoring component is being conducted, especially use of multivariate approaches for interpreting the data. [Note - Details on the benthic community monitoring methods and results have been requested for a more detailed review. Certain MMAG members may be providing further comment and recommendations on this component and the

mussel monitoring component of the monitoring program at a later date, once this information has been discussed with CRD staff and the consultant that conducted the data analysis.]

Suggestions:

There were no specific suggestions on this monitoring component.

2.5 Seafloor Monitoring – Mussel Communities

Comments:

There was general support for how this monitoring component is being conducted.

Suggestions:

There were no specific suggestions on this monitoring component.

2.6 Seafloor Monitoring – Mussel Tissue Chemistry

Comments:

There was general support for how this monitoring component is being conducted.

Suggestions:

The MMAG had one specific suggestion for the tissue chemistry studies:

- Do a comparison of deperated vs. undeperated results for metals as part of the basic monitoring program to determine whether lack of deperation could be adding variability to the tissue results. The CRD will conduct a deperation study as part of the 2007 program.

2.7 Additional Investigations

The MMAG recommends that the list of additional investigations and their prioritization be revisited once the location of treatment facilities is determined.

3.0 MARINE MONITORING ADVISORY GROUP GENERAL COMMENTS ON WMEP AND QUESTIONS TO THE BC MINISTRY OF ENVIRONMENT

3.1 General Comments

- The MMAG applauds the efforts and successes of the CRD Regional Source Control program and recommends continued support. The MMAG also recommends that the CRD provide more publicity for the program and increased recognition of participating

industry and/or businesses. For example, the 2006 CRD Regional Source Control program annual report noted that proper treatment works were installed or off-site waste management was being used at 100% of dental, dry cleaning, printing, fermentation and recreation facilities.

- It was recommended that CRD provide an interpretation of the results in sections of the annual report where data are presented that would be more accessible to non-specialists in the field. CRD does prepare a publicly accessible summary of the report, and it was suggested that CRD could provide a more obvious link to this summary for members of the public that may wish to read and understand the report.

3.2 Questions and Comments for the BC Ministry of Environment

- Concern was expressed by some members that the MacDonald report and the SETAC review which led to the decision to require treatment may not have been adequately peer-reviewed from a scientific perspective. These members expressed disappointment that the CRD no longer intends, as stated in its draft strategic plan, to conduct a critical review of the SETAC report and to facilitate discussion of the SETAC findings (Jon Chamberlain, Chris Garrett, Diana Varela).
- The MMAG accepts that the CRD must obey the provincial order with respect to sewage treatment, but some members are concerned that extensive misinformation about the impacts and benefits of treatment is being provided to the public through the press, and that the CRD is not providing enough factual information in response to this (Jon Chamberlain, Chris Garrett, Diana Varela).
- Conditions around the Macaulay and Clover Point outfalls have been found to be similar to the conditions around the outfalls from municipalities with secondary treatment. In view of this, the success of the CRD's source control program, and the apparently small impact of the discharges on the marine environment, some members of the MMAG expressed the view that the present scheme, or an enhanced version of it, should have been included as an option in the CRD's "triple bottom line" comparison of different treatment options (Jon Chamberlain, Chris Garrett, Diana Varela).
- Some members of the MMAG expressed the view that land-based treatment should not be a high priority in measures to protect the marine environment and human health. They argued that far greater return for an expenditure of several hundred million dollars could be obtained from other actions (Jon Chamberlain, Chris Garrett, Diana Varela).

**ATTACHMENT A
CAPITAL REGIONAL DISTRICT (CRD)
MARINE MONITORING ADVISORY GROUP (MMAG)**

**Terms of Reference
Revised July 2007**

ROLE OF THE MMAG

- A)** To advise on, provide an independent assessment of, and provide recommendations on the marine environment programs to the CRD, specifically:
 - (1)** Program design
 - (2)** Interpretation of monitoring results and conclusions
 - (3)** When requested, consultant's proposals and reports
 - (4)** When requested, appropriate levels of expenditures
 - (5)** Quality assurance/quality control
 - (6)** Additional investigations
- B)** To review the state of the receiving environments near CRD wastewater outfalls.
- C)** To review CRD environmental quality (water and sediment) guidelines.
- D)** To consider information particularly relevant to the marine monitoring program.
- E)** To periodically review the Terms of Reference of the MMAG.
- F)** When requested, to provide independent advice to the CRD on other marine or liquid waste issues.
- G)** To prepare an annual letter report that will include the MMAG's comments on the conclusions presented in the Macaulay and Clover Point outfalls Wastewater and Marine Environment Program report. This letter will also include the MMAG's recommendations on the program (noting any disagreement).

MEMBERSHIP

Membership will be determined by the MMAG through the chair.

Membership will consist of scientists with expertise appropriate to the terms of reference of the MMAG.

Invitations will be extended to representatives from Environment Canada, Fisheries and Oceans Canada, Provincial Ministry of Environment, Vancouver Island Health Authority, and academic institutions.

Members of the CRD Environmental Services department normally attend the MMAG meetings as non-voting participants. The chair may request of specific meetings that CRD staff do not attend.

The chair may invite other participants and/or observers from time to time.

CHAIR

The chair is selected by the members, and shall be reviewed every two years.

The incumbent chair may serve additional terms.

MEETING SCHEDULE AND AGENDA

Meetings will be held at the call of the chair.

The chair will determine the agenda in consultation with the CRD and members of the group.

DECISION MAKING

Decisions will be made by consensus. If consensus is not reached on an issue, it will be so stated.

REPORTING PROTOCOL

The MMAG will report to the CRD Core Area Liquid Waste Management committee through the general manager, Environmental Services.

CRD SUPPORT

The CRD will provide administrative support to the MMAG.

The CRD staff will keep MMAG informed of issues related to the mandate of the MMAG.