



**REPORT TO CORE AREA LIQUID WASTE MANAGEMENT COMMITTEE
MEETING OF WEDNESDAY 24 NOVEMBER 2010**

SUBJECT **MACAULAY AND CLOVER POINTS WASTEWATER AND MARINE ENVIRONMENT
PROGRAM – 2009 ANNUAL REPORT**

ISSUE

To consider the 2009 annual report for the Wastewater and Marine Environment Program (WMEP).

BACKGROUND

The Core Area Liquid Waste Management Plan and the two outfall operational certificates (granted under the BC Municipal Sewage Regulation) contain commitments to carry out a monitoring program for the Macaulay Point and Clover Point outfalls and to report on this program to the CRD Board and the provincial regulatory authority, the Ministry of Environment (MOE). The WMEP was developed in collaboration with the Marine Monitoring Advisory Group (MMAG) and has been in place since the late 1980s, with the current WMEP scope being largely unchanged since 2000.

In 2009, the WMEP consisted of the following components:

- 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 of fecal coliforms as indicators of potential for human exposure to wastewater in the marine environment (conducted monthly at each outfall);
- seafloor monitoring for chemical (sediment and mussel tissue contaminant concentrations) and biological (health of seafloor communities-benthic organisms and mussels) parameters on a yearly basis; and
- 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 (e.g., pharmaceuticals and personal care products).

The annual report's executive summary is attached as Appendix A and the public summary brochure is attached as Appendix B. The complete report is available on request from the CRD Environmental Sustainability department.

ALTERNATIVES

1. That the Core Area Liquid Waste Management Committee recommend to the Board that:
 - (a) the Macaulay and Clover Points Wastewater and Marine Environment Program 2009 Annual Report and public summary brochure be received for information;
 - (b) the Macaulay and Clover Points Wastewater and Marine Environment Program 2009 Annual Report be forwarded to the Ministry of Environment; and
 - (c) the Marine Monitoring Advisory Group's revised Terms of Reference be adopted.

or

2. That the Core Area Liquid Waste Management Committee recommend to the Board that:
 - (a) the Macaulay and Clover Points Wastewater and Marine Environment Program 2009 Annual Report and public summary brochure be received for information;
 - (b) the Macaulay and Clover Points Wastewater and Marine Environment Program 2009 Annual Report be forwarded to the Ministry of Environment; and
 - (c) the Marine Monitoring Advisory Group's revised Terms of Reference be sent back to staff for further modification.

ENVIRONMENTAL IMPLICATIONS

The 2009 WMEP results indicated that (i) predicted wastewater concentrations in the marine environment met receiving water quality guidelines for the protection of aquatic life, (ii) the potential for sea surface human exposure to wastewaters from the outfalls is low, and (iii) there are some limited effects on marine organisms which are restricted to within 100 m at Clover Point and within approximately 200 m east of the Macaulay Point outfall diffuser. Overall, monitoring results are generally consistent with previous years and indicate that the effects of the outfalls are not expanding or increasing over time.

One of the additional investigations undertaken in 2009 involved the assessment of 125 pharmaceuticals, personal care products, illicit drugs and their metabolites (PPCP) in wastewaters collected from Macaulay Point and Clover Point, as well as two upstream pump stations (Craigflower and Penrhyn). In addition, samples were collected from Macaulay and Clover points from 2004 to 2006 for the analyses of a group of seven pharmaceuticals. PPCPs are of environmental concern because they are designed to have a biological effect for human or veterinary use, and it has been assumed that their effects could potentially extend to non-target organisms in the environment. One of the primary sources of PPCPs to the environment is via municipal wastewater outfalls.

A detailed analysis of all of the PPCP results is ongoing through a collaborative research project with the University of Victoria, but preliminary results indicate that the concentrations of the substances in screened CRD wastewaters were similar to those observed in many other jurisdictions, including some with more advanced wastewater treatment in place. When environmental concentrations were predicted (using the anticipated dilution in the marine environment around the outfalls) the potential for adverse effects on marine organisms was estimated to be relatively low. However, it should be noted that there is limited toxicity data in the literature and, as such, there is a high degree of uncertainty in assessing current risks. Further assessments and research partnerships are ongoing and will inform our monitoring and assessment programs for the foreseeable future.

INTERGOVERNMENTAL IMPLICATIONS

Historically, the MMAG has had a mandate to review and report on the WMEP directly to the MOE. This mandate has recently been waived by MOE in light of the move to new treatment in the core area. Regardless, the MMAG has been maintained to provide advice directly to staff on the WMEP as well as other CRD programs that consider impacts on the marine environment (e.g., the Stormwater, Harbours and Watersheds Program). The MMAG Terms of Reference have been revised accordingly and are attached in draft as Appendix C.

In response to recommendations from MMAG and other reviewers (e.g., SETAC), and in anticipation of future monitoring requirements for the region, CRD and MOE staff are working together on a comprehensive review of the WMEP. This review has been ongoing since 2008 with the intent to revise the WMEP to ensure future regulatory requirements are met, program gaps are identified and resolved, and possible emerging concerns are anticipated and incorporated into the program. Staff will provide the Core Area Liquid Waste Management Committee with additional details about the proposed WMEP revisions at a future meeting. Staff will also ask the MMAG to review and comment on the proposed changes. It should be noted that MOE staff have an expectation that revisions to the WMEP will be implemented in the second quarter of 2011.

ECONOMIC IMPLICATIONS

Funding for the WMEP is included in the annual budgets for the northeast trunk (Clover) and northwest trunk (Macaulay) systems. It is anticipated that these budgets will be sufficient to allow for the incorporation of any revisions that result from the WMEP review discussed above.

RECOMMENDATIONS

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

1. the Macaulay and Clover Points Wastewater and Marine Environment Program 2009 Annual Report and public summary brochure be received for information;
2. the Macaulay and Clover Points Wastewater and Marine Environment Program 2009 Annual Report be forwarded to the Ministry of Environment; and
3. the Marine Monitoring Advisory Group's revised Terms of Reference be adopted.

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**MACAULAY AND CLOVER POINTS
WASTEWATER AND MARINE ENVIRONMENT PROGRAM
2009 ANNUAL REPORT**

EXECUTIVE SUMMARY

Monitoring of wastewater discharges, surface waters and the seafloor environment in the vicinity of the Macaulay and Clover points outfalls has been conducted as part of the Wastewater and Marine Environment Program (WMEP) on a regular basis since the late 1980s. Additional investigations have also 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 Capital Regional District (CRD) Core Area Liquid Waste Management Plan (LWMP) (CRD, 2000) was approved. This LWMP outlined the CRD's plans 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. On July 21, 2006, the CRD received a letter from the Minister of Environment requiring an amendment to the Core Area LWMP, detailing a schedule for the provision of sewage treatment. In his letter, the minister also requested that the CRD continue the current monitoring program. Liquid Waste Management Plan Amendment No. 7 (CRD, 2009a) was submitted to the Ministry of Environment (MoE) in December 2009 with a follow up Amendment No. 8 (CRD, 2010a) in June 2010.

The 2009 WMEP consisted of the following components:

- 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 of fecal coliforms as indicators of potential for human exposure to wastewater in the marine environment (conducted monthly at each outfall)
- seafloor monitoring for chemical (sediment and mussel tissue contaminant concentrations) and biological (health of seafloor communities-benthic organisms and mussels) parameters 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 2009 annual report presents results and updates for the different elements of the Macaulay and Clover points WMEP, including the routine 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 Macaulay Point and Clover Point outfalls in 2009 was similar to previous years. Concentrations of all conventional parameters were within the expected range for fine-screened wastewater, and the estimated receiving environment concentrations, based on the predicted minimum initial dilution, did not exceed applicable British Columbia (BC) or Canadian Council for Ministers of the Environment (CCME) water quality guidelines (WQG). Flow volumes did not exceed the allowable daily maximums stipulated in the Operational Certificates for the outfalls.

Priority substances frequently detected in wastewater in 2009 were similar to previous years. Substances detected greater than or equal to 50% of the time included a number of conventional parameters, total and dissolved metals, two phenolic compounds, PAHs, phthalates, a few miscellaneous volatile organics and terpenes. For those substances that were frequently detected, a minimum initial dilution factor (based on oceanographic modeling) was applied to predict concentrations in the receiving environment within the initial dilution zone (IDZ). Results were compared to applicable BC and CCME WQGs. In 2009

(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.

Overall, the 2009 wastewater monitoring results were generally consistent with previous years. The Macaulay and Clover points wastewaters met all flow, TSS and BOD requirements stipulated under their draft operational certificates, indicating that wastewaters, from an operational perspective, were as expected. In addition, all priority substances met applicable WQGs in the marine receiving environment following the application of minimum initial dilution factors.

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 predicted that during slack tide in winter, there is less than 5% chance that the Macaulay Point effluent may reach the surface. When surfacing does occur, the plume is highly diluted (average dilution of 1580:1). On these occasions, fecal coliform concentrations above 200 CFU/100 mL may be detected. The fecal coliform stations geometric means were all an order of magnitude below 200 CFU/100mL, indicating that the potential for human exposure to the Macaulay Point wastewaters in the marine environment was low. Thirty-seven individual measurements out of 456 (representing 8.1% of surface water samples) were above the value of 200 CFU/100 mL, mostly in August. The highest value measured was 9,100 CFU/100 mL, recorded in August, southwest of the outfall and outside of the IDZ. Plume surfacing events are also predicted in the summer, but less frequently than during the winter. Overall, the data indicated that the Macaulay Point effluent plume was predominantly trapped below the surface, albeit with a slightly higher percentage of values above 200 CFU/100 mL in comparison to previous years. The Macaulay outfall was inspected in the summer of 2009 and a number of clogged ports were observed as well as three small cracks, which could be contributing to these results. Additional data are needed to confirm these conclusions.

Additional sampling was undertaken in the summer to collect five samples in 30 days, as per recommendations by the Marine Monitoring Advisory Group (MMAG). This sampling was done to determine if fecal coliform levels exceed BC MoE WQG for recreational primary contact as they were defined, during the time of year when the most recreational activity is expected around the outfalls. Geometric mean results were far below the BC MoE WQG, confirming that the potential for human exposure to harmful levels of effluent derived fecal coliforms was very unlikely. Consideration is being given to monitoring for enterococci instead of fecal coliforms as they survive longer than fecal coliforms in marine waters. In addition, a positive correlation between gastrointestinal illness and levels of enterococci has been observed.

Clover Point

Fecal coliforms geometric means at all Clover Point stations were an order of magnitude below 200 CFU/100 mL in 2009, indicating that the potential for human exposure to the Clover Point wastewaters in the marine environment was low. All stations had geometric means of 50 CFU/100 mL or less. There were 11 individual measurements out of 456 (representing 2.4% of surface water samples) above the value of 200 CFU/100mL, with most occurring in October. The highest value measured was 11,000 CFU/100 mL, recorded in October, east of the outfall and within the IDZ. Results were within the expected concentrations predicted by hydrodynamic modelling. Recent modelling work predicted 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/100 mL are sometimes detected. Summer plume surfacing events are also predicted to occur, but at a lower frequency than in the winter.

Overall, the data indicated that the Clover Point effluent plume was predominantly trapped below the surface, at a slightly lower frequency in comparison to previous years. The Clover Point outfall was inspected in the summer of 2009 and one leak, six blocked diffusers, and one broken diffuser were observed, which could be contributing to these results. Additional data are needed to confirm these conclusions.

The additional five samples in 30 days sampling was also undertaken at Clover Point in the summer. Similar to Macaulay Point, all geometric mean results were far below the BC MoE WQG, confirming that the potential for human exposure was low.

Consideration is being given to monitoring for enterococci instead of fecal coliforms as they survive longer than fecal coliforms in marine waters. In addition, a positive correlation between gastrointestinal illness and levels of enterococci has been observed.

SEAFLOOR MONITORING

Macaulay Point

Sediment Chemistry

Samples collected from the outfall station (M0) and the reference station PB1 were analyzed for a full list of priority substances. For the remaining stations at Macaulay Point and Parry Bay, samples were analyzed for a modified list of priority substances. Results were compared to various sediment quality guidelines (SQGs) designed to predict potential biological effects in the environment.

The comparison of Macaulay Point sediment data to SQGs showed similar results to previous years. SQG exceedences were all within 200 m of the outfall and included mercury, some PAHs (acenaphthene, benz(a)anthracene, fluoranthene, fluorene, 2-methylnaphthalene, phenanthrene), 1,4-dichlorobenzene, bis(2-ethylhexyl)phthalate and phenol. There were fewer SQG exceedences in 2009 than in 2008. Overall, sediment chemistry data indicated that effects on the seafloor were primarily limited to within 200 m east of the diffuser. It is important to note that values above SQGs should not be interpreted as equating with adverse biological effects, but only as an indication of potential for effects on the receiving environment. A complete assessment requires additional follow-up and confirmatory measures such as assessing the health of the biological communities living within the sediments.

A comprehensive temporal and spatial trend assessment was undertaken for the 1990 to 2009 sediment quality dataset. The results over time indicate that a number of substances, particularly metals and PAHs, have consistently exceeded the lowest (i.e., most conservative) SQGs, but not in more than half the samples from either outfall location. Only 1,4-dichlorobenzene, mercury and phenol have consistently exceeded upper-bound (i.e., least conservative) SQGs in more than 10% of the samples.

The majority of sediment chemistry parameters in the 1990 to 2009 dataset were significantly negatively correlated with distance and direction from the outfalls, indicating that the outfalls are point sources for these substances. Stations nearest the outfall, particularly in the easterly and south-easterly directions, tended to have the highest concentrations of substances. This indicates that the spatial patterns of outfall influence were consistent with general water circulation patterns caused by currents in the region.

Approximately half of the frequently detected analytes, including TOC, AVS, several metals, PAHs and other organics, have been decreasing in concentration in the sediment over the 1990 to 2009 time period. This is consistent with previous decreasing temporal trends identified in Macaulay and Clover point wastewater concentrations. These parallel trends indicate that, in general, the substances of concern in sediments have generally been decreasing due to concurrent decreases in wastewater concentrations. The CRD Regional Source Control Program has been instrumental in developing programs to encourage industry, businesses and residents to eliminate or reduce the practice of disposing chemicals down the drain.

Overall, the 2009 results were generally consistent with previous years and recent reviews concluded that, although there were demonstrable impacts of the outfall on sediment chemistry, findings do not indicate that conditions are deteriorating over time. However, because there were SQG exceedences, the 2009 data do indicate that there is potential for the biological communities (within 200 m of the Macaulay Point outfall) to be affected by substances in sediments. As such, a detailed analysis of the benthic community at the Macaulay Point outfall was undertaken to assess if the sediment chemistry concentrations were linked to any observed effects in the biological communities.

Benthic Communities

The 2009 benthic community assessment results were also similar to previous years. There were more organisms near the outfall, with abundance decreasing as one moved away from the outfall. The decreasing trend was driven primarily by the higher abundances of polychaetes near the outfall. This polychaete signal is reduced by the 800 m stations. The decreasing trend was similar to the pattern observed in 2008, but slightly weaker relative to previous years. The polychaetes are often found in high numbers around municipal wastewater outfalls due to their opportunistic nature and general tolerance of outfall related impacts, specifically organic enrichment. Infaunal trophic index (ITI) values were generally lower near the outfall. This indicated that the prevalence of species that feed on suspended organic materials was high near the outfall, while further away from the outfall, species that feed on deposited materials were more predominant.

Overall, a general pattern of moderate biological alteration was evident outside the IDZ and in mid-field and far-field stations. However, the observation of benthic alteration does not necessarily equate with ecological degradation, as the community can still be fully functioning. Outside the IDZ or near-field areas, the benthic alteration translated to neutral or slightly positive responses because the majority of taxa were enhanced in these areas relative to the reference areas and the enhancement of organism abundances did not come at the expense of reduced species number.

The degree of benthic impairment at the outfall terminus appears to have declined since the 1990s, when more significant reductions of taxonomic richness were observed. The taxa richness at the outfall terminus in recent years has approximately doubled since the 1994 monitoring study. However, both the 2008 and 2009 data do not indicate as strong an improvement as in previous years. The CRD will continue to monitor the Macaulay Point benthic communities to determine whether these observations were an anomaly or whether conditions around the outfall are indeed worsening. It can be concluded that the outfall effects were limited spatially (i.e., mostly within 200 m of the outfall) and directionally (i.e., mostly to the east and south east).

Clover Point

Sediment Chemistry

Samples collected from the outfall station (C0) and the reference station CB1 were analyzed for a full list of priority substances. For the remaining stations at Clover Point and Constance Bank, samples were analyzed for a modified list of priority substances. Sediment chemistry data were compared to the same SQGs as for Macaulay Point. Lead and mercury exceeded SQGs within and outside the IDZ, but within 200 m of the outfall. Anthracene exceeded SQGs only within the IDZ, while phenol exceeded SQGs at majority of stations including the reference stations. These patterns of exceedences were similar to those in 2006 when the full set of Clover Point stations were sampled.

The results of the comprehensive temporal and spatial trend assessment undertaken for the 1990 to 2009 sediment quality dataset came to conclusions very similar to those described above for the Macaulay Point sediments.

Overall, the 2009 sediment chemistry data indicated that there was some potential for the biological communities adjacent to the Clover Point outfall to be affected by contaminants in sediments due to SQG exceedences. As such, a detailed analysis of the mussel community at the Clover Point outfall was

undertaken to assess if the sediment chemistry concentrations were linked to any observed effects in the biological communities.

Mussel Communities

Mussel mean lengths and weights for 2009 were greater at the majority of stations relative to the reference stations (i.e., growth enhancement or stimulation occurred around the outfall). Mean ages for the outfall monitoring stations were similar to the reference stations, as were mean mussel ages in the near-field and far-field station groupings. No statistically significant negative relationships were identified between gonad index and reproductive timing index and either distance from the outfall or depth. Overall, the 2009 biological data did not indicate any adverse effects to the resident mussel communities.

Tissue Chemistry

A total of 27 metals and 39 organic substances were analyzed in mussel tissue from all stations in 2009. The metals that were detected in 2009 were found at similar concentrations to previous years. Copper and lead were qualitatively higher near the outfall as compared to the reference area, with significant differences between the near-field stations and the reference stations. This indicates that the outfall is one source of these metals over a limited spatial extent. Mercury, nickel and silver concentration exhibited a reverse gradient (i.e., higher concentrations further away from the outfall). These results were similar to previous years and may be partly attributed to growth dilution (i.e., 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 copper and zinc concentrations were lower than relevant tissue effects threshold levels for the protection of wildlife and consumers of mussels. Lead levels were slightly elevated relative to tissue effects threshold levels, but the potential risks to organisms higher up the food chain were considered low.

Methylmercury was measured in mussel tissue for the first time in 2009. Similar to the results for inorganic mercury, methylmercury concentrations were higher at the reference stations than around the outfall. All methylmercury concentrations were below Canadian tissue residue guidelines for the protection of aquatic life.

Concentrations of most organic substances were either below routine analytical detection limits or were rarely detected. High-resolution concentrations of most PAHs decreased with distance from the outfall along with lipid concentrations. All 2009 high resolution PAH concentrations were substantially lower than lethal- or sublethal-effects threshold concentrations.

Overall, a comparison of the 2009 monitoring data to tissue benchmarks suggests that there is limited potential for adverse effects to the resident mussel communities or to higher trophic level organisms as a result of eating the mussels and the bioaccumulation and/or biomagnification of substances. Furthermore, the temporal trends of mussel tissue chemistry suggest that significant ecological harm is unlikely to occur in the near future, based on the current discharge regime.

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. Some additional investigations are also set as requirements under the Core Area LWMP approval. Studies undertaken as part of the additional investigations component of the WMEP are recommended and reviewed by the MMAG. The following additional investigations were underway and/or completed in 2009:

- supplementing the high resolution chemical and pharmaceutical and personal care products (PPCPs) analyses from previous years

- continuation of the collaborative study on the presence of PPCPs in wastewater and potential environmental effects on biological communities with University of Victoria
- continuation of the collaborative project on potential toxicogenomic effects of emerging chemicals in municipal wastewater with Environment Canada
- continuation of analysis of sediment core samples in collaboration with Fisheries and Oceans Canada
- continuation of a detailed PAH fingerprinting analysis in sediment and wastewater samples
- continuation of a collaborative project on potential mussel biomarker effects of municipal wastewater with Environment Canada
- collaborative study investigating PBDE concentrations in sediment cores and benthic invertebrates with the University of Victoria and Fisheries and Oceans Canada

Macaulay and Clover Points Additional Investigations: High-Resolution Analyses

High resolution analyses were supplemented in 2009 with the analyses of methylmercury in wastewaters, mussel tissues, sediments and tributyltin in wastewaters. Results of the analyses indicate that methylmercury concentrations were all well below relevant environmental guidelines. As such, the analyses of methylmercury will only be continued in wastewater to monitor concentrations and environmental loadings over time. Tributyltin levels did exceed some Canadian interim and BC WQGs, so TBT analyses will be retained for wastewater to monitor concentrations and environmental loadings over time.

Collaborative Study on PPCPs and Emerging Chemicals in Wastewater

A collaborative research project between the CRD WMEP and the University of Victoria was initiated in 2005. This type of investigation was included in the requirements of the LWMP approval. Additional PPCP characterization samples were collected in November 2009.

The Macaulay and Clover point outfalls and two pump stations (one upstream of each outfall) were tested for 125 different PPCPs in samples from five concurrent days in November 2009. A subset of typical PPCPs, including fluoxetine (antidepressant), gemfibrozil (fibrate), ibuprofen (anti-inflammatory), penicillin V (antibiotic), naproxen (anti-inflammatory) and triclosan (antimicrobial), were qualitatively assessed to determine if there was a difference in concentrations between Clover and Macaulay points outfalls and if there was a difference between each outfall and its associated pump station. Comparisons were also made between the CRD PPCP concentrations in wastewater and concentrations from wastewater treatment plants in other jurisdictions. Mean concentrations of the select PPCPs were much lower than reported for other jurisdictions except ibuprofen and triclosan. No consistent spatial or temporal patterns could be identified. Further assessment of these six PPCPs, and all of the other ones detected by AXYS, will be done at a later date to assess the potential ecological relevance of the results. Results will be made available in an upcoming annual report.

The University of Victoria collaborative project consists of two components.

1. Assessment of PPCPs in wastewater and the potential environmental and ecological relevance of the results, as well as the determination of potential correlations with prescription rates and demographic data

Wastewater samples from Macaulay and Clover points were collected from 2004 to 2006. Samples were analyzed for a select group of PPCPs. Concentrations and environmental loadings 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 analyzed and were, therefore, not available for presentation in this report. Results are expected in 2010/2011 and will be presented in an upcoming report.

2. Analysis of potential toxicogenomic effects on mussels

Phase one of this toxicogenomic project included the isolation of gene sequences from the Clover Point horse mussels (*Modiolus modiolus*) that present possible gene expression biomarkers for this species. Phase two of the project involved the design of gene-specific primers for QPCR and optimizing reaction conditions on a limited set of mussel samples collected from two Clover Point stations. The levels of each mRNA transcript were evaluated in adductor muscle, gonad, and hepatopancreas tissues. Phase 3 of this study was undertaken in 2009 to verify the phase 2 results by repeating the experiments using archived mussels collected from a greater number of stations. Results will be compared to routine monitoring endpoints and will likely be available in 2010 for inclusion in an upcoming annual report.

Collaborative Program on Potential Effects of Emerging Chemicals from Municipal Wastewaters

A collaborative study between the CRD 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 points 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. Final results from the toxicogenomic study will be reviewed by a panel of experts and will be made available following this review (likely in 2010).

Sediment Core Analyses

Over the years, sediment chemistry data collected as part of the WMEP have shown some variations. Variations in the measured surface sediment concentration of a contaminant may not only reflect variations in the source. The local rates of sedimentation and mixing can also affect the observed surface sediment concentration. As a result, collecting only surface sediment can be misleading. As such, a sediment core study was recommended as part of the additional investigations prioritized by the MMAG.

A collaborative research project was initiated between the CRD, Fisheries and Oceans Canada and the University of Victoria in 2009. Sediment cores will be collected in 2010, to assess individual PBDE congener and carbon:nitrogen ratios, and to supplement the sediment core results from 2006.

PAH Fingerprinting Analyses

High variability in PAH analyses has been an issue with Macaulay Point sediment samples for a number of years. A PAH fingerprinting assessment, undertaken in 2007, indicated that coal was not a likely source of the majority of PAHs as was previously thought. Additional assessments of the alkyl PAHs, a minor component of the total PAH sediment profiles, will be undertaken in 2009/2010 to better quantify the contribution of the alkyl substituted PAHs from the coal to the sediments. These results will be presented in a future annual report when available.

Mussel Biomarker Assessment

Mussels were collected from Clover Point in September 2007 for the toxicogenomic method validation described above. Additional tissue types were collected from the same mussels and sent to the Aquatic Ecosystem Protection Research group of Environment Canada in Montréal. It was anticipated that these biopsy samples would be analyzed for a number of biomarker endpoints and that the results would be directly comparable to the University of Victoria toxicogenomic results. The Environment Canada analyses were put on hold until further validation of the University of Victoria toxicogenomic endpoints have taken place; results will be presented in a WMEP annual report when available.

Investigations Planned for 2010

No new additional investigations or studies are planned for 2010. The following studies will continue:

- the collaborative study on the presence of PPCPs in wastewater and potential environmental effects on biological communities with the University of Victoria
- the collaborative project on potential toxicogenomic effects of emerging chemicals in municipal wastewater with Environment Canada
- the collaborative project on analysis of sediment core and benthic invertebrate tissue samples with Fisheries and Oceans Canada and the University of Victoria
- the detailed PAH fingerprinting analysis in sediment and wastewater samples
- the collaborative project on potential mussel biomarker effects of municipal wastewater with Environment Canada

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

OVERALL CONCLUSIONS

The different monitoring components of the WMEP and the additional elements of the WMEP (additional investigations) are effective tools to assess the effects of the Macaulay and Clover points discharges. The 2009 WMEP results showed effects on the receiving environment that were limited spatially. The 2009 results were consistent with previous studies and identified areas of effect generally within 200 m of Macaulay Point and 100 m of Clover Point.

Macaulay and Clover Point

Wastewater and Marine Environment Program

Capital Regional District | 2009



Making a difference...together

CRD Marine Programs

About 20 scientists and technical staff work for the CRD's Environmental Protection Division. They include five staff in Marine Programs with a wide range of field and research experience. These scientists monitor and assess the potential 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 have studied the Macaulay and Clover Point outfalls since the late 1980s. Their responsibilities include analyzing the wastewater discharged from both outfalls, and both the seawater and seafloor near each outfall. Since 2000, more detail has been added to the monitoring and data analysis following recommendations made by the Marine Monitoring Advisory Group (MMAG).

The MMAG is a voluntary advisory group of scientists from government and academia. The group has expertise in marine sciences and has provided an independent review of the CRD's Marine Programs since 1987.

Marine Programs also supports the CRD Regional Source Control Program (RSCP) by providing information about pollutants entering the environment. This information is used to develop programs to minimize substances of concern from entering the sewer system.

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

Guidelines

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

Scientific standards

The annual monitoring and assessment follow a rigorous quality assurance and quality control regime both in the field and in the laboratory. For example, the CRD uses established scientific protocols for sampling, such as taking triplicate samples, to confirm sample validity. Their work meets guidelines established by the BC and Canadian governments and the US Environmental Protection Agency.

Program design is regularly reviewed to ensure it remains environmentally relevant and up to date. In 2006, the Society for Environmental Toxicology and Chemistry (SETAC) was retained by the CRD to review the Core Area Liquid Waste Management Plan (LWMP) from an objective, scientific, and technical perspective. The panel found that the monitoring work being conducted is generally sound and consistent with best practices in other jurisdictions. The report also identified gaps, and recommended changes to the program.

Their report can be found online at:

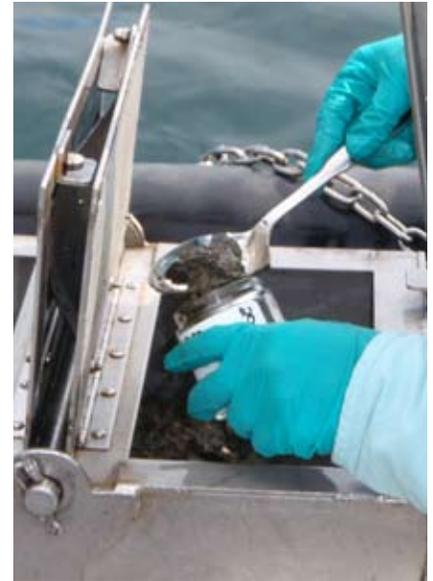
<http://www.crd.bc.ca/wastewater/reviewpanel.htm>

The MMAG also reviews all of the program report 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 scientific journals.

The 2009 Wastewater and Marine Environment Program annual report can be found online at: <http://www.crd.bc.ca/wastewater/marine/reports.htm>

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 increasing the level of sewage treatment at Macaulay and Clover Points be provided. Treatment is mandated to be in place by 2016. Liquid Waste Management Plan amendment #7 was submitted to Ministry of Environment in December, 2009 with a follow up amendment #8 in June 2010. These amendments detail the CRD's progress in planning for further treatment. In the meantime the minister requested that the CRD continue the existing marine monitoring program. However, the monitoring program is currently being reviewed in light of the move to new treatment, in conjunction with the BC Ministry of Environment. The MMAG will also contribute to the review process at a later date.



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

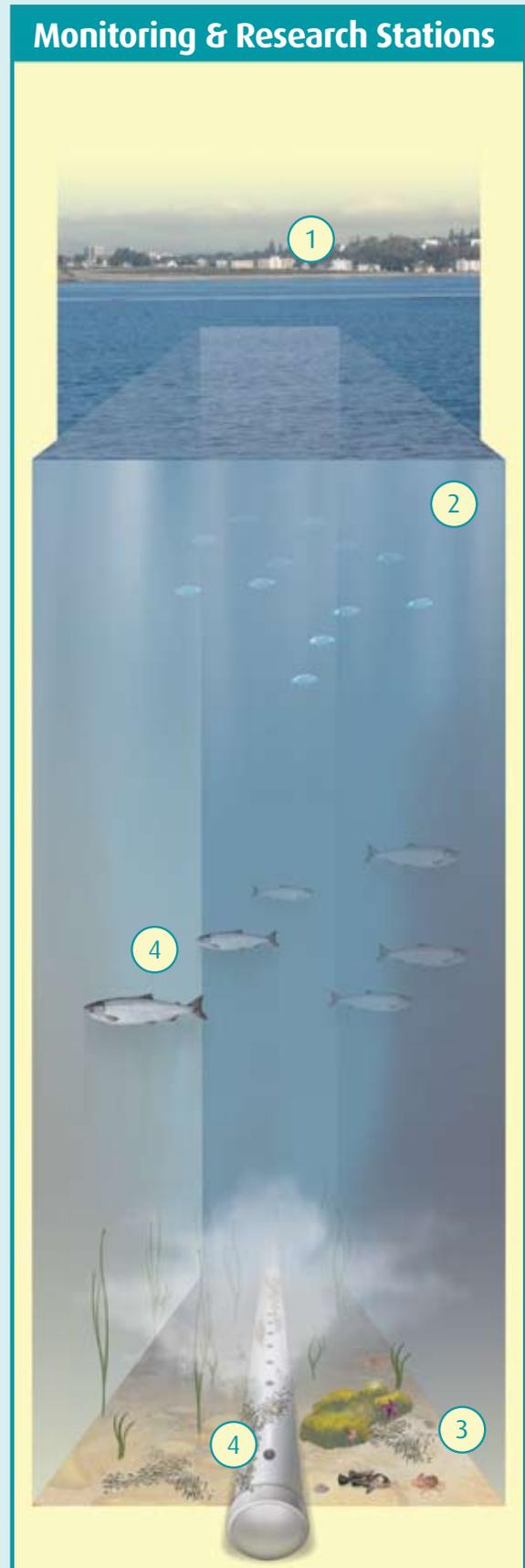
- SETAC Panel Report

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 daily to make sure they do not exceed permitted levels. See page xi for more details.
- 2 Monitoring surface water**
for fecal coliforms (an indicator of potential human exposure to wastewater) every month near the outfalls. See page xiii for more details.
- 3 Monitoring the seafloor**
and organisms living near each outfall every year. See page xv for more details.
- 4 Conducting collaborative research projects**
such as assessing the potential environmental effects from pharmaceuticals and personal care products. See page xix for more details.

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

In 2009, Marine Programs tested for over 170 priority substances in wastewater. These included measures of general wastewater quality, referred to as conventional parameters, 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 substances.

While Marine Programs scientists monitor for all the substances on a priority list, it is expected that only a small percentage of these will be found. Some substances that are detected may occur naturally, some are produced by residents, businesses and industry, while others, such as DDT and PCBs, remain in the environment long after they have been banned because they do not readily decompose. Many of the substances detected are found in wastewaters from all treatment plants, but at different concentrations partly depending on the level of treatment.

Findings in 2009

Substances that were detected frequently in 2009 included conventional parameters, metals, some PAHs, phthalates, two phenolic compounds, and a few substances used as solvents. Concentrations of these substances in wastewater and in the marine environment were compared to BC Water Quality Guidelines (WQG), which were developed to help protect aquatic life. The receiving environment concentrations were predicted using dilution factors from an oceanographic computer model. Results predicted for the receiving waters indicated that all concentrations except fecal coliforms would be below WQG. Most concentrations were below guidelines even in undiluted wastewater.



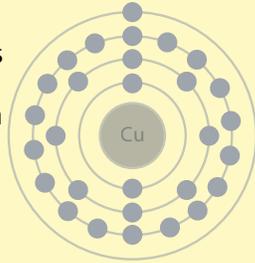
“There were 170+ substances analyzed in both discharges and more than half of these substances were never detected in 2009”

- 2009 Annual Report

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

Metals

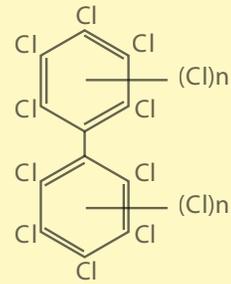
Tests have found that the concentrations of most metals of environmental concern have decreased over time in the Macaulay and Clover wastewaters.



Copper

PCBs (Polychlorinated Biphenyls)

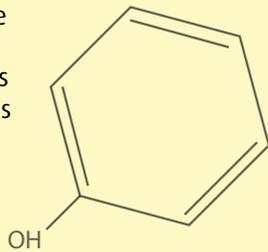
PCBs have been banned in North America since the 1970s. However, similar to organochlorine pesticides, they are still found at very low levels in the environment in water, wastewater, air and soil.



PCBs

Phenolic Substances

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



Phenol

PAHs (Polycyclic Aromatic Hydrocarbons)

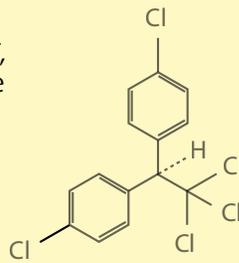
Four of the six PAHs showed slight increases and two PAHs had decreases since 1990. The increases could be the result of higher detection limits. These substances have been targeted by the CRD RSCP to help reduce them at their source.



Benzo-a-pyrene

Organochlorine Pesticides

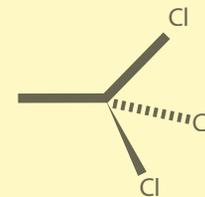
Organochlorine pesticides, such as DDT, are substances that are no longer used. However, they are still found at very low levels in the environment in water, wastewater, air and soil.



DDT

VOCs (Volatile and Semi-volatile Organics)

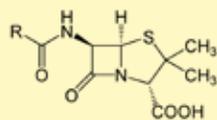
This category contains a wide range of compounds. While the majority of these have not been detected since 2005, there have been slight increases and decreases for a few VOCs since 1990.



Trichloroethane

PPCPs (Pharmaceuticals and Personal Care Products)

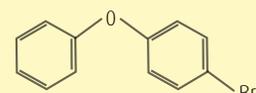
The effects of PPCPs are not yet understood. Studies are working on improving detection methods and determining effects on marine life.



Penicillin

PBDEs (Polybrominated Diphenyl Ethers)

Sediment core results have shown that PBDEs are higher near Macaulay Point outfall than at the Parry Bay reference site. PBDEs were not detected in 2008.



Bromophenyl Phenyl Ether

Monitoring surface waters

As well as monitoring wastewater, Marine Programs collects samples of surface water and evaluates them to ensure that the potential for human exposure to wastewater in the marine environment is low. The samples are collected by rapidly submerging sterile bottles to a depth of one metre, and testing for fecal coliform bacteria.

Findings in 2009

In 2009, there were a number of high fecal coliform concentrations observed but overall risk to human health was low. The higher fecal coliform values could be due to reduced diffuser performance resulting from partial blockages or minor cracks observed during the most recent outfall inspection. Maintenance will only be scheduled if it is confirmed that the Macaulay and Clover Point outfalls will continue to be part of the future sewage treatment system design.

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 indicators to assess public health effects are currently being reviewed in conjunction with the Ministry of Environment as part of the overall Wastewater and Marine Environment program review. Additional review of this monitoring component will be done with the MMAG once a formal decision on treatment locations and types is made.

“The 2009 surface water fecal coliform results indicated that the risk to human health from the wastewater outfalls was low”

- 2009 Annual Report



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 Hartland Landfill. The remaining wastewater is jetted 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 advanced wastewater treatment for Greater Victoria.

The Macaulay Point Outfall

Average flow rate in 2009	46,754 m ³ /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

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 at Constance Bank.





The Clover Point Outfall

Average flow rate in 2009	53,050	m ³ /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	

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 of the outfall is left open. It is in fact, capped off.



Key

-  Outfall
-  Diffuser
-  Seafloor Sampling Stations

Monitoring the seafloor



“There was no evidence of significant effects of the Clover Point outfall on mussel age or reproduction”

- 2009 Annual Report

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. Some material settles to the bottom. For this reason Marine Programs scientists monitor sediment quality within approximately 800 metres of both outfall 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).

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), including many of the metals, phenolic compounds and PAHs. The results are compared with sediment quality guidelines that have been developed by various government agencies (such as BC Ministry of Environment, Canadian Council of Ministers of the Environment, and Washington State) to help protect marine seafloor organisms.

Findings in 2009

The majority of substances in 2009 sediments were found at levels similar to previous years. Few substances exceeded sediment quality guidelines with concentrations above guidelines generally limited to the 200m stations at Macaulay Point. Only four substances exceeded guidelines at Clover Point. In 2009, a trend analysis was conducted examining sediment data from 1990-2009. The results of this analysis were generally consistent with the findings of the previous trend assessment. Trends from 1990 - 2009 found approximately half of the sediment chemistry parameters decreased with distance from the outfall indicating that the outfall is one source of these substances in the environment. The sediment chemistry results indicate there could be potential for effects on seafloor organisms within these areas.

There has been little change in seafloor organisms (benthic communities) around the Macaulay Point outfall. In general there are more polychaete worms, and more organisms overall, closer to the outfall, most likely due to an increased organic enrichment from the discharge.

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

The 2009 data deviate slightly from previous years in that the usual pattern of declining total organism abundance with increasing distance from the outfall was weaker. This was mainly due to lower abundances within 100 m of the outfall. Continued monitoring by the CRD will determine if the deviation is natural variability or true effects of the outfall.

At Clover Point, mussels near the outfall were larger than those further away or at the reference areas. Measures of age and reproductive status, as well as tissue chemistry showed very low potential for harmful effects off the outfall.

Overall Conclusions

Overall, analysis indicated that wastewater quality in 2009 was similar to previous years. After accounting for predicted environmental dilution and trapping, the levels of all substances in the wastewater would be below BC and national water quality guidelines. Surface water fecal coliform concentrations were generally low, with some exceptions. Sediment chemistry results showed very few sediment exceedances of quality guidelines. The benthic community at Macaulay Point exhibits some shift from background conditions, but it is still a functioning community. Mussel communities were generally larger at the outfall than at the reference sites.

These findings are consistent with previous years' monitoring results.





Science and Research

Additional Investigations & Conducting Collaborative Research Projects

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

Seven investigations were underway or completed in 2009:

High-resolution analyses were conducted from 2003 to 2008 for several persistent organic pollutants (POPs), such as DDT and PCBs. In 2009 methylmercury and tributyltin were investigated to determine whether regular monitoring of these substances was warranted. Results were below relevant guidelines. The CRD will continue to monitor these substances in wastewater in 2010 to determine if there are any changes over time.

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 (PPCPs) 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 includes the analysis of potential toxicogenomic effects on mussels exposed to the Clover Point wastewater outfall. Preliminary results have been presented in previous annual reports. Further results from the project will be available in 2010/2011.

The Macaulay and Clover Point outfalls and two pump stations (one upstream of each outfall) were tested for 125 different PPCPs in samples from five concurrent days in November, 2009. A subset of six PPCP results were compared between the outfalls and to other wastewater treatment plants. Results showed that four of the six PPCPs were much lower than reported in other jurisdictions. It is expected that the other PPCPs follow similar patterns. Data analysis is ongoing.



**University
of Victoria**

Department of Biology

CRD Collaborations

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



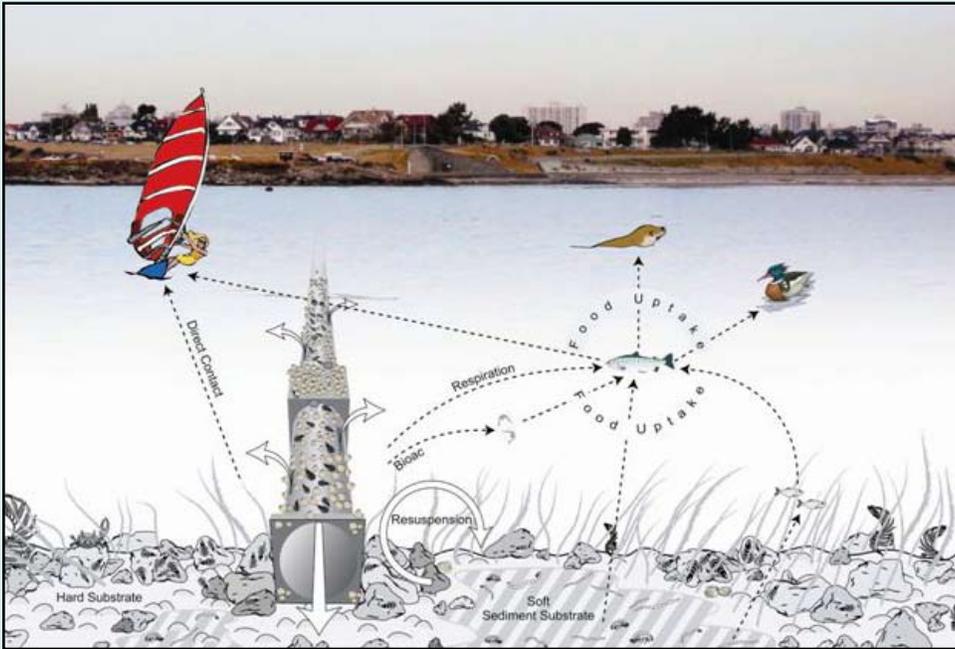
A sediment core study was undertaken in September 2006 in collaboration with Fisheries and Oceans Canada. Seafloor samples were collected near the Macaulay Point outfalls and at a reference site, with a core cylinder that is pushed into the seafloor. Initial analysis of the sediment core results confirmed that PBDE concentrations were higher near the Macaulay Point outfall than they were at the Parry Bay reference site. This indicates that the outfall is a potential source of these compounds. Parry Bay results were similar to other Strait of Georgia core samples that are far from any outfall discharges. Additional sediment cores and corresponding benthic invertebrate tissue samples will be collected in 2010.

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. Results of a fingerprinting analysis indicated that coal is not likely the main source of PAHs, as previously thought, but could be a small component. Additional assessments will be conducted in 2010/2011.

A collaborative study between the CRD and Environment Canada's Pacific Environmental Science Centre (PESC) was initiated in 2004 to determine the potential genotoxic effects of wastewater on marine fish. 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 concentrations. In addition to the exposure tests, all effluent samples were analyzed for various compounds, including PPCPs and natural and synthetic hormones. Final results from the study are still being reviewed and will be made available in a future annual report.

A collaborative research project between the CRD and Environment Canada was initiated in 2008 to validate the toxicogenomic method used in the University of Victoria study. Mussel samples will be analyzed for biomarkers that will be assessed as additional potential indicators of environmental exposure to effluent. Analyses have been put on hold until further work on the UVic study can take place. Results will be presented in a future annual report.

Potential Pathways for Outfall Environmental Effects



Clover Point Outfall



Macaulay Point Outfall

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 bacterium that comes from the intestines of warm-blooded animals, including humans and ducks. It is used as an indicator of potential for 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 offices).

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

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

PPCPs (Pharmaceuticals and Personal Care Products)

Refers, in general, to any products used by individuals for personal health or cosmetic reasons, or used by agribusiness to enhance growth or health of livestock.

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 products.

PBDEs (Polybrominated Diphenyl Ethers)

Chemicals that are used as flame retardants in a wide array of products including building materials, electronics, furnishings, motor vehicles, airplanes, plastics, polyurethane foams and textiles.

PCBs (Polychlorinated Biphenyls)

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

PAHs (Polycyclic Aromatic Hydrocarbons)

Substances that occur through incomplete burning of organic substances such as gasoline, 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 at:
<http://www.crd.bc.ca/wastewater/marine/index.htm>



Making a difference...together

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**CAPITAL REGIONAL DISTRICT
MARINE MONITORING ADVISORY GROUP**

**TERMS OF REFERENCE
Revised May 2010**

PURPOSE AND ROLE

The purpose of the Marine Monitoring Advisory Group (MMAG) is to provide support to the Capital Regional District (CRD) through the Environmental Protection division. Specifically, the role of the MMAG will be to:

- A. Advise on, provide an independent assessment of, and make recommendations on the wastewater and marine environment programs to the CRD, with specific focus on:
 - 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; and
 - 6) Additional investigations and emerging issues.
- B. Advise on, provide an independent assessment of, and provide recommendations on the stormwater programs to the CRD, with a scientific perspective and specific focus on:
 - 1) Sampling program design;
 - 2) Receiving environment effects;
 - 3) Emerging contaminants of concern; and
 - 4) Current topics from the literature and other sources.
- C. Review the state of the receiving environments near CRD wastewater outfalls and municipal stormwater discharges with an integrated and cumulative effects perspective.
- D. When requested, provide independent advice to the CRD on other related marine, stormwater or liquid waste issues.

RELATIONSHIP TO THE CRD

The MMAG will report to the Environmental Protection division of the Environmental Sustainability department. Staff will bring MMAG related information to the Core Area Liquid Waste Management Committee, as necessary. The Core Area Liquid Waste Management Committee, the CRD Board, or the General Manager of Environmental Sustainability may also refer matters to the MMAG.

The Supervisor of Marine Programs, or delegate, will act as a staff liaison to attend MMAG meetings, represent the CRD and provide effective communication between the MMAG and CRD. The Supervisor of Marine Programs will keep MMAG regularly informed of issues related to the mandate of the MMAG.

MEMBERSHIP AND SELECTION

MMAG membership will be six to nine members at any time. Membership will be determined by the CRD General Manager of Environmental Sustainability, in consultation with the chair. Membership will consist of scientists or technical experts with knowledge and experience relevant to the purpose and role of the

MMAG. Invitations will be extended, but not limited, to representatives from Environment Canada, Fisheries and Oceans Canada, Provincial Ministry of Environment, Vancouver Island Health Authority, and academic institutions.

Membership is on a two-year term, up to a maximum of six years. Members are to serve without remuneration.

The chair will be selected by the members, and shall be elected every two years. The chair may serve additional terms up to a maximum of six years. The chair is to serve without remuneration.

PROCEDURE

The MMAG will meet based on the consensus of the group and in discussion with the General Manager of Environmental Sustainability, but the expectation is that the group will meet three to four times per calendar year. Any additional meetings will be at the call of the chair. The CRD will determine the agenda in consultation with the chair and members of the group.

The CRD Rules of Procedure will apply.

BUDGET

An annual budget will be available to cover costs related to the administration and logistical support for convening meetings through the year. This budget will be included within the Marine Programs budgets, which are funded from the annual budgets for the northeast trunk (Clover) and northwest trunk (Macaulay) systems.

Approved by CRD Board on _____, 2010