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## OPTICS TRUMP EVIDENCE: THE SEATERRA PROJECT IN VICTORIA

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**A** perversion of public policy is playing out over land-based sewage treatment in Victoria, the capital city of British Columbia, on Canada's southern west coast. The Capital Regional District (CRD) has been ordered by the BC government to waste an estimated \$1.1 billion on a massive project that will cause environmental harm in one of the world's most stunning natural and built environments. The Capital Regional District plans to construct land based sewage treatment plants to serve the core area municipalities (Victoria, Oak Bay, Esquimalt, Saanich, Langford, View Royal and Colwood), with capital costs to be shared by municipal, provincial and federal governments. The project is called Seaterra.

This policy travesty is occurring despite solid evidence showing huge costs and net environmental harm. The professional assessments of marine scientists from BC and Washington State, public health officials, and engineers, that the present discharge of screened effluent via deep sea outfalls is cost-effective and causes minimal damage to the marine environment, have been ignored. Two Members of Parliament knowledgeable about science and the environment have spoken out against land-based treatment<sup>1</sup>, and the Canadian Taxpayers Federation (CTF) has produced an independent review<sup>2</sup> that calls into question the accuracy and completeness of the information the CRD has provided to local taxpayers.<sup>3</sup> Yet the CRD and the BC government continue to press ahead, telling critics that it is too late to stop the project.

No formal benefit-cost analysis, environmental impact assessment, or public vote is required by law, and none are planned. However, the CRD in March 2014 approved \$1.6 million in spending for a public relations campaign to tout the benefits of Seaterra to CRD residents.<sup>4</sup> Like other non-capital costs, this cost will be borne entirely by CRD taxpayers.

## I. A BRIEF HISTORY OF THE ISSUE

Sewage treatment has been a public policy issue in Victoria for more than twenty years. At various times it has involved two, three, or four levels of government (municipal, regional, provincial, and federal). In the early 1990s, the province asked greater Victoria to move to land-based treatment. Under the provisions of the Municipal Act, the CRD was required to receive voter approval by referendum before embarking on such a costly project. At that time, capital costs were to be shared 50/50 between the CRD and the province. The referendum was held Nov. 21, 1992, and voters approved (57%) continuing to use screening and long ocean outfalls, soundly rejecting two options for land-based treatment.<sup>5</sup>

In 2000, however, the province replaced the Municipal Act with the Local Government Act, and in 2004 a further regulation was passed (the Regional District Liabilities Regulation, B.C. Reg 261/2004), ensuring that no referendum is now required before the CRD implements land-based sewage treatment.<sup>6</sup>

In 2006, the BC Environment Minister ordered the CRD to develop a plan for sewage treatment, failing to acknowledge that the CRD already had approval for the existing preliminary-treatment system.<sup>7</sup> The CRD responded by deciding to proceed toward land-based sewage treatment.

With no referendum planned, and none required, it is impossible to know how Victorians would vote today. However, in a 2004 Ipsos-Reid survey, 50.1% of Victorians favoured either the status quo or enhanced source control, again rejecting land-based treatment.<sup>8</sup>

## II. THE CURRENT SEWAGE DISPOSAL SYSTEM

Victoria's current system has been in place since the 1970s. Liquid waste from households and businesses flows through collector pipes to two long ocean outfalls in the Strait of Juan de Fuca. Before entering the outfalls, the effluent<sup>9</sup> receives preliminary treatment via 6 mm screens that remove large solids. The Macaulay Point outfall pipe in Esquimalt travels 1.8 kilometres away from shore and is 60 metres below the surface. The Clover Point pipe in Victoria is 1.2 kilometres long, and 65 metres deep.

The outfalls end in long diffusers on the ocean floor that allow the effluent to emerge from small holes. The effluent rises rapidly because it is warmer and less dense than the cold, salty waters of the Strait; strong tidal currents add to the dispersion. As the effluent (already over 99.9% water after screening) rises and spreads, it mixes rapidly with oxygen-rich sea water, so that the top of the plume of mixed effluent and seawater (usually 45-60 meters below the ocean surface<sup>10</sup>) is much more than 99% seawater. The average volume

of effluent (up to 130 million litres a day<sup>11</sup>) sounds large but is actually small compared to the volumes of seawater and Fraser River water travelling out of the Strait, along the Canadian shore, to the Pacific Ocean. Victoria's sewage effluent (already more than 99.9% water) is less than 1/1,000 of the Fraser River's flow of water into the Strait of Juan de Fuca.<sup>12</sup>

Screening does not remove metals, grease, or other chemicals, but the Capital Regional District has since 1994 operated an exemplary "source control" program<sup>13</sup> aimed at reducing the contaminants discharged by industry, businesses, institutions, and households. The lack of heavy industry in Victoria, combined with good source control, means that toxic chemicals are not a serious problem in Victoria; in fact the screened effluent (undiluted) meets the Canadian drinking water standards for metals, in most cases being below the maximum amounts by a factor of 1,000 or more.<sup>14</sup>

Another important component of Victoria's current system is the comprehensive monitoring of the ocean environment near the outfalls. Annual monitoring is required by the province, but the CRD conducts additional monitoring, studying a range of water quality indicators, testing for over 200 substances, and taking samples of the seafloor mud and the marine animals living near each outfall. Since 1987, a voluntary Marine Monitoring Advisory Group (MMAG) of scientists with expertise in marine sciences has provided an independent review of the CRD's Marine Environment Program. BC water quality guidelines are usually met in the surface waters above the outfalls,<sup>15</sup> indicating that there is no significant hazard to human health from the outfalls. Ocean floor monitoring shows only localized negative effects on the marine environment near the outfalls; in fact, there are thriving colonies of sea creatures that would die off were the nutrients in effluent to be reduced or eliminated due to adoption of land-based treatment.

Victoria's storm drains, which are separate from the sanitary sewers,<sup>16</sup> discharge to local beaches throughout the area, and the CRD also monitors storm drain discharge points. Fecal coliforms on beaches result from cross-connections between sanitary sewers and storm drains during heavy rain; fortunately this is primarily a winter problem (when beach use by people is limited). No fecal coliforms reach local beaches from the long ocean outfalls, and the proposed land-based sewage treatment system would not correct the problem of storm drains carrying small amounts of sewage to beaches during heavy winter rains.

### III. COST OF THE LAND-BASED TREATMENT SYSTEM

Table 1 shows the expected total costs of the proposed project in 2014 dollars. CRD 2010 estimates<sup>17</sup> are adjusted for inflation at 2% per year,<sup>18</sup> and annual operating costs are converted to their present value, the sum that would need to be paid today in order to cover operating costs for 50 years (the expected life of the project) if invested for a real (inflation-adjusted) return of 5% per year.

Although the BC and federal governments initially promised one-third funding of capital costs, their actual share is less because land purchase costs and interim financing costs will not be shared; their combined share of total project costs (capital and operating) is only 46.6%, leaving CRD taxpayers to pay 53.4%. In addition to being responsible for all operating costs, CRD taxpayers would also be responsible for any cost overruns.

Table 1 Victoria Sewage Treatment Costs

	Total	CRD	BC**	Canada**
2010 dollars*				
Capital	782,685,800	287,566,332	247,559,734	247,559,734
Operating	14,571,000			
2014 dollars***				
Capital	847,204,281	311,271,046	267,966,618	267,966,618
Share of Capital Costs	100%	36.7%	31.6%	31.6%
Operating	15,772,119			
Present Value of Operating Costs****	302,331,360	302,331,360	-	-
Capital + PV Operating	1,149,535,641	613,602,406	267,966,618	267,966,618
Share of Total Costs	100%	53.4%	23.3%	23.3%

\* Costs from CRD 2010.

\*\* Promised 1/3 funding of capital costs reduced because land purchase costs of \$13,000,000 and interim financing costs of \$27,006,600 have been deemed ineligible. CRD is liable for all cost.

\*\*\* Adjusted for inflation at 2% per year.

\*\*\*\* Discount rate of 5%, 50 year project life.

#### IV. EFFECTS OF THE LAND-BASED TREATMENT SYSTEM

Incredibly, the CRD in 2013 commissioned an assessment of the environmental impact of the proposed new system that did not explicitly compare the proposed system with the existing one.<sup>19,20</sup> What is clear from the report, however, is that all of the environmental effects of the new system, on land, are negative. Some, like construction noise, odor, and dust, are temporary, but most are permanent, and some are significant for human health. These acknowledged harms include:

- Negative human health effects during construction (due to dust and noise);
- Increased traffic (heavy trucks) in residential neighbourhoods during construction, posing risks to cyclists and pedestrians;
- Risk of disturbing archaeological remains during construction;
- Disruption to tourism (Victoria's main "industry") during construction;
- Earthquake and tsunami risks (exceeding those of the current system);
- Permanent negative human health effects at the land-based treatment facility, definitely for workers and possibly for nearby residents;
- Reduced air quality (odors) that would require mitigation;
- Noise and light pollution in residential neighbourhoods from new or modified facilities;
- Loss of natural vegetation and wildlife habitat from new or modified facilities;

- Loss of recreational land from new or modified facilities; and,
- Loss of aesthetic appeal from new or modified facilities.

Not mentioned in the report are:

- The statistical likelihood that one or more serious injuries or deaths would occur during construction – this is an unavoidable risk of large construction projects;
- The ongoing need to dispose of the sludge resulting from treatment, which would concentrate some harmful chemicals in the effluent; the current plan is to build an 18 km pipeline to Hartland landfill, travelling through residential neighbourhoods (including some served by well-water), leaving the risks from contaminants to be managed at the landfill;
- Safety hazards from the biosolids “digesters” (to be used to convert sludge to fuel) as digesters can explode if they malfunction;
- The possible reduction in property values for neighbourhoods near new or modified facilities or along the path of pipeline construction – concerns about property values have been raised by residents but compensation has neither been offered nor incorporated into cost estimates (hence would not be cost-shared by senior governments);
- The likelihood of added costs to excavate first nations archaeological sites uncovered during construction (under BC’s Heritage Conservation Act the Minister can order excavations at the expense of the property owner<sup>21</sup>); in fact the CRD in March 2014 approved an initial \$600,000 contract for assistance with such excavations (and this and any additional such costs will not be shared by senior governments)<sup>22</sup>;
- The likelihood of occasional treatment plant or other system failures, including pipeline breaks, resulting in unplanned ocean discharges of untreated sewage or on-land sewage spills potentially affecting groundwater drinking supplies; and,
- The certainty of large greenhouse gas (GHG) emissions during construction<sup>23</sup> and ongoing emissions and high power consumption during operation (which contradicts provincial and CRD policy to reduce GHG emissions<sup>24</sup>).

The report acknowledges that some of the harms are significant enough that mitigation would be needed; however some mitigation (such as scrubbers to reduce odor discharges) can be vulnerable to system breakdowns. A major seismic event or tsunami could result in unplanned ocean sewage discharges or sludge leaks from pipeline breaks in residential neighbourhoods.

Harms on land might be acceptable if there were some significant benefit to the marine environment, compared to the current system. However, CRD monitoring consistently confirms that there is no significant harm to the marine environment from the current system. This is also the opinion of informed, reputable marine scientists from BC and Washington State, public health officials, and engineers.<sup>25,26</sup> As recently as December 2013, ten local marine scientists<sup>27</sup> reiterated their opinion that sewage treatment is a low priority for marine environmental protection:

The overriding impression we have of the CRD’s continuing plans for land-based secondary treatment, or suggestions by others for tertiary treatment, is that the allegedly scientific arguments put forward in support are very superficial. Protection of the marine environment is supposedly a primary goal, but nowhere can one find a detailed, quantitative, rational analysis of what the problems are with the present system and how the proposed schemes would fix them. The BC government’s order to the CRD in 2007 was largely based on the qualitative and inconclusive SETAC report<sup>4</sup>. Similarly, the federal government’s “one size fits all” regulations are clearly inappropriate in failing to take account of differences in receiving environments and hence different impacts and risks. The CRD’s willing compliance is disappointing...

Many of us in the marine science community who have examined the issues, based on the excellent monitoring work of the CRD's scientists together with consideration of local oceanographic conditions, have concluded that 1) in spite of some uncertainties, the impact of the present system is small, and 2) land-based secondary treatment in the Juan de Fuca Strait region is a low priority for marine environmental protection.

Much greater benefits for the marine environment could be achieved for a fraction of the cost of the proposed scheme by focusing on more serious issues such as habitat loss, harmful invasive species, and making our local ecosystem more resilient to climate change and ocean acidification.<sup>28</sup>

With insignificant benefits to the marine environment, and a wide variety of harmful effects on land, it seems clear that the proposed land-based treatment system would do net environmental harm.

## V. EVIDENCE-BASED PUBLIC POLICY AND THE CRD

The main principles of evidence-based public policy are that:

- Government should act in the public interest;
- Decisions should be based on the best available scientific evidence; and,
- Rigorous evidence should be collected (or produced) before major decisions.

The rationale for using evidence-based decision-making is that it avoids short-sighted, politically-motivated decisions. The CRD says, "The CRD has a mission to be local government leaders in providing cost effective, innovative and environmentally responsible sewage treatment to its residents."<sup>29</sup> That statement seems to indicate that the CRD agrees with the principles of evidence-based policy and supports the use of cost-benefit analysis (CBA) to guide decisions. However, cost-effectiveness can only be determined by formally comparing all relevant alternatives, including the status quo, which the CRD has refused to do.

In 2006, the CRD commissioned a "technical and scientific review" of planned land-based sewage treatment from the Society of Environmental Toxicology and Chemistry (SETAC). SETAC's report<sup>30</sup> stated that their review was undertaken with the values of protection of public health, protection of the environment, sound scientific reasoning, and cost effectiveness. Yet the conclusions to the report are not consistent with these values.

The conclusions state that "The benefits of treatment cannot be described or calculated with any precision. This observation does not mean that the benefits of treatment would be insignificant. The costs of treatment are more certain, and they are significant." Those statements only make clear that conducting a cost-benefit analysis would be difficult or impossible, as such a study requires good evidence on both costs and benefits. The report then continues, however, that "The Panel believes it is likely that, if a BCA<sup>31</sup> could be conducted to state-of-the art standards, it would find that treatment is justified. This conclusion rests on the Panel's perception that the electorate would now support treatment, that is, that the benefits perceived by a majority would exceed the costs they perceive. Put in very simple terms, if a referendum almost passed when the costs of treatment were represented as being very high, it likely would pass if costs were much lower."

As the results of a scientific and technical review, the above statements are problematic for several reasons. First, given cost-sharing by other governments, perceived costs were explicitly stated in the SETAC report to include only local costs; yet total costs must be considered when making decisions on a project of this kind, and would be in a competent CBA. Second, the 1992 referendum did not "nearly pass" – voters in 1992 soundly rejected land-based treatment. There is no evidence base for scientists assuming or asserting that a referendum would pass today.

Still referring to Panel members' belief that a new referendum would pass, the conclusions continue, "This argument begs the question of whether a new referendum should be held. This is a possibility, but the Panel's sense is that the outcome is not in great doubt. Advocates of the status quo have argued eloquently and convincingly, that treatment is unnecessary and even wasteful. However, the fact remains that, after many years of discourse, many people would decide the issue on grounds other than an absence of currently demonstrated health and ecological effects. The Panel cannot refute sentiments based on willingness to bear risks, ethics, esthetics, or other factors that cannot be resolved on purely "scientific" grounds."

It should go without saying that referenda or their results have no place in a scientific and technical report, even less so speculation on referenda yet to be held, but the greater shortcoming is the circularity of the argument. The SETAC report was commissioned in order to give an overview of the science involved in sewage treatment, and thereby to help potential voters and politicians make a decision; a reliance on speculation about existing voter opinions to support a decision consistent with those opinions is neither helpful nor scientific.

It is the duty of scientists to present the scientific point of view, whether or not they believe voters or decision-makers will be swayed by it; leaving voters and decision-makers to rely on unscientific information (without even presenting the science for their consideration) shirks this duty.

The SETAC conclusions are not scientific, are certainly not based on cost-effectiveness, and are not even internally consistent; if it were true that "great deference is due to the expressed will of the electorate" then surely a referendum would be essential, yet the SETAC conclusions do not call for a new vote.

One important safeguard in science is the practice of peer review. Others with knowledge and expertise should review work like the SETAC report, yet the CRD has consistently declined to send the report for peer review; it is unlikely to have passed had a peer review been commissioned.

## VI. FEDERAL REGULATIONS

In 2009, the federal government, through the Canadian Council of Ministers of the Environment (CCME) announced new wastewater regulations, the "Canada-wide Strategy for the Management of Municipal Wastewater Effluent", intended to "protect human health and the receiving environment"; the purpose was to protect drinking water supplies and prevent environmental damage. The north<sup>32</sup> was exempted for five years because of the need to study the special difficulties posed by its extreme climate. Initially, the government also considered deferring inclusion of locations where the "receiving waters" for wastewater effluent discharges were marine (ocean) rather than fresh water, but in the end instead adopted one-size-fits-all regulations.

The Strategy calls for local assessment and then implementation (across the country) starting with high-risk locations (by 2020), next medium-risk (by 2030), and finally low-risk (by 2040).<sup>33</sup> However, the water quality standards used to determine risk do not take into account Victoria's unique receiving waters in the Strait of Juan de Fuca.

For many years, the CRD and the BC Ministry of the Environment agreed to monitor effects on the receiving environment by monitoring at the edge of the Initial Dilution Zone (IDZ), 100 m from the ocean outfalls. Concentrations at the edge of the IDZ, compared to concentrations in effluent, were conservatively estimated by a CRD consultant<sup>34</sup> to be no more than 1 part in 245 for Macaulay Point or 1 part in 175 for Clover Point. CRD monitoring showed that in the raw effluent, there were 12 substances that exceeded CCME and BC water quality guidelines (WQGs). After applying minimum dilution factors<sup>35</sup>, however, there were no substances exceeding applicable WQGs, except for bacteriological indicators,

indicating that receiving environment concentrations were not likely to exceed WQGs and that the potential for effects on aquatic life are likely limited to within the IDZ.<sup>36</sup>

For biological oxygen demand (BOD) and total suspended solids (TSS), the CRD and the BC Ministry of the Environment had always agreed to compare Victoria's undiluted effluent with standards for screened municipal wastewater; the effluent at Clover and Macaulay Points always stayed within this standard.<sup>37</sup>

The federal government, however, under the new CCME regulations, has insisted on considering only the concentrations in undiluted effluent. Disregarding the 1/245 and 1/175 dilution of BOD and TSS results in Victoria being classified as "high risk", an arbitrary, artificial, and misleading determination in terms of the actual impact on the marine environment. Artificially classifying Victoria as high risk, and offering early federal funding, can only mean that some actual high-risk locations will not receive early funding as a result.

The CCME also commissioned a study entitled "Cost-Benefit Analysis for Cleaner Source Water", which was intended to develop a template for the cost benefit analysis of projects to be undertaken as part of the strategy. The authors noted that in the past, treatment decisions were justified based on an informal assessment of the costs and benefits; effectively it was assumed that benefits exceeded the costs because limiting the discharge of deleterious substances into surface waters was thought to be important for the natural environment and human health.

However the report then states: "In times of competing resources, and when alternative technical options have differing costs and environmental effectiveness, there is a need to take this reasoning farther. The policy objective becomes to not only improve surface water quality *per se* but rather to improve surface water quality in an economically efficient manner. Thus, there is a need for information on not just treatment costs, but also more information on the environmental and economic benefits that can be expected to flow from investments in municipal wastewater treatment."

Unfortunately, it is clear that the consultants had in mind primarily fresh water receiving environments, not marine environments, in their analysis. This is revealed in three key ways and underlies the entire report:

- The title of the report mentions "source water", which refers to drinking water sources;
- The report indicates that reducing discharges to zero would result in the receiving waters being drinking-water quality (never true for seawater); and,
- The report indicates that reducing the discharged amounts of key pollutants would a) improve human health, recreational opportunities, and aesthetics, b) increase property values, c) improve fish and shellfish health, and biodiversity, and d) reduce interference with shorelines and water intakes by algae and weeds. All of these are more important for freshwater than for marine environments.

The authors acknowledge that benefits will generally be reduced for marine environments, and further recognize that every marine location is different: "The size of these benefits would be highly dependent on the impact on marine receiving waters." The report emphasizes that local estimates of cost-effectiveness are needed before investments proceed. This is being ignored, as Victoria has been approved for federal funding without a local cost-benefit analysis.

The report goes on to examine the costs and benefits expected for the only two provinces where the consultants had sufficient data: New Brunswick and Newfoundland and Labrador. Results are summarized in two tables, showing the costs and benefits for land based secondary treatment at 43 locations in New Brunswick and 185 locations in in Newfoundland and Labrador.<sup>38</sup> Costs were estimated in 2005 dollars, with operating costs converted to present values based on a 25-year facility life and a discount rate of 4%. Table 2 on the next page shows these figures, adjusted to 2014 dollars. Victoria's costs have been recalculated with the same assumptions, and are shown for comparison.

Despite federal and provincial cost-sharing, the total cost for Victoria is the amount that is relevant for cost-benefit analysis and making a decision about whether or not to proceed with the project; and total costs were cited for New Brunswick and Newfoundland and Labrador.

Benefits have been shown at zero for Victoria, as none of the categories of benefit valued for New Brunswick and Newfoundland and Labrador are likely to apply. In fact, given the harms (on land) outlined above, and allowing for only small benefits to the marine environment, it is likely that net benefits would be negative in Victoria, adding to the \$1.1 billion cost.

In terms of cost-effective public policy, and assuming that the figures for New Brunswick and Newfoundland and Labrador are reliable, land-based treatment should certainly be done in those provinces before Victoria. Table 2 shows that for \$933.4 million, treatment could be implemented for 288 locations in New Brunswick and Newfoundland and Labrador – less than the \$1.1 billion cost of one plant for Victoria.

By offering immediate federal funding for Victoria, without a local cost-benefit analysis, the federal government is violating its own policies for prioritizing improvements to sewage treatment across Canada.

Table 2 Comparison of Treatment Costs and Benefits

	Newfoundland/ Labrador	New Brunswick	Victoria
2005 dollars*			
Number of facilities	185	43	
Treatment Costs	506.0	275.0	
Treatment Benefits	645.0	695.0	
Net Benefit (Cost)	139.0	420.0	
2014 dollars*			
Treatment Costs	604.7	328.7	1,103.5
Treatment Benefits (Costs)	770.8	830.6	0
Net Benefit (Cost)	166.1	501.9	(1,103.5)

\* In millions, adjusted for inflation at 2% per year, using a discount rate of 4%, and project life of 25 years

## VII. TOWARD EVIDENCE-BASED POLICY

Victoria is fortunate in having a natural sewage treatment plant, the Strait of Juan de Fuca, on its doorstep. The current sewage disposal system has at most localized ocean floor impacts and is sustainable. Forcing the capital region to move to land-based sewage treatment is a triumph of optics over evidence. Forcing such a project with neither an environmental impact assessment nor a cost-benefit analysis (both comparing the proposed system to the existing system) shows a lack of regard for evidence-based policy. Forcing such a change without a referendum is undemocratic and unreasonable.

The planned land-based treatment system would, literally, flush \$1.1 billion down the toilet. This billion dollar boondoggle would waste money that could be used for other types of environmental enhancement, cost-effective sewage treatment (after local study) in other locations in Canada, tax reduction, or any of the other priorities currently competing for government funding. For instance, in Victoria, fixing the storm/sewer cross-connections that allow sewage onto beaches, and improving source control, could probably be accomplished for less than a third of the cost of land-based treatment, with more benefit to human health, beach aesthetics, and recreation.

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<sup>1</sup> The Honourable David Anderson, former Minister of Fisheries and Oceans and Minister of Environment for Canada, and recipient of environmental awards including the John Fraser Award for Environmental Achievement from the Sierra Club of Canada (2005), the Dr. Andrew Thompson Award from West Coast Environmental Law for his lifetime contributions to the environment and sustainability in British Columbia (2004), and the 50th anniversary International Conservation Award (1998) from the Atlantic Salmon Federation; and the Honourable Keith Martin, medical doctor and former Member of Parliament for the riding of Esquimalt—Juan de Fuca (Esquimalt being the location of the Macaulay outfall and of the proposed sewage treatment plant); Dr. Martin has taken leadership roles in many areas including public health, conservation, and the environment.

<sup>2</sup> Peter, S. 2014. Seaterra – Projected Cost Allocation Scenarios. Vancouver, BC: Canadian Taxpayers Federation.  
[https://www.taxpayer.com/?section\\_id=5100&section\\_copy\\_id=18090](https://www.taxpayer.com/?section_id=5100&section_copy_id=18090).

<sup>3</sup> The Canadian Taxpayers Federation critique uncovered some inconsistencies in CRD information concerning the different costs homeowners in various municipalities would pay, and calculated likely costs to businesses (which have not been estimated by CRD). The CTF also pointed out that actual costs are likely to rise, as financing costs (currently at historical lows) can increase over the life of the project; such cost increases would not be shared by senior governments.

<sup>4</sup> Palmer, D. 2014, March 3. Greater Victoria sewage PR to cost \$1.6 million. Victoria News.

<sup>5</sup> Society of Environmental Toxicology and Chemistry (SETAC), panel members Stubblefield, WA; Servos, M; Gersberg, RM; Riley, C; Simpson, D; Smith D; and Wells, P. 2006. Scientific and Technical Review: Capital Regional District Core Area Liquid Waste Management Plan. Victoria, BC: CRD.

<sup>6</sup> Furey, M (Assistant Deputy Minister of the BC Ministry of Community, Sport and Cultural Development). 2011. Email communication to John Newcomb. Accessed at [http://sewagevictoria.blogspot.ca/2011\\_07\\_01\\_archive.html](http://sewagevictoria.blogspot.ca/2011_07_01_archive.html) February 2014.

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<sup>7</sup> As justification for this order, the Minister has cited the “MacDonald Report” (MacDonald and Smorong, 2006), which investigated contaminant levels on the ocean floor near the Clover Point and Macaulay Point outfalls. However this report was never peer reviewed, and its findings have been questioned by public health officials and marine scientists (see Peck). As the MacDonald report acknowledged uncertainties in the data, and recommended further study rather than land-based sewage treatment, it does not provide strong support for the Minister’s order. One conundrum for ocean floor sediment monitoring is that the metals and other chemicals in the ocean sediments may have arisen from causes other than the outfalls, including Victoria’s long-terminated historical practice of dumping solid waste (garbage) from barges into the ocean, shipwrecks, and other sources; Peck, S (former Deputy Provincial Health Officer and Medical Health Officer, CRD). No date. Accessed at <http://www.rstv.ca/is-victoria-dumping-raw-sewage> February 2014.

<sup>8</sup> SETAC, 2006, pp. 96-99.

<sup>9</sup> Wastewater that flows out of a treatment plant, sewer, or industrial outfall.

<sup>10</sup> Capital Regional District (CRD). 2013a. Macaulay and Clover Points: Wastewater and Marine Environment Program 2012 Annual Report. Victoria, BC: CRD.

<sup>11</sup> CRD 2013a, Table 2.4.

<sup>12</sup> Based on “Typical river flows at various locations in Canada”, <https://www.ec.gc.ca/eau-water/default.asp?lang=En&n=45BBB7B8-1>.

<sup>13</sup> Capital Regional District (CRD). 2013b. Regional Source Control Program 2012 Annual Report. Victoria, BC: CRD.

<sup>14</sup> Author’s comparison of reported levels at Clover and Macaulay Points (CRD 2013a, Tables 2.11 and 2.12) and Canadian standards; Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment (FPTCDW). 2012. Guidelines for Canadian Drinking Water Quality - Summary Table. Ottawa, ON: FPTCDW. Accessed at [http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/2012-sum\\_guide-res\\_recom/index-eng.php#t2](http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/2012-sum_guide-res_recom/index-eng.php#t2) February 2014.. Metals compared: Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, and Silver.

<sup>15</sup> The vastly diluted plume reaches the surface less than 4% of the time, usually in winter months (CRD 2013a, pp. 51 and 56).

<sup>16</sup> There remain a few combined sewers in the region.

<sup>17</sup> Capital Regional District (CRD). 2010. Report #EWW 10-52, Report to Core Area Liquid Waste Management Committee: Meeting of Wednesday 23 June 2010. Victoria, BC: CRD.

<sup>18</sup> Canada’s consumer price index increased at an annual average rate of 1.96% yearly from 2000 to 2013.

<sup>19</sup> Capital Regional District (CRD). 2013c. Environmental Impact Study of the proposed Core Area Wastewater Treatment Program Facilities: Terrestrial Environment – Volume I of II. Victoria, BC: CRD.

<sup>20</sup> This is unfortunately consistent with CRD past practice related to sewage treatment; the CRD in 2007 commissioned and approved the results of a report that included a “triple bottom line” analysis yet did not compare proposals for enhanced sewage treatment to the existing system; Capital Regional District (CRD). 2007a. The Path Forward: The Supporting Report to the Response to the Minister of Environment. Victoria, BC: CRD.

<sup>21</sup> Province of British Columbia. 2014. Heritage Conservation Act, RSBC 1996. Victoria, BC: Queen’s Printer. Accessed online at [http://www.bclaws.ca/Recon/document/ID/freeside/00\\_96187\\_01](http://www.bclaws.ca/Recon/document/ID/freeside/00_96187_01) February 2014.

<sup>22</sup> Palmer, 2014.

<sup>23</sup> Approximately one ton of carbon dioxide is produced for every ton of cement.

<sup>24</sup> In 2007, the Province mandated GHG reduction targets for municipalities and regional governments. The CRD has adopted a target of reducing community emissions to 33% below 2007 levels by 2020; Capital Regional District (CRD). 2008. Report to Environment Committee Meeting of Wednesday, 23 January 2008. Victoria, BC: CRD.

<sup>25</sup> British Columbia/Washington Marine Science Panel (BCWMSP). 1994. The Shared Marine Waters of British Columbia and Washington. Victoria, Vancouver, and Seattle: BCWMSP.

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<sup>26</sup> Stanwick, R; Millar, J; Peck, S; Emerson, B; Allen, B; and Barnard, K. 2008, Feb. 28. How to flush a billion-plus on sewage: What about environmental effects of a land-based treatment facility? Victoria Times-Colonist.

<sup>27</sup> Drs. Jay Cullen, Chris Garrett, Jack Littlepage, Rob Macdonald, Tim Parsons, Tom Pedersen, Vera Pospelova, Rick Thomson, Diana Varela, and Michael Whitar. All are current, former, or adjunct professors of marine science, Tim Parsons at UBC and the rest at UVic.

<sup>28</sup> (Cullen et al., 2013) Cullen, J; Garrett, C; Littlepage, J; Macdonald, R; Parsons, T; Pedersen, T; Pospelova, V; Thomson, R; Varela, D; and Whitar, M. 2013, December. Scientists on sewage treatment. Focus Magazine.

<sup>29</sup> Capital Regional District (CRD). 2007b. Report to Core Area Liquid Waste Management Committee, Meeting of Wednesday, January 27, 2007. Victoria, BC: CRD.

<sup>30</sup> SETAC, 2006.

<sup>31</sup> Benefit-cost analysis; an alternate name for cost-benefit analysis.

<sup>32</sup> The Northwest Territories, Nunavut, and north of the 54th parallel in the provinces of Quebec and Newfoundland and Labrador.

<sup>33</sup> Canadian Council of Ministers of the Environment (CCME). 2009. Canada-wide Strategy for the Management of Municipal Wastewater Effluent. Whitehorse, YT: CCME.

<sup>34</sup> Hodgins, D. O. (2006) Technical Memorandum: Assessment of Plume Trapping and Dilution at the Clover Point Outfall and the Macaulay Point Outfall. Seaconsult Marine Research Ltd., Salt Spring Island, BC, Canada.

<sup>35</sup> "Minimum" because the actual dilution is probably much greater, see CRD 2013a, p. 27.

<sup>36</sup> CCME 2009, p. 14.

<sup>37</sup> Ranges of 110-400 mg/L for BOD and 100-350 mg/L for TSS, see CRD 2013a, Table 2.4.

<sup>38</sup> New Brunswick's discharges are apparently to fresh water, but "most" discharges in Newfoundland and Labrador are to marine receiving waters; the report authors acknowledge that this reduces fresh-water-related benefits for Newfoundland and Labrador though no amounts are specified. The report also explains that small and very small communities in Newfoundland and Labrador show a negative net benefit, and caution that treatment adoption should depend on local cost-effectiveness; however as the report does not identify the costs for those communities, total costs for all communities are included here.