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SAANICH PENINSULA WASTEWATER COMMISSION
Notice of Meeting on **Thursday, November 17, 2016 at 8:30 am**
Saanich Peninsula Treatment Plant Meeting Room, 9055 Mainwaring Road, North Saanich, BC

M. Williams (Chair)	P. Wainwright (Vice-Chair)	R. Barnhart	M. Doehnel
C. Graham	M. Lougher-Goodey	C. Stock	M. Thompson
M. Wiesenberger	R. Windsor		

AGENDA

1. Approval of Agenda

2. Adoption of Minutes of October 20, 2016

3. Chair's Remarks

4. Presentations/Delegations
   - No one has registered to speak

5. Regional Source Control Program – 2015 Annual Report (Report #EPT 16-72)

6. Sea Level Rise Planning Projects Update - For Information at Request of Commission (from Environmental Services Committee)

7. BCWWA Issue Analysis Paper and Position Statement – Land Application of Biosolids, October 2016 (for information at Chair's request)

8. Draft Response to Organic Matter Recycling Regulation – Ministry Policy Intentions Paper (Report to Follow)

9. Integrated Resource Management Select Committee Report - Advanced Integrated Resource Management Project – Request for Expressions of Interest (Report #EEE 16-73) For Information

10. New Business

11. Adjournment

Distribution:
Staff/Town Halls, etc.

R. Lapham	T. Robbins	P. Robins, Central Saanich
L. Hutcheson	I. Jesney	D. McAllister, Central Saanich
N. Chan	M. McCrank	R. Buchan, North Saanich
A. Orr	D. Robson	P. O'Reilly, North Saanich
G. Harris	M. Cowley	R. Humble, Sidney
	M. Montague	T. Tanton, Sidney
	Commission file	Tsartlip First Nation

To ensure a quorum, advise Margaret at 250.474-9606 if you or your alternate cannot attend.
IWSS-928280410-4987

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Minutes of a Meeting of the Saanich Peninsula Wastewater Commission
Held October 20, 2016 in the Saanich Peninsula Treatment Plant Meeting Room,
9055 Mainwaring Road, North Saanich, BC

PRESENT

COMMISSIONERS: M. Williams, P. Wainwright, R. Barnhart, M. Lougher-Goodey, M. Weisenberger, R. Windsor, C. Graham, M. Underwood

STAFF: T. Robbins, R. Lapham, M. McCrank, D. Robson, M. Cowley, C. Lowe, D. Green, J. Poncelet (9:40 am), B. Semmens, M. Montague (recorder)

GUEST: K. Brown

The meeting was called to order at 9:35 am.

1. APPROVAL OF AGENDA

MOVED by Commissioner Graham and **SECONDED** by Commissioner Lougher-Goodey, That the Saanich Peninsula Wastewater Commission approve the agenda.

CARRIED

2. ADOPTION OF MINUTES

MOVED by Commissioner Lougher-Goodey and **SECONDED** by Commissioner Graham, That the Saanich Peninsula Wastewater Commission adopt the minutes of the September 15, 2016 meeting.

CARRIED

3. CHAIR'S REMARKS

The Chair remarked as follows:

- He noted that the IRM Select Committee is scheduled to meet on November 9 at which there will be a discussion on the RFEOI for the IRM; the Commission has asked staff to produce an RFEOI for the Peninsula also. This RFEOI will have to be coordinated with the Core Area project;
- He reported that, under Item 8, the Organic Matter Recycling Regulation is up for renewal and noted that any amendments may have some bearing on what is done on the Peninsula. This item is on the agenda for discussion and comment.

4. PRESENTATIONS/DELEGATIONS

There were no presentations/delegations.

5. CORRESPONDENCE

MOVED by Commissioner Wainwright and **SECONDED** by Commissioner Barnhart, That the Saanich Peninsula Wastewater Commission receive the correspondence for information.

CARRIED

6. 2017 SERVICE PLANS REVIEW PROESS

T. Robbins spoke to the report. He noted that the service and financial planning process for the Capital Regional District (CRD) is currently underway. The focus of the service planning cycle will be on years 2017 to 2019. This cover report is developed to provide information on the planning process to all Committees and various Commissions reviewing Service Plans.

MOVED by Commissioner Wainwright and **SECONDED** by Commissioner Lougher-Goodey,

That the Saanich Peninsula Wastewater Commission recommend to the Capital Regional District Board:

That the attached service plans be approved as presented, and direct staff to prepare the 2017 Financial Plan in accordance with the approved service plan.

CARRIED

7. 2017 CAPITAL AND OPERATING BUDGET

T. Robbins spoke to the report.

MOVED by Commissioner Wainwright and **SECONDED** by Commissioner Lougher-Goodey,
That the Saanich Peninsula Wastewater Commission direct staff to amend the 2017 budget to identify the $100,000 in the 2016 budget for Pilot Studies or Research into Disposal of Solids, as a carry forward item.

CARRIED

MOVED by Commissioner Wainwright and **SECONDED** by Commissioner Windsor,
That the Saanich Peninsula Wastewater Commission direct staff to amend the 2017 budget to include an item for a study regarding installation of solar power at the Saanich Peninsula Wastewater Treatment Plant.

MOVED by Commissioner Windsor and **SECONDED** by Commissioner Weisenberger,
That the Saanich Peninsula Wastewater Commission direct staff to amend the 2017 budget to include an item for a study regarding installation of solar power at the Saanich Peninsula Wastewater Treatment Plant, to a maximum of $25,000.

CARRIED

The main motion CARRIED
Commissioner Graham OPPOSED

MOVED by Commissioner Wainwright and **SECONDED** by Commissioner Windsor,
That the Saanich Peninsula Wastewater Commission recommend that the CRD Board:

1. Approve the 2017 Saanich Peninsula trunk sewers, treatment and disposal operating and capital budget, as amended;
2. Approve the 2017 Parks and Environmental Services program budgets that support the Saanich Peninsula Wastewater service, including Liquid Waste Management Plan, Saanich Peninsula Stormwater Quality Management, and Saanich Peninsula Stormwater Source Control, as amended; and

3. Direct staff to prepare the amendment bylaws to increase the maximum requisition for Saanich Peninsula Stormwater Quality Management Program and for the Saanich Peninsula Stormwater Source Control budget (subject to CRD Board approval of the program budgets).
4. Balance the 2016 actual revenue and expense on the transfer to capital reserve fund.

CARRIED

8. ORGANIC MATTER RECYCLING REGULATION – FOR DISCUSSION

C. Lowe reported on the Organic Matter Recycling Regulation, noting that the Provincial government announced in April 2016 that it will be undertaking a comprehensive review of the OMRR to ensure it remains protective of human health and the environment. Comments and feedback will be reviewed by the ministry and all information received during consultation will be considered when revising the regulation. The ministry expects to amend and implement the revised regulation in 2017. The deadline for submission of comments is December 2, 2016.

MOVED by Commissioner Windsor and **SECONDED** by Commissioner Wainwright,
That the Saanich Peninsula Wastewater Commission:

1. Provide comments on the Organic Matter Recycling Regulation to advise that the Commission is investigating options for suitable methods of dealing with the Peninsula green waste streams, and that the Commission's main concern is the ability to conduct pilot projects to evaluate different technologies;
2. Request that the permitting process for conducting pilot projects be streamlined so there are no delays and minimal red tape involved.
3. Direct staff to draft a letter incorporating the motion and bring it back to the next Commission meeting for approval; and
4. Provide a draft of the letter to the Saanich Peninsula municipalities to give them an opportunity to write a letter of support for this submission as well.

CARRIED

9. NEW BUSINESS

There was no new business.

10. ADJOURNMENT

MOVED by Commissioner Graham, **SECONDED** by Commissioner Windsor,
That the Saanich Peninsula Wastewater Commission meeting be adjourned at 10:30 am.

CARRIED

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CHAIR

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Agenda Item 5

EPT 16-72

REPORT TO SAANICH PENINSULA WASTEWATER COMMISSION
MEETING OF THURSDAY, NOVEMBER 17, 2016

SUBJECT **Regional Source Control Program – 2015 Annual Report**

ISSUE

To update the Saanich Peninsula Wastewater Commission (SPWWC) on the activities and accomplishments of the Regional Source Control Program (RSCP) in 2015.

BACKGROUND

On October 12, 2016, the Core Area Liquid Waste Management Committee received the staff report *Core Area Liquid Waste Management Plan - 2015 Annual Programs Report*, which included the RSCP 2015 Annual Report. The Annual Programs Report was approved by the Capital Regional District (CRD) Board on the same day. The RSCP 2015 Annual Report will now be forwarded to the Ministry of Environment and posted on the CRD website.

The executive summary of the RSCP 2015 Annual Report is attached as Appendix A for information.

ENVIRONMENTAL IMPLICATIONS

The RSCP five-year plan, guiding delivery of the program over the period 2011-2015, is attached as Appendix B. The main activities and accomplishments of the plan in 2015 are outlined below under each of the four main components.

Coordinated Inspections and Monitoring

- the number of business inspections completed increased substantially over 2014
- regulated business compliance rates remained high, reaching 97%. “overall compliance”

Coordinated Outreach and Education

- delivery of a new “Green 365” initiative, “In the Bathroom”
- more than 11 tonnes of medications were returned for proper disposal region wide

Program Review and Metrics

- completion of an independent five-year review of the program (2009-2013)
- preparation and Board adoption of a new program implementation plan (2016-2019)

Research and Emerging Technologies

- feasibility study regarding development of a new digital application for pre-treatment works maintenance and compliance tracking
- continued research into alternatives to a group of detergents containing nonylphenol ethoxylates

CONCLUSION

In 2015, the RSCP achieved high business compliance rates, increased inspection levels, further advanced its outreach and education initiatives and continued to contribute to decreasing wastewater contaminant trends throughout the region.

RECOMMENDATION

That the Saanich Peninsula Wastewater Commission receive the Regional Source Control Program 2015 Annual Report for information.

Submitted by:	Heidi Gibson, M.N.R.M., Senior Manager, Environmental Partnerships
Concurrence:	Larisa Hutcheson, P.Eng., General Manager, Parks & Environmental Services
Concurrence:	Ted Robbins, B.Sc., C.Tech., General Manager, Integrated Water Service

TS:dn

Attachments: Appendix A – Executive Summary, Regional Source Control Program – 2015 Annual Report
Appendix B – Regional Source Control Program Five-Year Plan 2011-2015

REGIONAL SOURCE CONTROL PROGRAM
2015 ANNUAL REPORT

EXECUTIVE SUMMARY

Introduction

The purpose of the Capital Regional District (CRD) Regional Source Control Program (RSCP) is to protect sewage collection and treatment facilities, public health and safety, and the marine receiving environment by reducing the amount of contaminants that industries, businesses, institutions and households discharge into the district's sanitary sewer systems. Source control is widely accepted as a cost-effective and essential first step in sewage treatment in all major urban areas throughout North America.

The program regulates approximately 2,000 businesses through industrial wastewater discharge permits, authorizations and 11 sector-specific Codes of Practice (CoP).

2015 Program Activities

The RSCP continued to apply a "sector-by-sector" approach to CoP inspections, focusing on the automotive repair, vehicle wash and food services sectors. Overall compliance rates for CoP, permitted industrial facilities and facilities operating under authorizations reached 97% in 2015.

Inspections coordinated with internal programs and external agencies have been very successful, with over 1,000 coordinated inspections being completed in 2015**.**

Outreach and education staff commissioned a residential survey to evaluate current behaviours and barriers to adopting new source control practices. Results identified successes, but also highlighted a growing challenge to the RSCP: a general belief that source control practices would no longer be required once enhanced sewage treatment is implemented in the core area.

The main activities and accomplishments of the program in 2015 are outlined below.

Industrial, Commercial and Institutional Liquid Waste Regulation

- Sector-by-sector inspections included the automotive, vehicle wash, and food services sectors.
- CoP inspections in 2015 (1491) represented a substantial increase over 2014 (964).
- 632 food services operations were inspected in 2015, with an additional 284 follow-up visits for compliance and/or further support.
- 457 automotive and vehicle wash sector inspections conducted in 2015.
- All permit inspections scheduled at the beginning of 2015 were completed within the year.
- Eight new permits were issued (total of 39 active) and 22 new authorizations were issued (total of 100 active).

Monitoring

- The monitoring targets set for 2015 were achieved.
- On average, there were two scheduled audit monitoring events per permit in 2015.
- CoP monitoring focused on the fermentation and automotive repair sectors in 2015.

Enforcement

- Five tickets were issued under the CRD Ticket Information Authorization (TIA) Bylaw in 2015.

Contaminants Management

- RSCP continued research into nonylphenol ethoxylates (NPE) alternatives.
- RSCP staff prepared a business case to identify a suitable technological solution for improving grease interceptor maintenance compliance and inspection efficiency.

Contaminant Reductions

- For the seventh consecutive year, Ganges Wastewater Treatment Plant mixed liquor results met the Class A criteria for all metals, including mercury. Saanich Peninsula Wastewater Treatment Plant dewatered sludge monitoring, initiated in 2013, continued in 2015. All of these results also met the Class A criteria for metals.

Significant Incident Response

- There were three significant incidents formally reported: one involving fats, oils and grease (FOG) build-up, one involving electroplating wastewater and another involving a diesel oil spill.

Residential Outreach

- A residential survey to gauge attitudes, practices and barriers regarding source control behaviors was implemented in 2015. A continuing trend toward proper disposal of medication (46% in 2007 to 71% in 2015) was noted; 50% of the respondents recognized “Clean Green” and “Medication Return” campaigns and 98% of respondents agreed that “what is disposed through the water system in my home can make a difference in protecting the marine environment”.
- A new “Green 365” campaign, “In the Bathroom” included significant source control messaging.
- Staff hosted outreach booths in nine pharmacies throughout the region to provide information and prompts promoting the Medications Return Program. Over 11 tonnes of medications were returned for disposal by participating pharmacies.

Business Outreach

- Outreach material, including the sector guidebook and a new rack card for “Automotive Repair Operations” was updated, revised or created to focus on “Mechanical Repair Operations”.
- CRD joined BizPal, a province-wide web-based tool for new and current businesses to promote awareness of, and access to, information on a range of business licenses and permits.
- Staff worked with other CRD programs and the non-governmental organization Synergy Sustainability Institute to revitalize the EcoStar business recognition awards.

Education

- Staff engaged the three main post-secondary institutions in the region to identify opportunities for incorporating CRD sustainability messaging in to their lesson plans. A web page was created for post-secondary students and educators to better access CRD environmental education resources.

Partnerships Initiatives

- RSCP staff conducted water audits for a large transit facility, 11 hair salons, a brew pub/restaurant/ marina, and a commercial catering company.
- RSCP staff collaborated in a Salon and Spa Working Group, focusing on water saving strategies, wastewater characterization and contaminant reduction opportunities.
- A seafood processing facility, under authorization with the RSCP, worked with staff to explore water conservation opportunities, resulting in approximately $12,000 per year in water savings.
- RSCP worked with the CRD Integrated Watershed Management Program and View Royal staff to resolve pollution coming from a car dealership site and contaminating a nearby stream.

Program Planning and Development

- A five-year review of the program (2009-2013), a commitment in the Core Area and Saanich Peninsula Liquid Waste Management Plans, was completed by a consultant.
- A new four-year implementation plan for the program (2016-2019), aligning program activities with the next CRD budget cycle, was developed and approved by the Board.
- A consultant was hired in November, 2015 to undertake a full technical review of the CRD's Code of Practice for Food Services Operations.

Performance Measures

- The percentage of businesses with a rating of "overall compliance" in 2015 was 97%.
- For the seventh consecutive year, the percentage of mixed liquor and dewatered sludge samples that met Class A standards for metals was 100%.
- The percentage of priority contaminants showing no increase in loads to the core area environment was 95% – based on the trend assessment for 1990-2011 core area wastewater data.

Table 13: Regional Source Control Program Five-Year Plan (2011-2015)

The RSCP five-year implementation plan consists of four main strategies which were aligned with the main elements of the Environmental Partnerships Strategic Plan and Business Plan. The five-year plan was designed to assist in the delivery of Environmental Partnerships' mandate and to help the CRD prepare for the initiation of advanced sewage treatment in the core area.

Main Strategies and Activities	Timeline
1. Coordinated Outreach and Education	
• Develop, through stakeholder consultation, new business outreach materials for industrial, commercial and institutional sectors incorporating a "one-window" approach to service delivery.	2011-2015
• Enhance and update four existing "Clean Water Begins at Home" residential outreach campaigns, including: - Medications return–expand to home and community care and investigate container labelling - Launch Source Control 201, "Sustainable U", social media campaign	2011-2015 2011 2012
• Develop and launch new "Clean Water Begins at Home" initiatives, including: - Promote alternative household cleaners through "Clean Green" - Promote proper hazardous waste and hobby waste disposal	2011-2015 2011 2013
• Develop education plans for K-12, post-secondary and trade schools, incorporating RSCP themes and information from other CRD programs	2012
• Enhance relationships with municipal and other agency staff by establishing procedures that facilitate efficient information exchange	2012
• Update business and residential components of RSCP website, incorporating interactive features and a "one-window" approach	2015
2. Coordinated Inspections and Monitoring	
• Coordinate inspections and audits for all Partnerships' programs - Demand Management, Cross Connection Control, Onsite Systems, Stormwater Source Control (Saanich Peninsula)	2012
• Focus inspection efforts on priority industrial, commercial and institutional sources - Hospitals, metal platers, ship waste treatment, vehicle washing, photo imaging, printing	2011-2015
• Enhance all RSCP monitoring plans (annual reviews) for: - Permits, authorizations, codes of practice, key manholes	2011-2015
3. Program Review and Metrics	
• Maintain existing program components to ensure Liquid Waste Management Plan commitments are met	2011-2015
• Review program measures of success	2012
• Review, develop and adopt standard operating procedures for all RSCP activities	2013
• Review, update and amend the Sewer Use Bylaw (coordinate with reviews of other program bylaws)	2014
• Coordinate data management and database development with all Partnerships' programs	2015
4. Research and Emerging Technologies	
• Research priority contaminants, sources, reduction strategies and targets - Investigate use of molybdenum-based corrosion inhibitors in heating/cooling systems and potential local impacts - Develop a reduction plan for phthalates (plasticizers) - Research use of copper-based algaecides and local impacts - Investigate local use of nano-silver products and potential impacts	2011-2015 2011 2012 2013 2014
• Research and pilot test new pre-treatment technologies for effectiveness at achieving contaminant reductions and meeting regulations	2011-2015

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Agenda Item 6
For Information

EEP 15-98

REPORT TO ENVIRONMENTAL SERVICES COMMITTEE
MEETING OF WEDNESDAY, SEPTEMBER 30, 2015

SUBJECT **Sea Level Rise Planning Projects Update**

ISSUE

To update the Environmental Services Committee on the progress of the Capital Regional District (CRD) Climate Action Program's sea level rise planning projects.

BACKGROUND

Staff last updated the Environmental Services Committee on the sea level rise planning projects at the March 25, 2015 meeting.

Sea level rise is a consequence of climate change. Senior levels of government are encouraging communities to consider sea level rise and other climate-related adaptation approaches. Working with the CRD Climate Action Inter-Municipal Working Group, the Climate Action Program has completed two background reports to support sea level rise planning across the capital region:

1. *Capital Region Sea Level Rise Planning Approaches Project Report* (CRD, 2015) (Appendix A)

2. *CRD Coastal Sea Level Rise Risk Assessment Report* (AECOM, 2015) (Attachment 1), (Includes Map Book)

It should be noted that maps produced through this project were done to inform initial regional and local government sea level rise planning activities, and were not completed for regulatory purposes.

Concurrent to the development of these reports, the Climate Action Program participated in a provincial consultation process to provide review and input on proposed amendments to the *Flood Hazard Area Land Use Management Guideline.* CRD staff submitted written feedback to the Province on October 30, 2014, and staff from the CRD and other regional municipalities participated in the technical working group to provide additional feedback to the Province over the past year. The consultation period is now closed and release of the final guidelines is expected in late fall 2015.

The next steps for the project include:

- Support the public release of sea level rise background reports by developing messaging about project need, methodology, findings and limitations and share with local government staff.
- Support future sea level rise planning efforts, including identifying costs associated with future local or regional studies and programming, with municipal/electoral area governments (i.e., Inter-municipal Steering Committee and Inter-municipal Working Group)

- Provide local government staff and elected officials with updates on the final *Flood Hazard Area Land Use Management Guidelines*, as they are released.
- Participate in the Stewardship Centre for British Columbia's project to develop and deliver Green Shores™ education and training for shoreline decision makers.

Appendix B provides a list of additional actions the CRD is currently engaged in to address sea level rise implications.

ALTERNATIVES

Alternative 1

That the Environmental Services Committee recommend to the CRD Board that the report, *Capital Region Sea Level Rise Planning Approaches Project Report* (CRD, 2015*),* and *CRD Coastal Sea Level Rise Risk Assessment Report* (AECOM, 2015) from the Sea Level Rise Planning Project be received for information and posted on the CRD website.

Alternative 2

That the Environmental Services Committee request staff to provide more information.

INTER-GOVERNMENTAL IMPLICATIONS

The sea level rise planning work completed to date confirmed the capital region is susceptible to future sea level rise and that the region would benefit from a coordinated regional approach to sea level rise planning. Notwithstanding the need for coordination, authority for implementing sea level rise planning tools, including land use regulation as per Section 910 of the Local Government Act, rests with each local government. The CRD has implementation authority in relation to regional service provision and land use within the Juan de Fuca Electoral Area.

To this end, the *Capital Region Sea Level Rise Planning Approaches Project Report* sets out a toolkit of complementary planning, regulatory and some site-specific adaptation tools that local governments may use to advance sea level rise planning. Enacting regulatory tools would require the individual municipalities or the CRD, on their behalf, to undertake additional review and analysis of the mapping products.

SOCIAL IMPLICATIONS

Considerable infrastructure and development are situated in areas potentially impacted by sea level rise. The policy response, from planning to implementation, can be phased over the long term with the recognition that land use and infrastructure planning decisions made today have the potential for impacts in the future. An open public process is needed to move forward with sea level rise planning as the potential impacts affect a large number of property owners.

ENVIRONMENTAL IMPLICATIONS

Further study and analysis is required to identify the adaptive capacity of environmental infrastructure and potential ecosystem effects of rising seas on highly-sensitive physical

shorelines. Funding may be available through additional grants or participation in pilot projects offered by industry and non-profit partners.

ECONOMIC IMPLICATIONS

The background reports were completed in part by leveraging $75,000 in external grant funds; a main funder being Natural Resources Canada's Climate Change Impacts and Adaptation Program. It is anticipated that additional funding will be required to undertake further studies and consultation activities recommended in the sea level rise planning reports. Costs will vary depending on scope.

CONCLUSIONS

The Climate Action Program led the development of two sea level rise planning background reports. Results indicate that: (i) the region is susceptive to sea level rise inundation; (ii) a coordinated approach to sea level rise planning is ideal; and (iii) future study and consultation activities will be required. Furthermore, the Province will likely release final amendments to the *Flood Hazard Area Land Use Management Guidelines*, which describes a local government regulatory approach to coastal flood hazard planning, which has implications for sea level rise planning.

The Climate Action Program will continue to work with CRD, municipal and electoral area staff and elected officials to support sea level rise analysis, planning and programming.

RECOMMENDATION

That the Environmental Services Committee recommend to the Capital Regional District Board:

That the report, *Capital Region Sea Level Rise Planning Approaches Project Report* (CRD, 2015), and *CRD Coastal Sea Level Rise Risk Assessment Report* (AECOM, 2015) from the Sea Level Rise Planning Project be received for information and posted on the Capital Regional District website.

Submitted by:	Glenn Harris, Senior Manager, Environmental Protection & Water Quality
Concurrence:	Larisa Hutcheson, General Manager, Parks & Environmental Services
Concurrence:	Bob Lapham, Chief Administrative Officer

NE:cam

Attachments: Appendix A – *Capital Region Sea Level Rise Planning Approaches Project Report* (CRD, 2015)
Attachment 1 – *CRD Coastal Sea Level Rise Risk Assessment Report* (AECOM, 2015) includes Map Book
Appendix B – CRD's Current Response to Sea Level Rise.

APPENDIX A

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Capital Region Sea Level Rise Planning Approaches Project Report

Parks & Environmental Services | Environmental Protection

Report developed for Natural Resources Canada's Climate Change Impacts and Adaptation Program as part of the CRD's Coastal Risk Assessment and Sea Level Rise Planning Tools Project (AP067)

Prepared by:

Emily Sinclair MCIP RPP

Project Contact:

Nikki Elliott, Climate Action Program Coordinator, nelliott@crd.bc.ca

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July 31, 2015

TABLE OF CONTENTS

Tables

1.0 INTRODUCTION

This report documents the results of a literature review and local government workshop activity undertaken to identify and evaluate policy options to address hazards associated with sea level rise along the southern coast of Vancouver Island. The input received from the local government workshop activity was used to support the development of a high-level approach to sea level rise adaptation planning across the region, and identify a series of adaptation tools to address sea level rise impacts.

1.1 Background

The Capital Regional District (CRD), in partnership with municipalities/electoral areas and with funding from Natural Resources Canada's Climate Change Impacts and Adaptation Program (NRCan), Tides Canada, the City of Victoria and the District of Saanich has completed a Sea Level Rise Planning Project.

In British Columbia, local governments have floodplain management responsibilities. The intent of the Sea Level Rise Planning Project was to further understand potential implication of future sea level rise inundation and identify potential sea level rise adaptation approaches appropriate for regional municipalities/electoral areas.

The Sea Level Rise Planning Project was undertaken in two phases.

- **Phase 1**: The first phase of the project prepared a Coastal Sea Level Rise Risk Assessment to further understand regional coastal vulnerabilities to sea level rise. This phase included using provincial simplified methodology to map potential sea level rise inundation using both a static sea level rise and 1:500-year storm surge scenario for the Years 2050, 2100 and 2200. This phase also included a coastal economic risk assessment for the Year 2100 storm surge scenario. This project, completed by AECOM (2015), is complete.

- **Phase 2**: This project identified a regional adaptation planning approach and describes a range of planning, regulatory and site-specific adaptation tools to respond to impacts associated with sea level rise. This phase included the development of a planning process and adaptation framework for municipalities to evaluate potential sea level rise adaptation tools. This phase also included a regional education and awareness component for municipal staff from across local government departments.

1.2 Phase 2 Objectives

The purpose for the second phase of the project was to coordinate a regional policy response to the vulnerabilities identified in the Coastal Sea Level Rise Risk Assessment (AECOM, 2015). Specific objectives were to:

1. Educate CRD and municipal government staff on potential sea level rise implications and adaptation approaches.
2. Support the development of regional and municipal sea level rise adaptation frameworks.
3. Identify potential adaptation measures appropriate for urban and rural coastal communities.
4. Identify the tools that are needed to implement the adaptation measures.

1.3 Project Team

A project team, consisting of representatives from several municipalities, provided direction and input into the project scope.

The project team was comprised of:

- CRD – Climate Action/Juan de Fuca Planning
- City of Victoria – Sustainability/Planning
- District of Saanich – Sustainability
- Town of Sidney – Planning
- District of North Saanich – Planning
- BC Ministry of Environment – Climate Action Secretariat (observer)

The CRD Climate Action Inter-Municipal Working Group (IMWG) provided further review and input on the process and deliverables. The CRD IMWG members that participated were staff from all of the capital region municipalities and electoral areas, apart from the City of Langford.

1.4 Methodology

The second phase of the project was undertaken in three steps.

1. **Literature Review and Adaptation Planning:** A literature review was completed to identify adaptation tools used by similar coastal jurisdictions. Results from the literature review are provided in Chapter 2.

   Criteria were then derived from the literature review to develop a draft regional adaptation framework, including a vulnerability scan and a capacity analysis to facilitate the identification of potential adaptation measures. The draft adaptation framework is presented in Chapter 3. The vulnerability scan and capacity analysis are included in Appendix A.

2. **Education and Outreach:** Working through the CRD Climate Action IMWG, a two-part workshop series was held to provide background information to interested municipal staff on the science of sea level rise and to receive input from municipalities on adaptation planning.

   The first part of the workshop series was a 2-hour seminar open to staff from local government planning, engineering, emergency management, finance, communications and sustainability departments. The second part of the workshop series was a 2-hour meeting offered to individual municipalities to complete a vulnerability scan and capacity analysis. Cross-departmental representation was encouraged for these meetings. Results from the meetings with municipalities are provided in Chapter 4.

3. **Tool Identification:** Based on the input received through the vulnerability scan and capacity analysis, an overall approach to sea level rise adaptation planning was confirmed. The preferred approach is to use planning, regulatory and some site-specific tools to address sea level rise vulnerabilities. Specific tools for each approach are described in Chapter 5.

1.5 Use and Limitations

This report presents the options that the CRD and municipalities/electoral areas may consider in sea level rise adaptation planning. Information provided in this report was developed from a literature review and staff interviews. It is the responsibility of each local government to determine an appropriate approach for sea level rise planning. It is assumed that additional factors and considerations may impact or influence final policy decisions that will be taken by individual local governments.

It is important to note that the Province undertook draft amendments to the 2004 *Flood Hazard Area Land Use Management Guidelines* (FHALUMG) concurrently with the Sea Level Rise Planning Project. The FHALUMG provide direction for coastal hazard mapping and regulatory responses under s.910 of the *Local Government Act.* The final amendments may affect how local governments choose to address impacts related to sea level rise in BC *(see Section 2.1 for more information).*

While there may be some overlap in potential policy responses, tsunami hazards were not included in this project scope. The region has completed a Modelling of Potential Tsunami Inundation Limits and Run-Up study (AECOM, 2013). The results of both projects could be combined in the future should this be of interest to the region.

2.0 LITERATURE REVIEW

A literature review was undertaken to collect information and examples on the policy responses, including various regulatory and non-regulatory tools, of coastal jurisdictions to address vulnerabilities to sea level rise. The *Sea Level Rise Adaptation Primer: A Toolkit to Build Adaptive Capacity on Canada's South Coasts*[1] provided a starting point for the literature review. Tools reviewed included adaptation frameworks plans, bylaws, legal instruments, development permits and infrastructure design considerations. Interviews and discussions with planners and engineers from other BC jurisdictions were also conducted as part of the literature review. Furthermore, given the scope the FHALUMG, the 2014 draft amendments have been considered in the review of potential adaptation measures.

Sources from the following jurisdictions were reviewed and where possible, electronic links are provided for reports, bylaws and plans.

Jurisdiction	Document Type	Source
BC Ministry of Environment	Planning Tool	Sea Level Rise Adaptation Primer: A Toolkit to Build Adaptive Capacity on Canada's South Coasts
	Guideline	Draft Amendments to the provincial 2004 Flood Hazard Land Use Management Guidelines
National Oceanic and Atmospheric Association (NOAA)	Planning Tool	What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure
City of Vancouver	Bylaw	Building By-law No. 10908 (re: FCL)
	Report/Study	Flood Construction Level Administrative Report (confidential)
District of Squamish	N/A	Interview / Discussion about dike design project
Town of Qualicum Beach	N/A	Interview / Discussion about Waterfront Master Plan project
Halifax Regional Municipality	Plan	Sea Level Rise Adaptation Planning for Halifax Harbour
Municipality of the County of Antigonish	Plan	Municipal Climate Change Action Plan
Municipality of the District of Barrington	Plan	Municipal Climate Change Action Plan
Swinomish Indian Tribal Community	Plan	Swinomish Climate Change Initiative Climate Adaptation Action Plan
The Cooperators	Report/Analysis	Partners for Action: Preparedness of Fifteen Canadian Cities to Limit Flood Damage
San Francisco	Plan	Guidance for Incorporating Sea Level Rise in Capital Planning in San Francisco: Assessing Vulnerability, Risk and Adaptation (DRAFT)

2.1 Amendments to the Provincial Flood Hazard Area Land Use Management Guidelines

The provincial *Flood Hazard Area Land Use Management Guidelines* (2004) provide direction for local governments to implement land use management plans and make subdivision approval decisions for flood hazard areas. The policy intent of the Guidelines is to "reduce or prevent injury, human trauma and loss of life, and to minimize property damage during flooding events."[2] The Guidelines follow the precautionary principle, stating that regulating land development "is the most practical and cost effective

[1] Province of British Columbia. 2013. *Sea Level Rise Adaptation Primer: A Toolkit to Build Adaptive Capacity on Canada's South Coasts.* Ministry of Environment. http://www2.gov.bc.ca/assets/gov/environment/climate-change/policy-legislation-and-responses/adaptation/sea-level-rise/slr-primer.pdf

[2] Province of British Columbia. 2004. *Flood Hazard Area Land Use Management Guidelines*. Ministry of Water, Land and Air Protection. P. 5.

way" to achieve provincial goals. Local government must consider the Guidelines in making bylaws under section 910 of the *Local Government Act.* The responsibility for flood plain mapping was downloaded from the Province to local government in 2004.

Provincial amendments to the Guidelines were undertaken concurrently with the Sea Level Rise Planning Project. The purpose of the amendments is to update requirements for buildings, subdivision and zoning that allow for sea level rise to the Year 2100. Specifically, the draft amendments set out two methodologies for establishing the Year 2100 flood construction level (FCL) and building setbacks. Several municipalities within the CRD, including CRD staff, participated in a technical working group tasked with providing review and input into the amendments.

It is the responsibility of each municipality/electoral area to review, interpret and consider implementation of the amended FHALUMG. It should be noted that Phase 1 mapping provided municipalities with a general estimation of the area subject to a FCL to facilitate review of the proposed amendments. Additional analysis by a suitably qualified Professional Engineer, experienced in coastal engineering, is required to confirm the mapping and establish a FCL. Additional policy analysis may also be required by each municipality to understand the economic, social and environmental implications of adopting a FCL.

2.2 Adaptation Frameworks

Given the complexity and uncertainty associated with sea level rise adaptation, communities and other regulatory bodies look to risk-based frameworks to select strategies best suited to anticipated impacts. Adaptation frameworks are structured around four land use adaptation strategies that are well-recognized in the climate change literature.[3] Each strategy responds to an identified risk, hazard, vulnerability or impact for a particular area or asset, and can be implemented through a variety of measures. The four adaptation strategies are summarized below:

1) **Avoid:** Do not build assets in areas vulnerable to sea level rise impacts
2) **Protect:** Continued occupation of areas while preventing sea level rise impacts
3) **Accommodate:** Continued occupation of areas while allowing for tolerable sea level rise impacts
4) **Managed or Planned Retreat:** Withdrawal of assets from areas vulnerable to sea level rise impacts

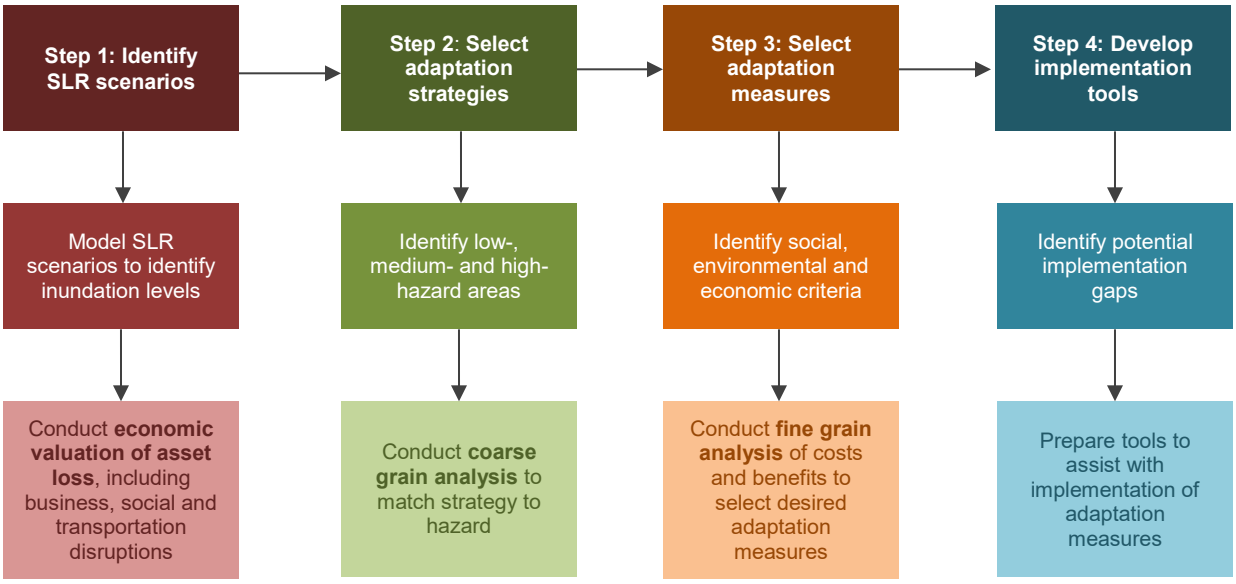
These frameworks rely on the identification of risk, hazard, vulnerability or impact for a given asset or land use. While the Phase 1 study provided valuation data for land, roads and key public assets, the data requires additional spatial resolution and evaluation in order to identify risks, hazards and vulnerabilities.

2.3 Decision-Making Process

Communities generally apply their chosen adaptation framework by using a four-step decision-making process that is grounded in climate action science. The process details the analytical inputs needed to support a robust decision that considers social, environmental and economic factors. The stepwise framework is critical for addressing the complexity of sea level rise issues, and some of the uncertainty associated with identifying and modelling sea level rise impacts. Figure 1 outlines the four-step process. This process was adapted from NOAA (2013).

[3] Ausenco Sandwell. 2011. *Climate Change Adaption Guidelines for Sea Dikes and Coastal Flood Hazard Land Use Draft Policy Discussion Paper.* BC Ministry of the Environment.

Figure 1. SLR Decision-Making Process



Phase 1 of this project identified preliminary sea level rise scenarios based on provincial methodology (Ausenco Sandwell, 2011) for identifying coastal inundation hazards. These scenarios provide baseline information to satisfy Step 1 in the SLR decision-making process; however, would require review by a Professional Engineer, experienced in coastal engineering for use in any regulatory context.

Phase 2 of this project assisted municipalities to develop a plan to move through the remaining steps in the decision-making process.

2.4 Adaptation Measures

As highlighted in the *Sea Level Rise Adaptation Primer (2013),* there is a combination of adaptation measures that can be used to address impacts from sea level rise. The following summarizes adaptation measures from coastal jurisdictions.

2.4.1 Planning Tools: Climate Change Action Plans

Many municipalities in the Pacific Northwest and the Maritimes have developed Climate Change Action Plans to identify sea level rise adaptation measures. These action plans are based in rigorous scientific study. As they relate to sea level rise, the action plans identify sea level rise planning areas and recommend a combination of:

- Structural and non-structural protection focused on site-specific vulnerabilities
- Regulatory tools to address impacts on private land
- Policy and procedural tools to guide public works and projects to mitigate sea level rise impacts

One benefit to these plans is that different sea level rise scenarios and their attendant impacts can be publicly presented through a planning process that allows for the deliberation of policy solutions. Although the plans have no statutory authority, they provide a mechanism through which to start the discussion about sea level rise impacts and policy implications. These planning processes recognize that regulatory tools are best suited to addressing the long-term impacts of sea level rise; however, are a challenge to implement as land use changes through zoning, bylaws and other legal instruments are likely to be met with public opposition.

2.4.2 Regulatory Tools: Flood Construction Level, Setbacks, Development Permits and Covenants

Flood Construction Level and Setbacks

A FCL and setbacks are regulatory tools to manage land uses within areas subject to impacts from sea level rise. A FCL establishes the minimum elevation for habitable buildings in relation to anticipated flood levels and a setback regulates the minimum distance from the coastal hazards. In BC, a FCL may be set by a local government as per s.910 of the *Local Government Act*, in accordance with the FHALUMG. To comply with the FCL, property owners may use structural elevation and flood-proofing to meet the minimum elevation. The cost of identifying the FCL is the responsibility of the local government. Property owners may incur some costs on engineering studies to comply with the FCL.

Municipalities in the Lower Mainland have adopted FCLs and setbacks as regulatory tools to manage land use within areas subject to coastal flooding. Several jurisdictions, including the City of Vancouver, are in the process of updating the FCLs to account for rising seas. These jurisdictions have chosen to use the *joint probability* method set out in the FHALUMG. It should be noted that this method is costly to implement when compared to a more simplified Ausenco Sandwell (2011) methodology.

Development Permits

Development permits or development agreements are another regulatory tool by which land can be managed to address impacts from sea level rise. The development permit can be used to specify conditions that would protect development from hazards such as erosion, inundation and wave effects in the form of objectives and guidelines. Development permits, determined in conjunction with a map or plan that delineates a 'Sea Level Rise Planning Area', could provide greater flexibility to municipalities than a FCL by allowing for the use of additional structural and non-structural tools. Development permits may also be a potential interim measure to regulate development prior to adoption of a FCL. Additional analysis would be required to set objectives and guidelines in order to demonstrate how the FHALUMG were considered in the development of this tool.

Covenants

Covenants are used by local government to enter into an agreement with landowners to place limits on land use, building and subdivision to further a public purpose. Covenants are frequently used where lands are subject to geotechnical hazards such as flooding or erosion. Covenants require the landowner to use the land in accordance with a qualified professional's report and indemnify the local government against liability arising out of the use of the land. Covenants are actively used by some municipalities/electoral areas within the capital region. The FHALUMG amendments suggest the use of a covenant to regulate development at the end of the building lifespan, in addition to building requirements and indemnification against liability.

2.4.3 Structural and Non-Structural Protection

Structural and non-structural protection requires specialized, site-specific study by a qualified professional. Several municipalities in the Lower Mainland rely on dikes for coastal flood protection. The design, construction and maintenance of structural protection is cost and resource intensive. A complete cost-benefit analysis should be undertaken to determine whether structural protection is feasible for any municipality within the capital region.

Current provincial examples of this work include the District of Squamish's conceptual and detailed design dike project and the Town of Qualicum Beach's planning process to identify the feasibility of structural and non-structural protection as part of an overall Waterfront Master Plan for approximately 9 km of coastline.

Smaller-scale structural protection in the form of seawalls and soft structural approaches tend to be used by smaller property owners on a site-by-site basis. Jurisdictions such as the Regional District of Nanaimo (RDN) regulate the construction of seawalls through a development permit. The development permit requires that soft structural protection be used unless proven otherwise. The policy intent for this requirement is to minimize the potential for negative environmental impacts such as scouring and erosion to the shoreline on adjacent properties.

2.5 Impacts and Challenges

As described in the *Coastal Sea Level Rise Risk Assessment (AECOM 2015),* the social, economic and environmental consequences of coastal inundation will affect communities, coastal ecosystems and public infrastructure. It is local government's responsibility to make decisions about floodplain hazards and adopt land management strategies to address potential impacts. However, it must be recognized that land management decisions may also result in social, economic and environmental impacts.

2.5.1 Property Values

There is concern that planning and regulatory tools have the potential to negatively impact property values. Decreased property values are a concern for landowners who may have significant savings invested in waterfront property as well as for the municipal tax assessment base. Unfortunately, there are limited studies on the impact of property values from local government sea level rise planning responses[4].

Notwithstanding these concerns, it is important to note that examples from Calgary, the eastern seaboard of the United States and the US Pacific Northwest, saw property values fall sharply after a flood event due to market forces[4]. This suggests that if action is not taken to regulate development in hazard-prone areas, coastal properties remain at risk to devaluation because of hazard exposure.

2.5.2 Insurance/Mortgage

There is concern that property owners within areas potentially affected by sea level rise will experience difficulty receiving insurance coverage or securing mortgage approvals. Canada currently does not offer flood insurance. The insurance and real estate industries are actively engaged in better understanding impacts associated with flooding and coastal hazards, however, have not released any major policy recommendations to date. In the United States, insurance and mortgage lenders work with the Federal Emergency Management Agency (FEMA) to regulate flood insurance. As described above, hazard-prone areas in the United States may have greater difficulty securing insurance.

2.5.3 Liability

There is concern about municipal liability in relation to planning and responding to coastal inundation hazards. It is the responsibility of each local government to receive a legal opinion on the interpretation and applicability of the amended FHALUMG in relation to s.910 of the *Local Government Act*.

2.6 Summary

The amended FHALUMG will assist local governments to develop bylaws related to floodplain mapping and the establishment of flood construction levels as they relate coastal inundation hazards. It is the responsibility of each municipality to review, interpret and consider implementation of the amended FHALUMG.

The literature review highlights that a risk-based adaptation framework and a science-driven decision-making process are critical to sea level rise adaptation planning. These planning tools are a pre-requisite for the selection and implementation of sea level rise adaptation measures. Local governments in the Maritimes and the Pacific Northwest incorporate these tools in the development of Climate Change Adaptation Plans.

[4] Ebbwater Consulting. 2015. *The Impact of Flood Hazard on Real Estate Values.* Retrieved July 2015 from: http://www.ebbwater.ca/wp/the-impact-of-flood-hazard-on-real-estate-values/#comments

Once a framework and decision-making process is in place, the selection of adaptation measures can be facilitated through a comparison of tools based on social, economic and environmental criteria. A review of the measures adopted by other jurisdictions highlights that:

1) Regulatory tools are generally preferred to address the long-term impacts of sea level rise. Public education and communication is needed in order to successfully implement these tools as they tend to result in changes to the management of public and private land. As these tools are just beginning to be adopted in areas facing coastal inundation from rising seas, there are still many lessons to be learned about how to move forward with implementation. Regulatory tools should be considered in relation to the amended FHALUMG once they are finalized.

2) Studies and implementation of adaptation measures can be costly. However, recent experiences of jurisdictions with climate-related disasters (e.g., Hurricane Juan, Calgary floods, Superstorm Sandy) show that investment in prevention is less expensive in the long run than the total cost of disaster relief and rebuilding. The selection of appropriately scaled studies should be guided by a cost-benefit analysis.

Findings from the literature review have been used to inform preliminary adaptation planning undertaken for Phase 2 of the Sea Level Rise Planning Project.

3.0 REGIONAL SLR ADAPTATION PLANNING

Sea level rise adaptation planning is science-driven and risk-based. This section reviews the approach used to develop a proposed adaptation planning process for the capital region and presents a draft adaptation framework. A preliminary list of potential regional impacts associated with sea level rise is also identified.

3.1 Sea Level Rise Scenarios

Phase 1 of the Sea Level Rise Planning Project developed coastal inundation scenarios for municipalities in the capital region for the Years 2050, 2100 and 2200. The scenarios map areas potentially affected by sea level rise, provide a baseline for identifying vulnerable assets and are a preliminary evidence base to direct adaptation planning.

The evidence base includes economic valuation of assets within potentially affected areas and transportation disruption, community disruption and business disruption case studies. Detailed methodology and results are provided in the *Coastal Sea Level Rise Risk Assessment* (AECOM 2015) report. Tsunami hazard mapping was not in the scope of the project.

3.2 Draft SLR Adaptation Planning Framework

Based on the results of the literature review, the project team identified the need to develop a sea level rise adaptation framework to inform the planning process. As a high-level planning tool, the framework helped municipalities conduct a coarse-grain analysis of overall adaptation strategies in order to identify a targeted list of potential adaptation measures. The framework also helped to identify opportunities and gaps to be addressed through ongoing adaptation planning such as data needs, public education and outreach, and planning priorities.

Five (5) overall criteria categories, with multiple indicators to capture social, environmental and economic considerations related to sea level rise, were used to develop the adaptation framework and to support the analysis of adaptation tools. The criteria categories are:

- **Effectiveness:** The relative success of the measure to mitigate potential SLR effects
- **Impact:** The degree to which the measure results in ancillary impacts
- **Readiness to implement:** The requirements needed to implement the measure
- **Opportunity:** The degree to which the measure can be operationalized across departments and in conjunction with other projects
- **Priority/timing:** The timeline needed to implement the measure

The draft sea level rise adaptation framework is presented in Table 1. The framework identifies adaptation strategies best suited to achieving desired outcomes based on asset characteristics, vulnerability/hazard/risk, and timing. From this coarse-grain analysis, a list of more detailed adaptation measures was identified for review and analysis.

The adaptation framework was used in conjunction with a vulnerability scan and a capacity analysis to identify potential actions that could be undertaken on a regional basis and by individual municipalities. The vulnerability scan and the capacity analysis are included in Appendix A.

Table 1. DRAFT SLR Adaptation Framework

	Avoid	Protect	Accommodate	Retreat
1 Outcomes	Do not build vulnerable assets in areas impacted by SLR impacts	Continued occupation of areas while preventing SLR impacts	Continued occupation of areas while allowing for tolerable SLR impacts	Withdrawal of vulnerable assets from areas impacted by SLR impacts
2 Timing + Asset Characteristics	Long-term • Planned future assets • Planned replacement	Short-medium term • Existing assets	Ongoing • Existing • Planned future assets • Planned replacement	Long-term • Existing assets
3 Assets in Need of Adaptation	<<To be completed by municipality based on results of vulnerability scan>>			
4 Adaptation Measures (SLR Adaptation Capacity Scan)	• Policies + standards • Restrict development (zoning) • Legal (acquisition, easement, tenure, trust)	• Build grey infrastructure • Retrofit incentives	• Build green or grey infrastructure • Retrofit assets • Adopt policies + standards • Regulate development (FCL) • Legal (indemnification covenant) • Retrofit incentives	• Relocate assets • Policies + standards • Restrict development (zoning) • Legal (acquisition, easement, tenure, trust)
5 Social, Environmental and Economic Cost	Lost development potential/decrease property values & associated tax base	Tend to be expensive (major capital investments); cost to government	Cost to asset-owner – can vary	Lost development potential/decrease property values & associated tax base
6 Tools	Planning, design, zoning, training and/or communication/outreach tools required to assist with implementation.			

3.3 Asset Vulnerabilities

The vulnerability scan helped refine a list of potential impacts to land uses and municipal assets. These potential impacts provide an additional evidence-based approach to direct adaptation planning. Although further study would be required to confirmed site-specific impacts, the literature review and interviewees identified the following:

3.3.1 Higher natural boundary/permanent flood in Year 2100 (1m SLR + HHWLT scenario)

Low-lying areas such as beaches, estuaries and wetlands are sensitive to rising sea levels. These areas are most susceptible to long-term effects associated with permanent daily inundation and higher natural boundary over the 100-year planning horizon.

Assets located within low-lying areas are more vulnerable to the following impacts:

- Coastal flooding
- Saltwater intrusion in wells
- Harbour infrastructure may require upgrades (electrical, docks)
- Private structures/properties damaged
- Loss of cultural sites
- Alternation/loss of cherished landscapes
- Damage/loss of municipal infrastructure (mostly trails/parks/roads?)
- Loss of natural ecosystems
- Damage to pump stations/lift stations
- Contaminated site issues
- Provincial guidance as set out in FHALUMG may result in potentially negative impacts on land values that will be challenged by private property owners

3.3.2 Erosion

Coastal erosion results in negative biophysical effects to natural infrastructure and built landscapes. Erosion is a natural process caused by wave energy, tidal currents and wind, which can be exacerbated by more frequent and intense storm events. Localized erosion impacts may also be worsened by coastal armouring through the construction of structural protection such as sea walls.

Assets located in areas experiencing erosion are more vulnerable to the following impacts:

- Roads and bridges may wash out and cut access
- Loss of private property/buildable land
- Loss of municipal infrastructure such as roads and underground utilities
- Loss of natural ecosystems

3.3.3 Storm Events

High winds, high waves and heavy rains occurring at the same time as large tides may cause short-term disruption of daily activities as well as long-term impacts on public and private assets.

Assets located in areas experiencing storm events are more vulnerable to the following impacts:

- Increased surface water on roads, bridges and properties
- Physical damage to public and private buildings and other assets in flood-prone areas
- Wastewater system overflows and backups
- Environmental damage from spills/overland floods
- Clean up costs
- Damage to coastlines, trees, etc…
- Public health and safety

4.0 WHAT WE HEARD – FINDINGS FROM AROUND THE REGION

Sea level rise will profoundly affect the way coastal municipalities look, develop and operate. This section presents the results from the two-part workshop series held with municipalities around the region.

The meetings were structured around two exercises—a vulnerability scan and a capacity analysis. The vulnerability scan helped identify land use and key asset vulnerabilities resulting from potential impacts of sea level rise. The issues raised as part of the vulnerability scan are consistent with those identified in the sea level rise literature. An overview of strengths, weaknesses, opportunities and constraints based on input received from the capacity analysis is also presented, along with a summary of areas of agreement and disagreement.

It should be noted that during project planning, the capacity analysis was intended to help municipalities compare and select different adaptation measures. Participants found this exercise to be a challenge as a sea level rise adaptation requires the use of multiple tools. This finding helped confirm that a regional approach to adaptation planning is needed to ensure that municipalities have the knowledge and support to move forward with implementation of the tools of their choice. The capacity analysis was helpful for identifying areas of agreement and disagreement as well as knowledge gaps. This information provided the basis for the list of tools and actions provided in Chapter 5.

4.1 Participation

The two-part workshop series was well attended by municipalities around the region. Eleven municipalities attended the seminar and nine municipalities, including the Juan de Fuca Electoral Area and CRD corporate staff, participated in the meetings offered to individual municipalities. A video recording of the seminar was provided to staff who could not attend. Meetings with municipalities who did not participate could be scheduled at a later date to assist with sea level rise adaptation planning.

Participation included a mix of staff from across departments, including planning, engineering, emergency management and finance. This mix of participants ensured the cross-pollination of perspectives, and allowed the meeting to cover a range of topics from infrastructure to land use, emergency preparedness and long-range financial planning. Invitations were circulated through Climate Action IMWG representatives. Participation and meeting objectives is summarized in Table 2.

Table 2. Workshop Series Participants

	Part 1: Sea Level Rise Seminar	Part 2: Sea Level Rise Adaptation Planning Meeting			
	Date: May 7, 2015 **Location:** CRD Headquarters **Time:** 1.5 hours	**Date:** Late May (dates TBD) **Location:** At municipal halls **Time:** 2 hours			

Description	Seminar with presentations by leading professional engineers with experience in coastal engineering Mr. Eric Morris (P.Eng.) from Kerr Wood Leidall and Dr. John Clague, P. Geo from Simon Fraser University on:
	• The state of sea level rise in the region, including short-term fluctuations and wave effects.
	• A review of the amendments to the Flood Hazard Area Land Use Management Guidelines & different methodologies for determining flood construction levels.
	• Adaptation strategies relevant to local conditions.
		Guided discussion facilitated through a vulnerability scan and a capacity analysis. Meeting objectives were to:
		• Work through the proposed methodology for SLR planning and adaptation:
		  • Identify inputs to populate the draft SLR Adaptation Framework.
		  • Apply the analytical tool to identify capacity to implement adaptation measures.
		• Gather comments to refine the proposed methodology.
		• Identify opportunities and gaps to prioritize future work.			

Central Saanich	✓	Regrets			
Colwood	✓	**Date:**	June 24, 2014	**Time:** 1–3 p.m.	10 participants
CRD	✓	**Date:**	Thur., May 28, 2015	**Time:** 10 a.m.–noon	
Esquimalt	✓	**Date:**	Fri., June 5, 2015	**Time:** 10 a.m.–noon	4 participants + representatives from DND
Highlands	✓	Regrets			
Islands Trust	✓	Regrets			
Langford	Regrets	Regrets			
Metchosin	✓	Regrets			
North Saanich	Regrets	**Date:**	Tues., June 23, 2015	**Time:** 2:30–4:30 p.m.	2 participants
Oak Bay	✓	**Date:**	Wed., June 17, 2015	**Time:** 2–4 p.m.	5 participants
Saanich	✓	**Date:**	Thur., June 4, 2015	**Time:** 1–3 p.m.	12 participants
Sidney	Regrets	**Date:**	Tues., June 23, 2015	**Time:** 10:30 a.m.–12:30 p.m.	8 participants
Sooke	✓	Regrets			
Victoria	✓	**Date:**	Tues., June 16, 2015	**Time:** 1:30–3:30 p.m.	5 participants
View Royal	✓	**Date:**	Fri., July 3, 2015	**Time:** 10–11 a.m.	2 participants

4.2 Vulnerability

During the municipal meetings, participants discussed the degree of **sensitivity** and **resilience** of each land use category/asset to impacts related to coastal erosion and inundation resulting from sea level rise. The following rating scales were used to guide the discussion:

Name	Description	Rating Scale
Sensitivity	The degree to which an asset is affected by inundation or erosion resulting from rising seas and/or storm events.	**(L) Low:** Asset is easily replaced, disruption from loss or failure is minor, relatively few people are impacted **(M) Med:** Moderate cost to repair/replace, impacts a relatively greater number of people, disruption is/can be mitigated **(H) High:** Major cost to repair/replace, critical to public health and safety/provides essential service, can't be mitigated **(?) Unsure/Don't Know:** Insufficient data/information
Resilience	An asset's inherent ability to adjust to potential impacts, moderate damage, or cope with consequences without the need for intervention.	**(H) High:** Can accommodate SLR impacts/modifications are easy **(M) Med:** May tolerate SLR impacts/modifications are easy **(L) Low:** Can't tolerate SLR impacts/modifications are difficult **(?) Unsure/Don't Know:** Insufficient data/information

Table 3 describes the aggregated results from the municipal meetings. It is important to note that vulnerability is site-specific and, therefore, may be higher or lower depending on a location.

Table 3. Regional Vulnerability Scan

Land Use / Asset Type	Sensitivity	Resilience	Notes
Residential/Commercial/Employment • Low-lying • Coastal bluff	 L-M L	 M H	General agreement among municipalities/electoral areas that sensitivity increases as density increases.
Infrastructure • Pump stations/Lift stations • Roads • Harbours/Marinas	 H L M	 M M H	Roads susceptible to erosion have a higher sensitivity. • Dallas Road at McNeill Bay • Cordova Bay Road. Roads that provide an essential service link that could be severed if flooded have a higher sensitivity. • Highway 14 south of Shirley • Portion of Helmcken Road.
Parks	L-M	H	General agreement that parks can act as an existing SLR buffer for municipalities.
Environment • Estuary • Sand/Beach/Gravel • Coastal Bluff	 H H L-M	 H H H	Natural coast lines provide adaptive capacity to addressing impacts related to sea level rise. Additional research is needed to better understand the value of these ecosystem services. Pilot studies may be available to integrate coastline management into an SLR adaptation plan.

4.3 SWOC Analysis

The SWOC analysis presents a snapshot of regional strengths, weaknesses, opportunities and constraints related to sea level rise adaptation planning. These findings have helped inform the responses and actions presented in Chapter 5.

Table 4. Regional SWOC Analysis

Strengths	Weaknesses
• FHALUMG provides two methods for calculating the FCL • Natural coastal areas (unarmoured shorelines) provide best approach for disrupting wave energy • Existing seawalls can be raised if needed • Park lands buffer private property from SLR impacts • Existing institutional coordination, regionally through Inter-Municipal Working Group and locally through cross-departmental interaction • Emergency management plans are a resource for adaptation planning • Some OCPs provide policy direction for adaptation planning • Shoreline setbacks/DPs can be updated with SLR considerations as per FHALUMG • Some approving officers/building inspectors currently requiring geotechnical studies that include SLR criteria	• Aging pump station infrastructure makes it difficult to access replacement parts if infrastructure fails • Approving officers/building inspectors interpret/apply geotechnical requirements differently, stemming from different consultant methodology and lack of clarity between s.56 of the Community Charter and the proposed FHALUMG amendments • No dedicated/assured funding for studies and implementation • Accelerated property loss in areas prone to erosion • Additional study/new policies and regulations needed to move forward with adaptation on private land • Armoured coastlines reduce non-structural options • Unknown impacts to property values from changes in mortgage lending/insurance regimes • Regulatory changes are likely to face public opposition • Potential devaluation of properties with high residential tax base is a risk to local government
Opportunities	**Constraints**
• Introduce SLR policies or criteria in upcoming master planning projects (e.g.: Official Community Plan updates, Utilities Master Plan, etc…) • Integrate SLR adaptation BMPs into pilot redevelopment projects • Integrate SLR criteria into RFPs when infrastructure is replaced (roads, pump stations) • Access external funding for future study/data collection • DND has conducted studies for jetty upgrades that may be of interest to other marina/harbour jurisdictions	• Information gaps with decision-makers and public • Coordinated approach to shoreline management on private coastal lots • Easement or acquisition along the shoreline requires permission from private landowners and is time and resource intensive • Areas with active development applications require interim policy direction • Public opposition to enacting measures that limit ability to develop on property • Public apathy as this is not an immediate concern • Current lack of funding to support future study

4.4 Agreement

Municipalities tend to agree on the high-level approach to sea level rise adaptation planning, including the need for a coordinated response. Areas of agreement, described below, provide a starting point for the region in terms of moving forward with sea level rise adaptation planning.

- **Sea Level Rise Scenario**
  The Year 2100 sea level rise scenario is the baseline planning horizon for sea level rise adaptation. This scenario is consistent with provincial amendments to the FHALUMG.
- **Tools**
  Planning and regulatory tools tend to be preferred over large-sale structural protection works. There is general agreement that some additional study is needed to confirm specific regulatory requirements.
- **Infrastructure**
  Pump station infrastructure assets are ageing across the region. These assets require upgrading to meet the Year 2100 sea level rise scenario.
- **Cooperation**
  There is an ongoing need for regional cooperation moving forward with sea level rise adaptation planning. Cooperation should strive to create complementary regulatory regimes.
- **Education/Outreach**
  An education and outreach strategy is needed to engage with several different audiences, including potentially impacted landowners, decision-makers and the general public.
- **Liability**
  Some clarification around municipal liability is needed for the interim period while sea level rise adaptation planning is underway.
- **Immediate Actions**
  Many municipalities/electoral areas with active development applications within sea level rise focus areas are interested in adopting immediate regulatory actions.

4.5 Disagreement

There is less agreement on the details of how to proceed with planning and implementation. Disagreement tends to reflect different municipal needs, including varying levels of participation, potential for impact resulting from sea level rise, land use regulation and existing political and policy direction on climate- and environment-related issues.

- **Timing**
  There is some disagreement regarding the timing of moving forward with additional study, regulation and public education and outreach. Municipalities/electoral areas with active development applications in areas potentially affected by sea level rise are interested in moving forward with policies and regulation in the near-term. Other municipalities suggest waiting until other major regional policy decisions are resolved before introducing new regulation around sea level rise.
- **Studies**
  Some municipalities are comfortable moving forward with the mapping and study results from the CRD Coastal Sea Level Rise Risk Assessment report (AECOM, 2015). Other municipalities would prefer more detailed studies to enact regulatory tools or plan for site-specific structural and/or non-structural adaptation.

- **Education/Outreach**
  In addition to the potential timing for public education and outreach, there is some disagreement over whether the engagement should be targeted to potentially affected property owners or conducted broadly across the region. Some municipalities could begin working with key property owners immediately on sites where redevelopment is expected, whereas others would prefer to develop clear policy requirements.
- **Political Direction**
  Some municipalities require political direction in order to move forward with adaptation planning. Other municipalities are comfortable with existing direction provided in planning and strategic documents.

5.0 POLICY OPTIONS

The vulnerability scan and the capacity analysis identified that municipalities in the capital region will look to planning, regulatory and some site-specific tools to address impacts resulting from sea level rise. The capacity analysis further identified that education and outreach, and some additional level of study is needed to move forward with the implementation of any sea level rise adaptation measure. The details of an education and outreach strategy, as well as study scope and timing, are to be determined as part of finalizing a broad sea level rise adaptation plan for the region.

The tools identified below are drawn from the *Sea Level Rise Adaptation Primer: A Toolkit to Build Adaptive Capacity on Canada's South Coasts (2013).* The tools are divided into overarching categories, with a brief description and priority rating to guide implementation. The tables encourage a coordinated regional approach, while providing municipalities with the flexibility to move forward with implementation in a manner that best fits with timing, funding and ultimately local adaptation needs.

5.1 Planning Tools

Planning tools set overarching direction for the implementation of sea level rise adaptation. Planning tools are critical for regional coordination and for ensuring a consistent approach to adaptation across local government departments. Specifically, planning tools help establish considerations, policy and procedures for long-range planning, and for the design, operation and maintenance of municipal infrastructure and publicly-owned land. Further, tools such as the SLR Adaptation Plan provide a knowledge base and justification for the adoption of regulatory tools, as described below in section 5.2. Actions local governments may consider include:

Action		Priority
P-1	Prepare an **SLR Adaptation Plan** or report. The plan or report can be based on the results from the individual meetings held with municipalities. The plan or report should: • Confirm mapping and identifies a sea level rise planning area to inform infrastructure and land use responses. • Provide an inventory of areas/assets vulnerable to SLR impacts. • Set out planning, regulatory and site-specific responses to areas/assets vulnerable to SLR impacts. • Prioritize projects such as additional technical study and infrastructure upgrades. • Identify potential funding sources. The adaptation plan can be used as a starting point for public dialogue on the implementation of regulatory and non-regulatory tools.	Short-term
P-2	Set **policy direction** in statutory documents such as the Official Community Plan (OCP) requiring the municipality to address sea level rise impacts. For many municipalities, this direction falls under the development of climate-adaptive tools. Consider including language that prioritizes regulatory and non-structural protection ("green") tools. Example language : • "Identify policies and actions for climate change adaptation that strengthen community resiliency to future impacts"[5] • "Incorporate climate change, its potential impacts, and mitigation measures when reviewing new development applications and undertaking long-term planning initiatives."[6]	Opportunistic

[5] City of Victoria. 2014.
[6] District of Saanich. 2008. Sustainable Saanich Official Community Plan. Bylaw #9073. P. 4-5.

Action		Priority
P-3	Integrate sea level rise adaptation planning into the development of **plans, procedures and policies**. Specific considerations are provided below.	Opportunistic
P-3A	**Strategic Plan**: Allocate resources to sea level rise adaptation planning and implementation. Prioritize project implementation (e.g.: completion of studies, adoption of regulatory tools, infrastructure investments).	Yearly
P-3B	**Utilities Master Plan/Sanitary System Master Plan** and **Transportation Master Plan:** Explicitly define vulnerabilities and adaptation measures to built infrastructure. Items to consider include: • Backflow prevention in the pipe network and to homes/buildings. • SLR scenarios and design criteria to the Year 2100 for facility planning and redevelopment[7]. • Inventory of infrastructure and components to facilitate replacement if damaged by storm events or flooding. • Allocation of resources for SLR adaptation in facility redesign/replacement, including the potential relocation of facilities.	Opportunistic
P-3C	**Parks Master Plan:** Research and identify the potential adaptive capacity of parks. Items to consider include: • Potential for park land to achieve setbacks, providing a community amenity and a buffer area to minimize sea level rise impacts to private property. • Potential to incorporate soft structural ("green") approaches to coastal park management. • Inventory of infrastructure/assets and potential vulnerabilities to sea level rise impacts to inform long-range facilities planning. • Plan to address potential for loss of parkland as a result of sea level rise such as acquisition of new parkland through purchase, easement or land dedication as properties redevelop over time.	Opportunistic
P-3D	**Asset Management Plan:** Explicitly define asset vulnerabilities and costs associated with adaptation planning and implementation in an. Items to consider include: • Inventory of assets in need of adaptation to meet the Year 2100 sea level rise scenario. • Begin reserving money for additional technical study to set criteria (e.g.: raising sea walls, infrastructure replacements) and/or asset replacement.	Opportunistic
P-3E	**Acquisition Plan**: Identify properties that may need to be purchased to implement sea level rise adaptation. Items to consider include: • Road right of way if road needs to be set back from shoreline to avoid damage due to erosion. • Properties adjacent to existing public parks that could be part of park to increase adaptive capacity. • Assembly of properties to create public park/land that could increase municipal adaptive capacity.	Opportunistic

[7] Design criteria should be consistent with methodology identified in the provincial FHALUMG, once amended.

Action		Priority
P-4	Develop **RFP criteria** for infrastructure investments to ensure sea level rise is considered as part of project planning, design, construction, operation and maintenance. Consider criteria for the following types of projects: • Pump Station – *City of Colwood example*[8] • Roads • Harbour infrastructure	Short-term
P-5	Prepare an **Adaptation Guide for homeowners/developers** to provide information about sea level rise studies, measures and costs that can be undertaken when redeveloping on existing lots or subdivision. The guide could be used in conjunction with R-3 and R-4.	Medium-term

5.2 Regulatory Tools

Regulatory tools set out the land use and building requirements that control how development occurs. The statutory authority of tools such as bylaws and development permits provide local governments with the ability to place restrictions on land uses, densities, setbacks, siting and servicing. Actions local governments may consider include:

Action		Priority
R-1	Adopt a **Flood Construction Level Bylaw** as per s.910 of the *Local Government Act*. Amendments to the FHALUMG provide a choice of two methodologies for establishing the FCL. Additional study will be required to set the FCL. Regional coordination would support a consistent planning approach as not to create different regulatory regimes around the region.	Immediate
R-2	Amend or adopt new **Development Permit Areas (DPA)** to identify requirements and appropriate adaptation tools (structural/non-structural) to address the redevelopment of existing properties within the sea level rise planning area. Items to consider include: • Requirements for studies and design criteria set by suitably qualified Professional Engineer experienced in coastal engineering if property is located within the sea level rise planning area. • Prioritizes non-structural protection for coastal shoreline management on private property. • Requirement to register a s. 219 covenant, as per R-4.	Short-term
R-3	Amend or adopt new **Building Permit policy** that building inspectors consider Year 2100 sea level rise scenarios as identified in the amended FHALUMG when providing approvals as per s.56 of the Community Charter.	Short-term
R-4	Require property owners to register a **Restrictive Covenant** as per s.219 of the *Local Government Act* for buildings within the FCL, for developments subject to a DPA, or for development within the sea level rise planning area. In addition to addressing issues of liability, the covenant should indicate that additional adaptive measures may be required at the time of redevelopment that are consistent with requirements in place at that future time.	Short-term

[8] City of Colwood. 2015. *Request for Proposals: RFP-2015-02 Ocean Boulevard Pump Station Protection Plan 2015*. Retrieved July 2015 from: http://www.colwood.ca/sites/default/files/RFP/RFP-2015-02%20Ocean%20Boulevard%20Pump%20Station%20Protection%20Plan%202015.pdf

Action		Priority
R-5	Explore the use of **Environmental Easements** to create a publicly-accessible amenity along the shoreline to buffer properties from sea level rise impacts. The easement can also be used pursue a more comprehensive approach to shoreline protection through non-structural or structural adaptation measures. A rolling easement mechanism could be explored to address areas where changes to the shoreline will result in the loss of property.	Medium-term

5.3 Education and Outreach

Education and outreach is needed to implement planning and regulatory tools. It is important to recognize that the impacts of sea level rise and adaptation responses can affect land owners. It is, therefore, critical to ensure that people understand what the potential impacts are, how they are identified and how adaptation responses are developed. A strategy is necessary to ensure a transparent process that provides people with access to the best information possible in a responsible way. Actions local governments may consider include:

Action		Priority
E-1	**Present results** from the Sea Level Rise Planning Project to the regional Environmental Services Committee (ESC). Place study results on the CRD Climate Action Program webpage. Provide web-ready information to support municipalities, as needed.	Immediate
E-2	Develop an **education and outreach plan** to support the dissemination of sea level rise information, and any public consultation needed to adopt regulatory tools. Target audiences include: • Mayor, Council and administration • Local government staff • Potentially affected property owners • Development community (contractors/builders, geotechnical engineers) • Area realtors • General public	Immediate
E-3	**Implement education and outreach**. Activities will be determined as part of the education and outreach plan.	Short-term

5.4 Studies

Additional studies are required for adaptation planning, and for the administration of several regulatory tools. Some of the studies are the responsibility of local government, whereas others are the responsibility of private landowners. The following provides a list of some of the anticipated studies, and the corresponding plan or project with which they are associated.

Study		Plan/Project
S-1	**Confirm FCL** through review by a suitably qualified Professional Engineer, experienced in coastal engineering. Specifically, confirm an appropriate wave effects number that can be used by municipalities.	R-1
S-2	Collect **LiDAR data** to refine digital elevation models in order to provide minimum elevations in low-lying coastal areas to input into a potential FCL.	R-1
S-3	For major projects and new infrastructure, undertake or require **site-specific studies** by a suitably qualified Professional Engineer, experienced in coastal engineering to identify suitable building criteria.	P-3B, P-3C

Study		Plan/Project
S-4	**Coastal Management Study** or similar environmental shoreline study to identify adaptive capacity of coastal areas for integration in Parks/Environmental Master Plans and other planning documents.	P-3C
S-5	**Land Acquisition Study** to identify and plan for any land acquisition needs as determined through an adaptation plan.	P-3E
S-6	**Saltwater Intrusion Study** in areas serviced by groundwater near the coast.	P-3B

5.5 Land Use Considerations

Given the regional scale of this project, site-specific adaptation measures cannot be described in detail. The following considerations have been identified for different land use types based on aggregated characteristics derived from discussions with the individual municipalities. These considerations are meant as a guide to the development of more detailed adaptation needs in a Sea Level Rise Adaptation Plan.

Action	
L-1	Areas with active land use applications/redevelopment • On properties with significant infrastructure investments or large redevelopment projects, local government should work closely with land owners or developers to design and build to the Year 2100 sea level rise scenario. If an FCL or a DPA is not in force to set requirements, approving officials will need to work collaboratively with landowners to include adaptation tools. • If a FCL or other adaptation measures are recommended by a suitably qualified Professional Engineer, experienced in coastal engineering, the municipality can require the property owner to enter into a s.219 covenant.
L-2	Harbour/Marina • Consider studies/planning/timeline to raise harbour infrastructure/docks that are nearing the end of their service life. Harbour Air and DND have recently completed studies and would be good resources.
L-3	Low-lying coastal areas • Rocky Ramp/beach: Consider studies/planning/timeline to determine when/how to raise infrastructure or make way for soft armouring. • Estuary: Consider studies/planning/timeline to identify potential impacts to natural environment and determine how to use natural infrastructure as adaptation tool (i.e., Esquimalt Lagoon).
L-4	Industrial • Prepare an inventory of hazardous materials and relocation/adaptation plan to prevent spills in storm surge or flood event. • Mechanical/electrical equipment.
L-5	Linear Coastal • Consider additional impacts such as erosion when using regulatory tools that could be exacerbated by sea level rise. • Plan for/identify any setback adjustments that may be required as part of the amended FHALUMG.
L-6	Park Land • Parks are an opportunity to provide land in terms of setback and adaptation. • Parks can continue to be used for recreation; however, a plan for replacing park infrastructure should consider the Year 2100 sea level rise scenario. • Some areas subject to large tides/heavy storms may require disclaimers/warnings.

6.0 CONCLUSION

Local governments have the responsibility to manage flood hazards. Using the results of the Coastal Sea Level Rise Risk Assessment (AECOM, 2015), the intent of this project was to support regional municipalities/electoral areas in considering the various approaches to dealing with sea level rise along the southern coast of Vancouver Island. A literature review and municipal workshop activity found that local governments can access a series of adaptation tools to address sea level rise impacts. Regional policy consistency has been identified as an important factor in flood hazard planning. It is up to municipalities/electoral areas to ultimately consider the information provided in this report in order to develop local government adaptation plans and implement actions when ready, depending on local vulnerabilities and priorities.

6.1 Next Steps

With completion of Phase 2 of the Sea Level Rise Planning Project, information will be shared with municipalities to inform individual adaptation platforms and for review through the political process.

Regional municipal/electoral areas will identify appropriate next steps, which may include confirming FCL mapping, developing plans and policies, investigating further study requirements and developing education materials. Timing is dependent on when the FHLUAMG amendments are finalized and adopted by the Province. It should be noted that tsunami mapping could be included in the mapping at this time. The CRD Climate Action Program will continue to work with inter-municipal staff and elected officials to support municipalities moving toward implementation, as required.

6.2 Lessons Learned

A key success of the project was the use of a consistent adaptation planning framework with municipalities around the region. Holding individual meetings allowed each municipality to identify specific sea level rise vulnerabilities as well as opportunities and gaps for addressing these vulnerabilities. When aggregated at a regional level, it was possible to identify shared concerns as well as different needs. This process helped clarify that planning and regulatory approaches are generally preferred to help avoid, accommodate and begin planning for retreat in some areas.

Lessons learned through this project include:

- ✓ **Coordination:** Cross-departmental participation is needed to promote knowledge sharing and to increase staff understanding that sea level rise is an issue to be addressed by all departments rather than simply the “sustainability planner” role.
- ✓ **Climate Adaptation Plans:** The literature review highlighted that sea level rise considerations can be incorporated into broader policy responses to climate adaptation.
- ✓ **Knowledge Gaps:** It was a challenge to prioritize adaptation measures with the level of detail from the Phase 1 study. Many vulnerable land uses or assets around the region are site-specific, and would require additional inundation modelling to fully understand potential impacts from sea level rise. The adaptation framework, vulnerability scan and capacity analysis were helpful for highlighting site-specific areas that may require additional analysis as adaptation planning moves forward.
- ✓ **Scenario Mapping and Methodology**: Much of the consultation focused on the amendments to the FHALUMG and the potential policy implications of adopting a FCL. Technical mapping should be completed by provincial or federal governments to ensure that a consistent, rigorous mapping methodology is applied to best support science-based decision-making.

APPENDIX A
VULNERABILITY SCAN + CAPACITY ANALYSIS

Agenda

Date:

Time:

Location:

Meeting Objectives

1. Work through the proposed methodology for SLR planning and adaptation:
   a. Identify inputs to populate the draft SLR Adaptation Framework.
   b. Apply the analytical tool to identify capacity to implement adaptation measures.
2. Gather comments to refine the proposed methodology.
3. Identify opportunities and gaps to prioritize future work.

Time	Activity	Description
5 min	Welcome + Introductions	Introduce participants. Review the Sea Level Rise Planning Project.
45 min	Exercise 1: Sea Level Rise Adaptation Framework	Review Phase 1 findings (10 min). Complete a vulnerability scan (25 min) for land uses and key assets in the focus area and other shoreline areas. Identify a (re)development horizon (10 min) for land use and key assets in the focus area and other shoreline areas.
50 min	Exercise 2: Sea Level Rise Adaptation Capacity Scan	Evaluate the suitability of different adaptation measures for a given asset, land use, focus area or shoreline site. Evaluate municipal capacity to implement adaptation measures.
15 min	Exercise 3: Action Plan	Identify opportunities and gaps to prioritize future work. Generate a list of desired short-term actions.
5 min	Thank You + Next Steps	Update on next steps in the Sea Level Rise Planning Project.

Meeting Instructions

Step 1: Review the workbook to prepare for the meeting (optional).

Step 2: At the meeting, complete the exercises as a group. The exercises are guided self-assessments that use simple rating scales for different components of sea level rise adaptation planning.

Step 3: A meeting facilitator will record the findings in the workbook. Results will be used to conduct a region-wide analysis on adaptation planning needs.

Proposed Methodology for SLR Planning + Adaptation

Coastal communities recognize the need to address impacts associated with sea level rise. Given the complexity and uncertainty of sea level rise adaptation, local governments and other regulatory bodies use stepwise decision-making frameworks to select strategies best suited to anticipated impacts.

The draft sea level rise adaptation framework, shown in Table 5, proposes a high-level planning tool for municipalities in the CRD that identifies adaptation measures best suited to addressing impacts associated with sea level rise.

The exercises for this meeting are focused on identifying the inputs that will populate this framework and evaluating the capacity to implement adaptation measures. These are the first steps to preparing an adaptation plan.

Table 5. Draft Sea Level Rise Adaptation Framework

		Avoid	Protect	Accommodate	Retreat
1	**Outcomes**	Do not build vulnerable assets in areas impacted by SLR impacts	Continued occupation of areas while preventing SLR impacts	Continued occupation of areas while allowing for tolerable SLR impacts	Withdrawal of vulnerable assets from areas impacted by SLR impacts
2	**Timing + Asset Characteristics**	Long-term • Planned future assets • Planned replacement	Short-medium term • Existing assets	Ongoing • Existing • Planned future assets • Planned replacement	Long-term • Existing assets
3	**Assets in Need of Adaptation**				
4	**Adaptation Measures** (SLR Adaptation Capacity Scan)	• Policies + standards • Restrict development (zoning) • Legal (acquisition, easement, tenure, trust)	• Build grey infrastructure • Retrofit incentives	• Build green or grey infrastructure • Retrofit assets • Adopt policies + standards • Regulate development (FCL) • Legal (indemnification covenant) • Retrofit incentives	• Relocate assets • Policies + standards • Restrict development (zoning) • Legal (acquisition, easement, tenure, trust)
5	**Social, Environmental and Economic Cost**	Lost development potential/decrease property values & associated tax base	Tend to be expensive (major capital investments); cost to government	Cost to asset-owner – can vary	Lost development potential/decrease property values & associated tax base
6	**Tools**	Planning, design, zoning, training and/or communication/outreach tools required to assist with implementation.			

VULNERABILITY SCAN

1. Using the rating scale below, indicate the degree of **sensitivity** and **resilience** of each land use category/asset to impacts related to coastal erosion and inundation. Add the totals for the total vulnerability score.

Name	Description	Rating Scale
Sensitivity	The degree to which an asset is affected by inundation or erosion resulting from rising seas and/or storm events.	**Low:** Asset is easily replaced, disruption from loss or failure is minor, relatively few people are impacted **Med:** Moderate cost to repair/replace, impacts a relatively greater number of people, disruption is/can be mitigated **High:** Major cost to repair/replace, critical to public health and safety/provides essential service, can't be mitigated **Unsure/Don't Know:** Insufficient data/information
Resilience	An asset's inherent ability to adjust to potential impacts, moderate damage, or cope with consequences without the need for intervention.	**High:** Can accommodate SLR impacts/modifications are easy **Med:** May tolerate SLR impacts/modifications are easy **Low:** Can't tolerate SLR impacts/modifications are difficult **Unsure/Don't Know:** Insufficient data/information
Land Use Characteristics	The planned future land use characteristics of the area around the asset.	**Undeveloped/sparsely populated** **Planned future development** **Built-out and redeveloping**
Timing	The replacement/redevelopment horizon for the asset.	**Immediate:** 0–5 years (planning for asset replacement has begun) **Short-term:** 5–20 years **Medium-term:** 20–50 years **Long-term:** 50–100 years
Social Equity	The degree to which vulnerable populations are affected by SLR impacts.	**Neutral Impact:** No discernible difference in impact **Negative Impact:** Vulnerable populations are disproportionally affected by SLR

VULNERABILITY SCAN

Asset Category	Name	Sensitivity	Resilience	Land Use Characteristics	Timing	Social Equity
Infrastructure						
Utility						
Land Use						

ADAPTATION FRAMEWORK

2. Based on results from vulnerability scan, complete row 3 of the adaptation framework.

		Avoid	Protect	Accommodate	Retreat
1	**Outcomes**	Do not build vulnerable assets in areas impacted by SLR impacts.	Continued occupation of areas while preventing SLR impacts.	Continued occupation of areas while allowing for tolerable SLR impacts.	Planned withdrawal of vulnerable assets from areas impacted by SLR impacts.
2	**Timing + Asset Characteristics**	Long-term • Planned future assets • Planned replacement	Short-medium term • Existing assets	Ongoing • Existing • Planned future assets • Planned replacement	Long-term • Existing assets
3	**Assets in Need of Adaptation**				
4	**Adaptation Measures**	• Policies + standards • Restrict development (zoning) • Legal (acquisition, easement, tenure, trust)	• Build grey infrastructure • Retrofit incentives	• Build green or grey infrastructure • Retrofit assets • Adopt policies + standards • Regulate development (FCL) • Legal (indemnification covenant) • Retrofit incentives	• Relocate assets • Policies + standards • Restrict development (zoning) • Legal (acquisition, easement, tenure, trust)
5	**Social, Environmental and Economic Cost**	Lost development potential/decrease property values & associated tax base	Tend to be expensive (major capital investments); cost to government	Cost to asset-owner – can vary	Lost development potential/decrease property values & associated tax base
6	**Tools**	Planning, design, zoning, training and/or communication/outreach tools required to assist with implementation.			

Exercise #2: Quick Scan Exercise

CONSIDERATIONS

3. Complete the checklist to assess the opportunities to operationalize SLR adaptation planning/implementation.

	Low	Medium	High	Unsure	Description/Notes
Adaptation Measures	No measures OR Modification is prohibitively expensive	Modifications needed, with significant cost/planning	Modifications needed, with some cost/planning		List of adaptation in place and/or opportunities/constraints
Cost	High cost relative to inaction	Moderate cost relative to inaction	Low cost relative to inaction		Anticipated cost of adaptation measure
Emergency Management	No emergency management in place	Updates to emergency management are needed	No updates required		List of protocols/plan relevant to asset or area
Ancillary Public Benefit	Not possible due to site constraints or potential for hazard	Could be realized, but would require additional resources	Currently being realized		List potential benefits that could be realized through an adaptation project
Window of Opportunity	No upcoming projects, no plan in place for SLR adaptation measures	Projects are upcoming, no plan in place for SLR adaptation measures	Plan in place to include SLR adaptation measures in upcoming projects		List of projects and examples of plans
Environmental Services	Challenge- coast is degraded/armoured	Potential – a program needs to be created	Already underway		List of initiatives, and/or opportunities/constraints
Natural Environment	Actions have negative impact	Actions have little/no impact	Actions will restore/improve		List of potential impacts to coastal ecosystems
Social Equity	Action is not possible; impacts to vulnerable populations	Action needed to address impacts to vulnerable populations	No effect on vulnerable populations		List of opportunities/challenges

Exercise #2: Quick Scan Exercise

Readiness

4. Complete the checklist to assess the ease of successfully adopting the tool.

	Low	Medium	High	Unsure	Description / Notes
Funding	External funding is needed, but has not been identified	External funding is needed, and is likely to be secured	Funding is available		List of funding needs + sources
Staffing Resources	Staff resources are needed, but have not been identified	Staff resources are needed, and likely to be secured	Staff resources are available		List of staffing needs or resources
Knowledge	Significant data gaps – additional study needed	Some data gaps – can be addressed with minimal resources	No data gaps – little additional work needed		List of data needs or studies undertaken
Policy/Program Capacity	New policy/ program/ bylaw needs to be created	Existing policy/ program/bylaw can be modified	Policy/program/ bylaw is in place		List of policy needs or policies in place
Institutional Coordination	Coordination Is needed – may be a challenge	Coordination is needed – likely not a challenge	Coordination is in place, and working successfully		List of challenges/opportunities
Public Acceptance	Likely to face public opposition	Not likely to receive much public attention	Likely to receive public support		List of challenges/opportunities
Communicability	Education is needed – messaging may be difficult	Education is needed – messaging is easy	No need for education – messaging in place		List of challenges/opportunities

Exercise #3: Action Plan

ACTIONS

5. Thinking about the quick scan exercise, what are the actions needed in the short-, medium-, and long-term to achieve the goals?

Short-Term	Medium-Term	Long-Term
EG: Complete xx study	Adopt xx policy	Build xx asset

Capital Regional District

Coastal Sea Level Rise Risk Assessment

AECOM

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Executive Summary

1. **Project Context.** With global sea levels projected to continue rising, public and private assets and shoreline land uses across the Capital Regional District (CRD) have the potential to experience an increase in frequency and magnitude of periodic inundation events as well as permanent inundation. The Coastal Sea Level Rise Risk Assessment project has been developed as a first phase in CRD's multi-year project to gather information to support future analysis and policy response for sea level rise (SLR) within the CRD. CRD is the first BC regional district to have completed mapping based on the draft provincial guidelines for floodplain mapping and intends to use the mapping and findings from this project to consult and provide feedback to the Province on the proposed guidelines, and planning for the impacts that SLR will have in the CRD region. Mapping based on provincial guidelines shows that any significant impacts from sea level rise will not be felt until 2050 or beyond, and advanced planning can be applied to help avoid or manage such impacts before they are realised.

2. **Uses and Limitation.** This project is the very first step to assess how the region's shoreline may look 35, 85 and 185 years in the future. The mapping from this study considers static sea level rise, coupled with relatively extreme 1 in 500 year storm surge conditions, so while areas may be depicted within an inundation zone, this does not mean these areas will necessarily experience flooding due to sea level rise and storm surge in the future. Significant further analysis is necessary to fully understand what the effects of future sea level rise may be in these coastal areas. Establishing flood hazard boundaries is a responsibility of local government, and each municipality within the region will determine how they will respond to future sea level rise. Once future flood hazard area boundaries are established by municipalities, there are many tools that can be used to address sea level rise within these areas. These include planning and regulatory tools, land use change or restriction, structural tools including flood protection works, and non-structural tools such as soft armouring by wetland construction. Future work for specific locations should be used to confirm the data used and produced in this report.

3. **Project Objectives.** The primary purpose of this project was to identify and map areas that are vulnerable to SLR within the CRD. The secondary purpose was to understand the potential economic consequences of SLR, thereby providing information to support development of future policy and land use regulations. The technical scope of work to deliver these objectives was designed to align with the available project funding, and the mapping (Appendix A) and other data reporting (Appendix B) was focused on 24 key areas ("Sea Level Rise Focus Areas") that were selected because of the relatively high levels of expected future inundation and / or the key community assets that are present in those areas. Three high-level case studies were developed to help identify the potential service disruption effects that could occur under sea level rise and storm surge conditions. These case studies were for transportation disruption (based on disruption to Highway 14 south of Shirley), local community disruption (in the Oak Bay Windsor Park residential area), and business disruption (in the Victoria Inner Harbour).

4. **Approach to Mapping.** The maps developed for the project show the anticipated future shoreline at high tide, and during storm surge conditions in 2050, 2100 and 2200. The mapping is based on the 2011 Province of BC Coastal Floodplain Mapping Guidelines and Specifications Report, and uses the recommended SLR levels for those time periods and 1 in 500 year storm surge conditions. A digital elevation model was developed for across the region, and then factors that will influence future sea levels were layered onto the model to give an estimation of the future shoreline. These factors include projections for static SLR, highest high water large tide (HHWLT) values collected from hydrological monitoring at over 30 sites across the region, vertical land elevation figures which address seismic activity, and the 1 in 500 year storm surge conditions.

5. **SLR Focus Areas.** Once maps were developed for the entire CRD coastline a workshop was run with the CRD Project Team to identify the key assets (e.g. key municipal infrastructure) that exist within the coastal areas that could be subject to flooding for the scenarios considered. This was used to help define SLR Focus Areas for a selection of areas with key assets and relatively high levels of expected future inundation. A set of 24 SLR Focus Areas were then defined and for each area maps were produced to show inundation levels for the different sea level rise scenarios (for 2050, 2100 and 2200, and with and without 1 in 500 year storm surge conditions).

6. **Description of land and assets within each SLR Focus Area.** Data were compiled to define land use, shoreline sensitivity to sea level rise, valuation of land and improvements, roads and presence of key public assets within the areas that would be flooded within the selected scenario of SLR in year 2100 plus the 1 in 500 year storm surge conditions. These data were provided by CRD and included: municipal zoning data, BC Assessment data for actual use of land and market valuation of land and improvements, location of roads, and replacement cost estimates for key public assets. These data are reported in Appendix B and help describe the assets that would theoretically be at risk for the selected scenario if the 1 in 500 storm surge scenario occurs and assuming no management measures were put in place.

7. **Key Findings and Recommendations.**
   a. As a result of varying topography there are different levels of inundation that may occur across the CRD coastline for the SLR and storm surge scenarios that were considered as part of this project. Many of the lower lying areas that may have higher levels of inundation coincide with developed and populated areas, leading to the potential for infrastructure damage, safety risk and service disruption. As well as the key areas represented in the 24 SLR Focus Areas, there are other parts of the CRD outside of these selected areas that could have inundation effects under these scenarios and these areas should also be considered during future mapping and planning work.
   b. For the 24 Focus Areas used for this project the total valuation of land and improvements (as defined by BC Assessment) within the year 2100 + 500-year storm surge inundation line ranges from $330 million (for the Oak Bay Windsor Park SLR Focus Area) to $3.4 million (Albert Head SLR Focus Area). These are total asset values based on market valuation and do not infer expected losses that would occur from periodic inundation. Across the 24 SLR Focus Areas, BC Assessment data show that residential property has the highest total assessed value followed by commercial and then civic, institutional and recreational land uses.
   c. The key assets that would be at least partially inundated for this selected scenario (and assuming no future management measures are put in place) within the 24 SLR Focus Areas are principally network structures for water and wastewater, and some road bridges could be affected. There is the potential for some large businesses to be at least partially inundated, with some of their operations (e.g. ferry, float plane) being regionally important for the tourism sector. There are also a large number of marine docks that are within the inundation line for this scenario, though it has not been assumed that infrastructure damage would necessarily occur to the dock structures themselves.
   d. One of the main areas of Highway inundation for the year 2100 plus 1 in 500-year storm surge scenario is at Highway 14 between Sooke and Port Renfrew, and this area was used as a case study for transport service disruption. In other SLR Focus Areas there are a range of local and connector roads that would be subject to inundation for this scenario.
   e. The key recommendation is that CRD use the analysis and mapping conducted for the 24 SLR Focus Areas as an evidence base for the identification and appraisal of options for a future model bylaw that deals with SLR management for the CRD. In particular, the data reported in this project demonstrates the types of land use, key assets, services and indicative economic values that exist in areas at inundation risk, and this evidence will help to develop the objectives for and assess the impacts of different management options.

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Appendices

1. Introduction

1.1 Background

Historically, the main causes of coastal flooding are attributed to astronomical tides coupled with the meteorological influences associated with storms (BC Ministry of Forests, Lands and Natural Resource Operations, 2011). With global sea levels projected to continue rising, public and private assets along with land uses in shoreline areas across the Capital Regional District (CRD) have the potential to experience an increase in frequency and magnitude of periodic inundation events as well as permanent inundation. Therefore, incorporation of future flood hazard impacts into development of coastal hazard maps can provide science-based support to allow prioritization of resource allocation to best prepare coastal communities, fragile ecosystems, and jeopardized infrastructure.

Within the Province of British Columbia (BC), local governments have responsibility for making decisions about local floodplain management practices, including decisions about floodplain bylaws (BC Ministry of Forests, Lands and Natural Resource Operations, 2011). The CRD is planning a series of work that will contribute to the development of a model bylaw for managing the impact of sea level rise (SLR). Such a bylaw is one of the regulatory adaptation strategies that can be put into place at the local level (BC Ministry of Environment, 2013).

In 2011 the Province of BC issued guidelines and specifications for the development of floodplain maps to show coastal hazard, including from SLR (BC Ministry of Forests, Lands and Natural Resource Operations, 2011). This project is the first application of these guidelines by the CRD for the purposes of understanding coastal SLR risk at the regional level.

The Coastal Sea Level Rise Risk Assessment project has been developed as a first phase in CRD's multi-year project to gather information to support future analysis and policy response for sea level rise (SLR) within the CRD. CRD is the first BC regional district to have completed mapping based on the draft provincial guidelines for floodplain mapping and intends to use the mapping and findings from this project to consult and provide feedback to the Province on the proposed guidelines, and planning for the impacts that SLR will have in the CRD region. The mapping based on provincial guidelines show that any significant impacts from sea level rise will not be felt until 2050 or beyond, and advanced planning can be applied to help avoid or manage such impacts before they are realised.

1.2 Project Objectives

The primary purpose of this project was to identify and map areas that are vulnerable to SLR within the CRD. The secondary purpose was to conduct a risk assessment to understand the potential economic consequences of SLR, thereby providing information to support development of future policy and land use regulations.

The specific objectives of this project were:

1. To map future limits and depth of inundation in the CRD study area for multiple climate change planning scenarios with Higher High Water Large Tide (HHWLT; the average annual high tide) and extreme high tide (HHWLT plus storm surge).
2. To identify the different land uses that exist within areas that may be subject to future inundation.
3. To identify the total value of land, developments and infrastructure that exist within areas that may be subject to future inundation.
4. To identify the key public assets that exist within areas that may be subject to future inundation.

5. To provide an evidence base of the above maps and data that can be used by CRD and regional municipalities / electoral areas for future development of a model bylaw.

The technical scope of work to deliver these objectives was designed to align with the available project funding and the geographic context of the CRD region, with extensive shoreline on the mainland portion of Vancouver Island as well as many islands, with varying shoreline topography and land uses. The analysis and mapping for the project was focused on a series of key areas that were selected because of the relatively high levels of expected future inundation and / or the key community assets that are present in those areas (see section 2.4). The digital files developed by the project and delivered to CRD give expected inundation profiles for the whole of the CRD coastline and can be used by CRD to replicate this scope of work for those areas that were not included in the areas covered by this project.

1.3 Project deliverables

The deliverables from this project are:

- This project report as a written record of the project.
- A separate map book showing spatial inundation information for the key areas that were analysed as part of the project.
- Digital files that provide inundation levels for the different planning scenarios for the entire CRD coastline.

1.4 Report Outline

This report is structured with the following sections:

- Method – a summary of the technical approaches used to achieve the project objectives.
- Results – a summary of the maps and other data generated from the project.
- Conclusions – a summary of the key findings identified from the project.
- Recommendations – a listing of next steps and further work that could be done by CRD to implement these findings in the context of model bylaw development.
- Appendix A – map book showing inundation levels for different scenarios (provided as separate documents)
- Appendix B – detailed land use and valuation statistics for each focus area.
- Appendix C – detailed methods used for service disruption case studies.
- Appendix D – listing of referenced data sources used in the project.

1.5 Uses and Limitations

This project is the very first step to assess how the region's shoreline may look 35, 85 and 185 years in the future. The mapping from this study considers static sea level rise, coupled with relatively extreme 1 in 500 year storm surge conditions, so while areas may be depicted within an inundation zone, this does not mean these areas will necessarily experience flooding due to sea level rise in the future. Significant further analysis is necessary to fully understand what the effects of future sea level rise may be in these coastal areas. Establishing flood hazard boundaries is a responsibility of local government, and each municipality within the region will determine how they will respond to future sea level rise. Once future flood hazard area boundaries are established by municipalities, there are many tools that can be used to address sea level rise within these areas. These include planning and regulatory tools, land use change or restriction, structural tools including flood protection works, and non-structural tools such as soft armouring by wetland construction. Future work for specific locations should be used to confirm the data used and produced in this report.

1.6 Acknowledgements

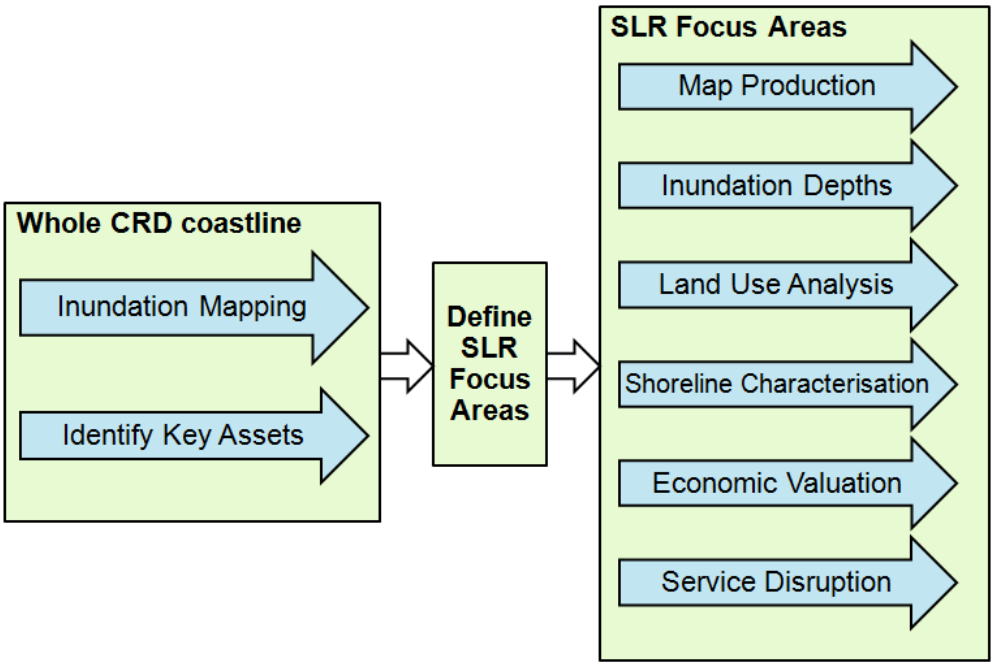
This project was made possible with financial support from Natural Resources Canada's Climate Change Impacts and Adaptation Program, Tides Canada, City of Victoria, District of Saanich, and the Capital Regional District, with additional support from the Province of British Columbia Climate Action Secretariat.

2. Methods

2.1 Overview

This project included a number of related tasks that were used to develop mapping, followed by the selection of SLR Focus Areas, and then data compilation and analysis for those SLR Focus Areas. These tasks are outlined in Figure 1 and described in the following sub-sections.

Figure 1 - Overview of project tasks



2.2 Inundation Mapping

Analyses were conducted to determine appropriate inundation water levels under future SLR projections following the methods outlined in the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) Coastal Floodplain Mapping Guidelines and Specifications (BC Ministry of Forests, Lands and Natural Resource Operations, 2011). The sections below present a summary of:

- The existing and future conditions water level analysis for the CRD study area, and
- The methods to produce SLR inundation mapping associated with each of the planning time horizons.

2.2.1 Water Level Analysis

The general approach for the water level analysis is to first characterize the existing conditions of the hydrodynamic tidal environment. Two reference water levels were selected for inundation mapping purposes: the HHWLT (average annual high tide) and an extreme high tide (HHWLT plus storm surge). The present-day HHWLT values were determined through examination of published tide data tables (Section 2.2.2). Existing conditions were then projected into the future by adding the specified amount of SLR for each climate change scenario, including the effects of storm surge for the extreme high tide case (Section 2.2.3).

2.2.2 Existing Conditions Water Levels

The Canadian Hydrographic Service (CHS), tasked with maintaining Canada's network of tide gauge instruments, collects and publishes HHWLT elevations for approximately 40 Reference Stations and Secondary Stations for the CRD study area in a series of Tide Table Volumes. The HHWLT is the average of the annual maximum higher high water levels from approximately 19 years of predicted tide data and represents the average annual high tide level. HHWLT and mean water level (MWL) values were obtained from Volume 5 of the Canadian Tide and Current Tables. Data values are recorded relative to each station's local Chart Datum (CD), which typically corresponds to the lowest recorded low tide value. Since each station's CD is different, it was necessary to convert all water levels to a common vertical datum to facilitate consistent inundation mapping across the region. Conversion to Canada's national datum, the Canadian Geodetic Vertical Datum of 1928 (CGVD28), was achieved by assuming the local MWL datum is approximately equal to the CGVD28 datum at each tide station (BC Ministry of Forests, Lands and Natural Resource Operations, 2011). This approximate conversion technique is supported by comparing the CD to MWL conversion factor derived from the tide tables to the vertical offset of HHWLT and CD elevations obtained from 24-hour benchmark occupations of two tidal stations as shown in Table 1. HHWLT values relative to CD were converted to CGVD28 using the MWL offsets at each tide station (Table 2).

Table 1 - Comparison of Conversion Techniques from Local CD to CGVD28

Tidal Station	CD to CGVD28 conversion based on 24-hr benchmark occupation	CD to CGVD28 conversion based on CD-MWL difference
Patricia Bay	2.26 m	2.26 m
Victoria	1.89 m	1.90 m

Source: Personal communication with Canadian Hydrographic Service.

Table 2 - Tidal Datums for CRD Study Area Tide Stations

Station	Latitude (deg)	Longitude (deg)	HHWLT (m CD)	MWL (m CD)	HHWLT (m CGVD28)
Port Renfrew	48.55	-124.417	3.8	1.9	1.9
Sooke	48.367	-123.733	3.6	1.9	1.7
Victoria	48.417	-123.367	3.4	1.9	1.5
Fulford Harbour	48.767	-123.45	3.8	2.3	1.5
Point No Point	48.4	-123.967	3.63	1.92	1.71
Sooke Basin	48.383	-123.683	3.32	1.83	1.50
Becher Bay	48.333	-123.633	3.41	1.77	1.65
Pedder Bay	48.333	-123.55	3.35	1.83	1.52
William Head	48.333	-123.533	3.26	1.77	1.49
Esquimalt	48.433	-123.433	3.38	1.89	1.49
Clover Point	48.4	-123.35	3.41	1.89	1.52
Oak Bay	48.433	-123.3	3.54	2.01	1.52
Finnerty Cove	48.467	-123.3	3.44	1.98	1.46

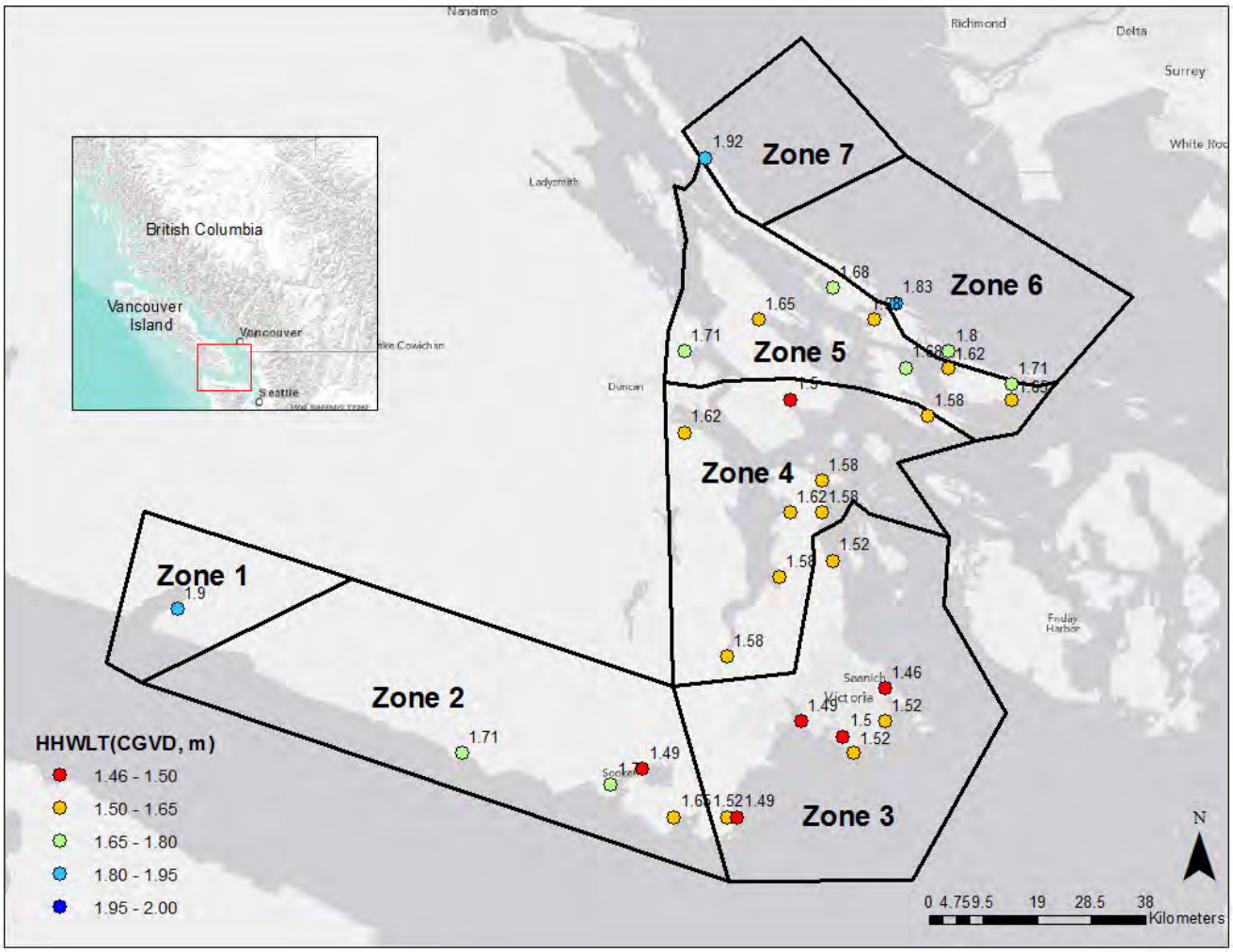
Station	Latitude (deg)	Longitude (deg)	HHWLT (m CD)	MWL (m CD)	HHWLT (m CGVD28)
Saanichton Bay	48.6	-123.383	3.72	2.20	1.52
Sidney	48.65	-123.4	3.63	2.04	1.59
Swartz Bay	48.683	-123.4	3.84	2.26	1.59
Patricia Bay	48.65	-123.45	3.87	2.26	1.62
Brentwood Bay	48.583	-123.467	3.84	2.26	1.59
Finlayson Arm	48.5	-123.55	3.84	2.26	1.59
Cowichan Bay	48.733	-123.617	4.0	2.38	1.62
Maple Bay	48.817	-123.617	4.30	2.59	1.71
Narvaez Bay	48.767	-123.1	4.0	2.35	1.65
Bedwell Harbour	48.75	-123.233	3.84	2.26	1.59
Hope Bay	48.8	-123.267	4.02	2.35	1.68
Samuel Island South	48.8	-123.2	3.99	2.38	1.62
Ganges Harbour	48.85	-123.5	3.96	2.32	1.65
Village Bay	48.85	-123.317	3.90	2.32	1.59
Montague Harbour	48.883	-123.383	4.21	2.53	1.68
Porlier Pass	49.017	-123.583	4.51	2.59	1.92
Crofton	49.867	-123.65	4.21	2.47	1.74
Tumbo Channel	48.783	-123.1	4.30	2.59	1.71
Samuel Island North	48.817	-123.2	4.42	2.62	1.80
Georgina Point	48.867	-123.283	4.51	2.68f	1.83

Source: Canadian Hydrographic Service Tide and Current Tables (Volume 5)

Once converted to the CGVD28 datum, the HHWLT values for each station were mapped to qualitatively evaluate spatial trends in tidal characteristics (Figure 2). Within the CRD study area, values of HHWLT ranged from 1.46 to 2.0 meters; however, HHWLT levels were found to vary systematically and are relatively consistent over spatial scales of tens of kilometers. To capture spatial variability of the observed HHWLT, while also simplifying the inundation mapping, the CRD study area was divided into seven distinct 'Hydrographic Zones' based on similar values of HHWLT (Figure 2).

All coastal waters located within each zone were assigned a representative HHWLT value based on the average of the local HHWLT values at each station encompassed by the zone boundaries. Representative HHWLT values associated with each zone are presented in Section 2.2.3.5.

Figure 2 - Spatial Variability of HHWLT and Hydrographic Zones in CRD Study Area



2.2.3 Future Conditions Water Level Analysis

Once the existing conditions water levels were determined, they were projected to future conditions by adjusting for SLR. The sections below describe the SLR and storm surge scenarios examined to develop the future conditions water levels for inundation mapping.

2.2.3.1 Sea Level Rise

Based on guidance from the MFLNRO Coastal Floodplain Mapping Guidelines and Specifications, the following SLR scenarios were developed for the inundation mapping in the CRD study area:

- 0.5 m increase by 2050.
- 1.0 m increase by 2100.
- 2.0 m increase by 2200.

Regional adjustments based on local vertical land movements were applied to reflect the influence of subsidence and uplift on future SLR conditions at a local scale. Representative rates of ground movement for each Hydrographic

Zone were derived from information presented in the Coastal Floodplain Mapping Guidelines and Specifications and are displayed in Table 3 for the years 2050, 2100, and 2200. For each SLR scenario, the global rates presented above were adjusted to account for the amount of local vertical land movement shown in the table.

Vertical land movements presented in Table 3 consider long-term geological processes occurring over millennia. It should be noted that shorter-term processes, such as rapid subsidence or uplift as a result of a major earthquake, could result in significant changes in ground elevations, thereby warranting the re-evaluation of potential inundation impacts.

Table 3 - Vertical Land Movement for Each Hydrographic Zone in CRD Study Area

		Vertical Land Movement		
Zone	**Rate (mm/year)**	**2050 (m)**	**2100 (m)**	**2200 (m)**
1	-0.4	-0.02	-0.04	-0.08
2	3.1	0.155	0.31	0.62
3	1.1	0.055	0.11	0.22
4	1.1	0.055	0.11	0.22
5	1.1	0.055	0.11	0.22
6	1.1	0.055	0.11	0.22
7	1.1	0.055	0.11	0.22

Note: Positive values indicate zones of uplift and negative values indicate zones of subsidence.

2.2.3.2 Storm Surge

Taking into account the influence of storms on coastal water levels, the MFLNRO Coastal Floodplain Mapping Guidelines and Specifications provides recommendations for incorporating appropriate storm surge scenarios in the determination of design water levels. For highly developed areas of British Columbia such as Victoria, a 500-year (0.2-percent annual chance) magnitude storm surge of 1.3 m is recommended based on work by Ausensco Sandwell (2011a, b). This amount of storm surge was added to the future HHWLT water level to obtain an additional set of extreme tide scenarios considering the influence of storm events on coastal inundation.

2.2.3.3 Wave effects

The presence of breaking wave conditions may further increase the depth of water near the shoreline and will result in wave runup, potentially resulting in erosion and flooding. The extent of flooding will depend on terrain located landward of the shoreline. Wave effects were not included in the analysis, but the MFLNRO Coastal Floodplain Mapping Guidelines provides recommendations for estimating an allowance for wave effects.

2.2.3.4 Freeboard

A nominal freeboard is typically added to the FCL to provide an additional factor of safety, accounting for uncertainties associated with the estimation of the design water level (e.g. 500-year storm surge). The inundation analysis did not take into account freeboard of 0.6 m as noted in the MFLNRO Coastal Floodplain Mapping Guidelines. For the identification of impacts, neglecting freeboard is appropriate, as the inclusion of freeboard in the inundation itself would bias the inundation depths. The SLR scenarios selected for mapping are at the high end of the uncertainty range of the current SLR projections therefore neglecting freeboard for determining inundation depth

and impacts is appropriate. However, when developing the model bylaws, the inclusion of freeboard would be appropriate, as noted in the Guidelines.

2.2.3.5 Inundation Mapping Scenarios

Six inundation scenarios were evaluated as a part of the SLR assessment for the CRD (Table 4). Each SLR scenario – 0.5 m by 2050, 1.0 m by 2100, and 2.0 m by 2200 – was evaluated under two tide conditions: inundation associated with 1) HHWLT (average annual high tide) and 2) extreme high tide (HHWLT plus storm surge).

Table 4 - Future Projections of HHWLT and Extreme High Tide for the CRD Study Area

	Estimated Future HHWLT (including vertical land movement and sea level rise) (m CGVD28)				Estimated Future Extreme High Tide (including vertical land movement and sea level rise) (m CGVD28)			
Zone	**Existing**	**2050**	**2100**	**2200**	**Existing**	**2050**	**2100**	**2200**
1	1.9	2.42	2.94	3.98	3.2	3.72	4.24	5.28
2	1.7	2.05	2.39	3.08	3.0	3.35	3.69	4.38
3	1.5	1.95	2.39	3.28	2.8	3.25	3.69	4.58
4	1.6	2.05	2.49	3.38	2.9	3.35	3.79	4.68
5	1.7	2.15	2.59	3.48	3.0	3.45	3.89	4.78
6	1.8	2.25	2.69	3.58	3.1	3.55	3.99	4.88
7	1.9	2.35	2.79	3.68	3.2	3.65	4.09	4.98

*Note 1: Future water levels include global SLR projections with local adjustments for vertical land motion at 2050, 2100, and 2200, as described in Section 2.2.3.1 (Table 3). Allowance for regional uplift or subsidence for each time period was calculated using vertical land movement values taken from Table 3. The formula is as follows: Allowance for Regional Uplift or Subsidence = Vertical Land Movement x (-1). Example calculation: Zone 1 (2050) = Existing HHWLT (1.9 m) + Subsidence (-0.02 * -1) + Sea Level Rise (0.50 m) = 2.42 m. Subsidence values increase the amount of relative sea level rise; uplift values decrease the amount of relative sea level rise. The extreme tide scenarios include a 500-year storm surge magnitude of 1.3 m..*
Note 2: The Canadian Hydrographic Service is in the process of updating local luni-tidal based HHWLT estimates, which are consistent with provincial sea level rise mapping guidelines and used in this study, to values established using a new datum calculator program."

2.2.4 Inundation Map Development

Once the relevant water level statistics were generated for the six inundation mapping scenarios, the inundation maps were generated utilizing methodologies developed by the NOAA Coastal Services Center (Marcy et al., 2011).

2.2.4.1 Topographic Data

AECOM used topographic and bathymetric data provided by the CRD and public sources to develop a 1-meter resolution seamless topographic-bathymetric Digital Elevation Model (DEM). This dataset was leveraged from the DEM created for the CRD Modelling of Potential Tsunami Inundation Limits and Run-up study (AECOM, 2013). The DEM forms a single, bare earth surface that extends from open water up to a specified interior land surface elevation. An interior contour elevation of 10 m CGVD28 was used as the upland cutoff. Although more recent 2013 LiDAR data was available from the CRD, a digital elevation model could not be created from this LiDAR data within the timeframe and budget for this project. The 2013 LiDAR was used to spot check elevation data within the sea level rise focus areas.

2.2.4.2 Water Surface DEM Creation

The initial step in creating the inundation maps was to create the inundated water surface, or DEM. Projected SLR and storm surge were added to the tide scenarios to develop the tidal water surface over the open water portion of the CRD study area for each of the six inundation scenarios.

The water surface DEM was extended inland to project the water surface over the inundated topography. It should be noted that the water surface DEM is simply an extension of the tidal water surface at the shoreline over the inland topography. This represents a generalized estimate of the inland inundated water surface. This step does not take into account the associated physics of overland flow, wave dissipation, levee overtopping, or potential shoreline erosion associated with extreme water levels and waves. In order to account for these processes, a more sophisticated modelling effort would be required.

2.2.4.3 Inundation Depths

Depth and extent of flooding raster files were created by subtracting the land-surface DEM from the water surface DEM. Both DEMs were generated using a 2-meter horizontal resolution with the same grid spacing in order to allow for grid cell-to-grid cell subtraction. The resultant DEM provides both the inland extent and depth of inundation (in the absence of considering hydraulic connectivity).

The final step in creating depth and extent of flood maps relies on an assessment of hydraulic connectivity. The methodology described by Marcy et al. (2011) employs two rules for assessing whether or not a grid cell is inundated. A cell must be below the scenario water level, and it must be connected to an adjacent grid cell that was either flooded or open water. NOAA's methodology applies an "eight-sided rule" for connectedness, where the grid cell is considered "connected" if any of its cardinal or diagonal directions are connected to a flooded grid cell. This approach decreases the inundated area over earlier inundation methods that considered a grid cell to be inundated solely based on its elevation (i.e., all grid cells with elevation below the reference water level were shown as inundated, even if they were separated from the flood source by topographic high ground).

The assessment of hydraulic connectivity removes areas from the inundation zone if they are protected by levees or other topographic features that are not overtopped. It also removes areas that are low-lying, but inland, and not connected to an adjacent flooded area.

2.2.4.4 Inundation Mapping Caveats

The Provincial Coastal Floodplain Mapping Guidelines and Specification document provides the following notations for use with floodplain maps:

- Under the provisions of the Flood Hazard Statutes Amendment Act, 2003 (Bill 56), local governments have the role and responsibility for making decisions about local floodplain development practices, including decisions about floodplain bylaws within their communities. Information on floodplain management guidelines can be found in the BC Flood Hazard Area Land Use Management Guidelines.
- Users must note the dates of base mapping, aerial photography, ground or bathymetric surveys and issue of mapping relevant to dates of development in the map area. Subsequent developments or changes within the floodplain or channel will affect flood levels and render site-specific map information obsolete.
- The accuracy of the location of a floodplain boundary as shown on this map is limited by the base topography. It is generally assumed to be plus or minus one-half the increment of the ground contours.

- The floodplain limits are not established on the ground by legal survey. A site survey is required to reconcile property location, ground elevations and designated flood level information. Building and floodproofing elevations should be based on field survey and established benchmarks.
- Flooding may still occur outside the defined floodplain boundary and the local government does not assume any liability by reason of the failure to delineate flood areas on this map.
- The required or recommended setback of buildings from the natural boundaries of watercourses to allow for the passage of floodwaters and possible bank erosion is not shown. This information is available from the local government. In addition, site-specific setbacks from the floodplain limit must be considered.
- Flood construction level is based on a global sea level rise described in Section 2.2.3.1. This may need to be revised to reflect updated future sea level rise values.

2.3 Identification of key assets

2.3.1 Use of Key Assets

This project used the identification of important shoreline assets in order to:

- Develop SLR Focus Areas that provide coverage across areas containing important assets (see section 2.4).
- Develop a shortlist of public assets for which valuation data would be compiled (see section 2.9).

The definition of Key Assets used for this project was:

Physical infrastructure and buildings that provide important services to the community. Key Assets include:

- *Transportation assets such as transportation infrastructure (rail lines, airports, highways),*
- *Utility Asset such as utility infrastructure (water and wastewater treatment plants, power plants and their key transmission and distribution lines),*
- *Community Assets such as public health and safety facilities (hospitals, police and fire stations).*
- *Business assets such as major employers, such as schools, universities, government, and large businesses.*

This definition was used as the basis for compiling relevant data provided by CRD (see section 2.3.2) and for eliciting input and review from regional municipalities / electoral areas through a workshop (see section 2.3.3).

The Key Assets identified for each of the SLR Focus Areas are reported in Appendix B and summarised in Table 11.

2.3.2 Spatial data

The following spatial data were used to develop a preliminary list of Key Assets:

- BC Assessment Actual Use Codes with values higher than 610. These codes correspond to non-residential parcels of land that may have important institutional, commercial or utility assets.
- CRD stormwater and sanitary key assets database – key structures layer.
- CRD water assets database – data layers for network structures, water structures and containment structures.
- CRD Atlas Civic Sites layer.

A 6 metre contour line was used as a conservative approximation of potential SLR and storm surge scenarios[1], and the assets shown by these spatial data layers that were within this 6 metre contour were identified. The definition of Key Asset (section 2.3.1) was used to shortlist those assets that would be classified as Key Assets.

2.3.3 Workshop

A workshop with representatives from regional municipalities and electoral areas was conducted with the objective of reviewing the preliminary set of Key Assets and gaining participant review of this list and suggested additions to the list. In advance of the meeting the participants were asked to identify the Key Assets that exist in shoreline areas of their respective municipalities and electoral areas. The definition of Key Assets and a list of specific asset types was sent to participants to help them identify assets in advance of the meeting.

The workshop was facilitated by using ArcGIS software to take participants through all coastal areas of the CRD, showing the locations of the Key Assets included in the preliminary list, and asking participants to identify other Key Assets that had not been recorded in the preliminary list.

2.4 Definition of Sea Level Rise Focus Areas

This project was concentrated on the mapping and analysis of a series of SLR Focus Areas that had relatively high levels of future inundation and / or with key community assets present in areas that would be inundated. There was also a preference to include SLR Focus Areas for a range of the regional municipalities / electoral areas. SLR Focus Areas were defined based on a set of guiding principles, rather than strict, rule-based criteria that had to be adhered to in all cases. This approach recognised that there were trade-offs and subjective judgements to make in achieving the inclusion of a range of representative areas while also having an objective and transparent basis for SLR Focus Area definition.

The selected principles for guiding the selection of SLR Focus Areas were:

1. Each SLR Focus Area should be defined to:
   a) Contain one or a small number of different types of land use. This helps avoid having significant mixes of urban / rural and developed / undeveloped land within each SLR Focus Area.
   b) Contain areas with similar topography. This helps ensure that the summary data for each SLR Focus Area are representative, rather than masking a high level of variability in the level of inundation that occurs across the shoreline of the area.
   c) Contain at least one key asset that is highly important locally or regionally. This helps ensure that the selected areas are of importance in relation to potential risks from SLR.
   d) Avoid crossing municipal / electoral area boundaries. Where candidate SLR Focus Areas cross a boundary separate SLR Focus Areas should be developed for each municipality or electoral area. This division will help support future use of these SLR Focus Areas for consideration in bylaw development at the individual municipality or electoral area level.
2. The land-ward limit of each SLR Focus Area will be the Floodplain Limit for the selected Scenario of 2100 + 500-year storm surge. This land-ward limit is defined as per Figure 2-4 of the Provincial Coastal Floodplain Mapping Guidelines and Specifications (BC Ministry of Forests, Lands and Natural Resource Operations, 2011). Lateral limits were also defined for the SLR Focus Areas in order to allow separate areas to be defined and be subject to the land use and economic analysis conducted for this project. The selected scenario of 2100 + 500-year storm surge was proposed to and accepted by CRD for use in the land use and economic

[1] *A basic scenario was used for this task as it was undertaken prior to completion of the inundation mapping for different SLR and storm surge scenarios.*

analysis on the basis that it is a time horizon that would include identifiable SLR effects, and uses the storm surge period recommended by the provincial guidelines. The maps in Appendix A for this scenario show the lateral limits (marked as the 'Economic Impact Analysis Area') that define each SLR Focus Area for use in the land use and economic analysis described in sections 2.5 to 2.9.

3. The set of selected SLR Focus Areas should:
   a) Include at least one SLR Focus Area for each regional municipality / electoral area that would experience coastal effects from SLR.
   b) Include SLR Focus Areas for a broadly representative variety of different land uses, critical assets and stages of development.

2.5 Land Use Analysis

The existing land use and key infrastructure present within each SLR Focus Area were identified for those areas within the 2100 + 500-year storm surge scenario inundation line. This inundation line was developed through the mapping described in section 2.2.4, and includes all land that would be flooded for the 2100 + 500-year storm surge scenario. Land use and key infrastructure were identified through the use of six different sets of data analysis:

- **Recorded actual use.** As part of the property assessment system, BC Assessment provides a record of actual uses for each parcel of land. There are over 200 categories of actual use, with each parcel of land being assigned one of these categories. BC Assessment actual use data for 2013 were spatially linked to each parcel registered in the CRD's cadastral data layer. The total area of different actual use categories was calculated and is provided in tabulated form for each SLR Focus Area in Appendix B. These data provide an indication of the *current* uses of land at a relatively fine resolution.
- **Zoning.** Each municipality and electoral area defines different zoning types for land within their areas. The total area of land for each zoning type was calculated for each SLR Focus Area and is provided in tabulated form for each SLR Focus Area in Appendix B. These data provide an indication of the *permitted* uses of land at a relatively coarse resolution.
- **First Nation Reserves.** Spatial data for First Nations reserve land was used to identify the presence of any reserves within each SLR Focus Area. Where a reserve is present the area of that reserve within the inundation line is given for each SLR Focus Area in Appendix B.
- **Road and rail.** CRD spatial data sets were used to identify the presence and length of road and rail within the inundation line for each SLR Focus Area. Attribute data were used to allow a breakdown of road distances by different categories of road type and number of lanes. Data are reported for each SLR Focus Area in Appendix B.
- **Major pipeline and transmission line.** Spatial datasets were used to identify the length of any key pipelines or major electric transmission lines present within the inundation line for each SLR Focus Area. The presence of any key part of the major pipeline and transmission systems are reported for each SLR Focus Area in Appendix B. Local pipeline and transmission systems (i.e. to localised areas for domestic distribution) were not reported as key assets.
- **Bridges.** Bridge elevation data were provided by CRD for selected bridges within regional coastal areas. From this list of selected bridges, those that would be inundated within each SLR Focus Area for the selected 2100 + 500-year storm surge scenario are identified in Appendix B. Due to limitations in data accuracy for elevation of bridge structures, the bridge features shown in Appendix A maps should not be relied upon to determine if bridges would be inundated for the selected scenarios. If required for planning, site-specific analysis should be undertaken to determine the precise extent or level of inundation for these and other bridges across the CRD.

Spatial data were used to compile attribute data for each feature (e.g. parcel of land, length of road) that exists within the 2100 + 500-year storm surge scenario inundation line. For features that crossed over that inundation line only

the extent of the attribute (e.g. area, length) that exists inside the line was used. For example, if a parcel of land was 70% in the inundation line and 30% outside, only the 70% within the inundation line was included in the calculations.

2.6 Identification of Physical Shoreline Characteristics

The provincial BC Parks Shoreline Sensitivity to Sea Level Rise Model (BC Parks, undated) provides data on the physical shoreline type and sensitivity to SLR for all parts of the CRD coastline, as well as other parts of the province. This dataset was used to calculate two measures, both of which are reported in Appendix B:

- **Shoreline Type.** The model provides a determination of which category of foreshore type best applies to each segment of shoreline. The model uses a series of categories based on substrate, width and slope characteristics.
- **Sensitivity Rating.** The model provides an overall sensitivity to SLR rating for each segment of shoreline. This rating is based on separate sensitivity ratings derived for foreshore (based on substrate, width, slope, sediment mobility and exposure) and backshore (based on slope and coastal habitat type), with the most sensitive rating of the two being used for the overall sensitivity rating.

Appendix B provides a summary of the total length for each Shoreline Type and Sensitivity Rating category within the inundation line for the year 2100 + 500-year storm surge. The BC Parks Shoreline Sensitivity to Sea Level Rise Model report describes the relationship between shoreline type and sensitivity to SLR rating.

2.7 Valuation of Land and Improvements

The valuation of land and improvements[2] is based on BC Assessment data that represent an assessed market value for each property. BC Assessment's data were spatially linked to each parcel registered in the CRD's cadastral data layer. The market value assessment data were summed for land and for improvements present within the 2100 + 500-year storm surge inundation line for each SLR Focus Area. For parcels that crossed over that inundation line the valuation data were assigned proportionally to the area of land that is inside of the inundation line. As such, the analysis cannot account for the position of infrastructure (e.g. building footprints) within the parcel in relation to the inundation line[3]. Any area of the parcel within the inundation line that also extends beyond the shoreline to the ocean was also included in the valuation. This is particularly relevant for the Inner Harbour where there are a number of marine parcels, such as those that contain marine infrastructure.

Data analysis was conducted by AECOM using BC Assessment 2013 data and the method stated above. This analysis was then updated by CRD using BC Assessment 2014 data and refined cadastral data, and is reported in this report.

The total assessed market values are provided in Appendix B for each of the following categories of property:

- Residential
- Commercial
- Civic, Institutional And Recreational
- Transportation, Communication, And Utility
- Industrial
- Mining And Allied Industries
- Farm

[2] *Improvements are defined by BC Assessment as "any building, fixture, or other similar structure attached to land or another improvement".*

[3] *Spatial data on building footprints for the CRD region were reviewed and did not provide sufficient coverage across the region to allow for an analysis based on precise building location to be developed.*

- Forest & Allied Industry

The valuation data used for this task represent market values and should not be interpreted as the total financial cost or economic impact of SLR in these SLR Focus Areas. Actual property impact costs will be determined by:

- The level of adaptation that takes place prior to effects arising from SLR.
- The frequency and depth of inundation events that occur following SLR, and the impact that this has to property.

Within the scope of this project the BC Assessment data has been the sole data source for the aggregated data provided in Appendix B. For some publically owned properties that have not been subject to sale or have unique or restricted uses the extent to which BC Assessment valuation fully reflects market valuation would have to be reviewed and validated before using those valuation data for any further analysis.

The limitations of the BC Assessment data for estimating market value are:

- BC Assessment data for cadastral parcels registered on Indian Reserve land were not available for use in the valuation of land, and so the valuations provided in this report do not include the Indian Reserve land recorded in Appendix B. This is relevant to the valuation developed for the Port Renfrew and Island View SLR Focus Areas as these have relatively high areas of Indian Reserve land within the Focus Area. The valuation data for these two areas should be interpreted as low-end estimates that do not include the area of land in Indian Reserve (as stated in Appendix B) within the valuation.
- For the small number of other cadastral parcels that do not have an associated valuation in the BC Assessment database, a check was undertaken using 2013 BC Assessment data to determine if their absence from the analysis could significantly alter the total valuation estimates. The only other SLR Focus Area that includes a significant parcel without an associated valuation is in the Patricia Bay SLR Focus Area, where 23% of the assessed area did not have associated valuation data. For other SLR Focus Areas there were either no or minor (e.g. a few percentage points of total land area) levels of cadastral parcels without associated valuation data, or the cadastral parcels without valuation data would not significantly alter the valuation, because: they are undeveloped water lots that have been surveyed as cadastral parcels but do not have any identified development or economic use (present in the Jordan River and Highway 14 south of Shirley SLR Focus Areas), they are undeveloped water lots and relatively small parts of shoreline park (Gorge Esquimalt SLR Focus Area), or they are a single water lot (Central Ganges SLR Focus Area).

Within these limitations, the total valuation data presented in Appendix B should be interpreted as the total market value of property within areas that may be inundated in the 2100 + 500-year storm surge scenario. These valuation data are relevant as being *broadly indicative* of the values of land and improvements that may be at risk from effects from SLR. These are present day valuations and have not been discounted or in any other way altered to reflect that potential effects relate to a future time period. They do not include other costs associated with disaster recovery.

2.8 Valuation of Roads

This project developed and used replacement costs per unit length of road to calculate the total value of roads that are within the inundation line for the 2100 + 500-year storm surge scenario. These costs per unit length of road were applied to the total distances of road identified within the inundation line. The assumed replacement cost per unit length of road were estimated using AECOM in-house experience. Current unit costs for materials (asphalt course, crushed base course, sub grade/sub base) were used to develop estimates based on typical roadway design with shoulders of 1.5 m width, and lane width of 3.6 m, and road materials thicknesses as per Table 5. These stated road materials thicknesses are assumptions based on AECOM experience of roads in comparable conditions. In reality, roads will be built with thickness designed for site-specific conditions. The assumptions provide a reasonably indicative basis for deriving the cost estimates used to value road assets within the CRD.

The cost estimates are present day costs and have not been discounted or in any other way altered to reflect that potential effects relate to a future time period. They do not include other costs associated with disaster recovery.

Table 5 - Assumed Road Construction Material Thicknesses

Road Type	Arterial	Collector	Local
AC thickness	0.15 m	0.15 m	0.1 m
CBC thickness	0.3 m	0.2 m	0.2 m
SGSB thickness	0.5 m	0.4 m	0.3 m

(AC = asphalt course; CBC = crushed base course; SGSB – sub grade / sub base)

Construction costs also include estimates for keying in the road. Road appurtenances have been estimated and assumed to consist of ditches and central barriers for arterials, curbs for collectors, and curb and sidewalk for local roads. Detailed estimates of the different minor 2-lane road categories (restricted, strata, resource, recreation and service) was not possible within the scope of this work. They have been conservatively assumed to have the same cost as the 'local' 2-lane road category. The ferry 2-lane category has been assumed to be equal to an arterial lane.

The cost assumptions used for this project are applied to the category of road given in the attribute data provided in the CRD roads data layer (Table 6).

Table 6 - Cost assumptions used for different road types

Road type	Cost ($/m)	Road type	Cost ($/m)
Arterial minor and major		**Highway**	
Arterial Lane-2	$1,190	Highway	$1,850
Arterial Lane-3	$1,550	**Other 2 lane**	
Arterial Lane-4	$1,850	Restricted Lane 2	$770
Collector minor and major		Strata Lane 2	$770
Collector minor Lane-2	$870	Ferry Lane-2	$1,190
Collector minor Lane-3	$1,180	Resource Lane-2	$770
Collector minor Lane-4	$1,530	Recreation Lane-2	$770
Local		Service Lane 2	$770
Local Lane 1	$620		
Local Lane-2	$770		
Local Lane-3	$980		
Local Lane-4	$1,230		

2.9 Valuation of Key Public Assets

Valuation estimates were compiled for the key public assets that are present within the 2100 + 500-year storm surge scenario inundation line for the selected SLR Focus Areas. CRD and regional municipalities / electoral areas provided valuation data for a shortlist of publically-owned assets identified during the 'Identification of Key Assets' task (section 2.3). The valuation data were generally provided on a 'Cost of Reproduction New' or replacement cost basis, and so represent the full cost to reproduce the property in like kind and materials in accordance with current market prices. As with private property (see section 2.7) this valuation should not be interpreted as the total financial

cost or economic impact of SLR effects on these public assets. They do not include other costs associated with disaster recovery. Actual impact costs will be determined by:

- The level of adaptation that takes place prior to effects arising from SLR.
- The frequency and depth of inundation events that occur following SLR, and the impact that this has to property.
- Costs to acquire any new land for redevelopment of replacement assets and any extra costs incurred for developing in those new areas.

The valuation data for each of the public Key Assets presented in Appendix B should be interpreted as the total replacement cost of the public assets that exist within areas that may be inundated in the 2100 + 500-year storm surge scenario. These valuation data are relevant as being *broadly indicative* of the value of those selected public assets that may be at risk from SLR.

2.10 Service Disruption

The project included the development of three high-level case studies to characterize the potential service disruption and related economic effects that could arise from SLR. These case studies relate to each of the following three types of assets of importance to the CRD region:

- A transportation asset (case study of Highway 14, south of Shirley);
- A residential community (case study of Oak Bay / Windsor Park);
- A major business center (case study of Victoria's Inner Harbour).

These case studies were selected in consultation with CRD staff and were selected based on the anticipated inundation that would occur for the year 2100 + 500-year storm surge scenario.

The key economic costs of temporary service disruption caused by storm surge generated inundation are expected to include:

- Foregone revenues of businesses that cannot operate and related lost wages to employees;
- Extra costs incurred from both providing alternative service provision, where applicable, and repairing damaged service delivery infrastructure;
- Benefits lost to users from not being able to use the service and subsequent costs to users for utilizing alternative service options.

For each of the case studies, AECOM developed high-level estimates of the costs of these impact types to arrive at a total gross operational cost. Gross operational costs include all the above costs, with the exception of repairing damaged infrastructure.

The resulting estimates are meant to provide an order-of-magnitude understanding of potential impacts of disruption arising from SLR, *in present economic terms*. This analysis does not project changes in transportation mode shifts, business revenue, or population, which will ultimately determine future economic impacts. Instead, the case studies adopted a replicable methodology for assessing potential economic impacts according to existing economic conditions, using publically available data whenever possible. It is the intent of this analysis that each case study's methodology could be applied across the other Focus Areas or for other jurisdictions.

The "Total Economic Impact" of a case study is a gross measure of economic impact, which aggregates a series of metrics estimating externalities posed to different groups. The externalities considered in the following case studies are often interdependent and overlapping. For example, the business case study includes metrics of lost revenue, lost worker productivity, and lost sales tax revenue resulting from inundation impacting the Inner Harbour. Wage, output, and tax impacts are aggregated to determine the gross economic impact.

The service disruption valuation for all case studies is constrained by available model metrics. The selected metrics differ for each case study as they are designed to describe impacts to the specific asset types that are the focus for each case study. As a result, the service disruption valuation given each of the three case studies does not reflect the *total* service disruption effects for each Focus Area. For example, the transportation case study only includes relevant transportation metrics and so the valuation given for the Focus Area studied for that case study does not include other service disruption effects. For future work the metrics used across the three case studies could be applied together to each Focus Area in order to provide a more comprehensive valuation of total service disruption costs.

A detailed description of the methods used for these case studies is provided in Appendix C.

2.11 Summary of Source Data

For ease of reference, Table 7 lists the source data used for inundation mapping, identification of existing land use, and valuation of land and infrastructure. AECOM has not undertaken any validation of the accuracy of the data provided from these external data sets.

Table 7 - Summary of data sources used for project analysis

Land use / asset type	Data layer and attributes to report
Actual Land Use	• CRD data 'cdCadastre', attribute JUROL. • BC Assessment database – table 'tblValuation', column Actual_Use, linked by JUROL.
Zoning	• CRD data 'Municipal Zoning 2008', attribute ZoningCode • For Juan de Fuca: CRD data 'jfZoning', attribute Zoning Code.
First Nation Reserves	• CRD data 'adFirstNationReserves'
Physical Shoreline	• Provincial Shoreline Sensitivity Model layers 'StraitofGeorgia.kmz' and 'Juandefuca.kmz'.
Road	• CRD data 'trRoads', attributes: Road SubClass, Road Surface Type, Number of Lanes.
Rail	• CRD data 'trRail'.
Major Gas Pipeline	• Canvec data layer 'Pipeline' • Fortis BC gas distribution layer. This data layer shows the whole distribution system and was used to identify only the key parts of the system that could affect more regional supply.
Major Transmission Line	• Canvec data layer 'Transmission'
CRD stormwater and sanitary key assets – Discharge Points	• **C**RD's SanitaryStormwaterData.mdb, data layer ssDischargePoint.lyr
CRD stormwater and sanitary key assets – key structures	• CRD's SanitaryStormwaterData.mdb, data layer NetworkStructure.lyr
Key bridge assets	• Bridge elevation data for selected key bridges, provided by CRD. Data based on 2013 Lidar, NRC 2007 Lidar and Provincial TRIM.
Water Assets	• CRD's CRDWaterSupplyData.mdb, data layer s Network Structure.lyr, WaterStructure.lyr, ContainmentStructure.lyr.
Market value of land and improvements	• CRD data 'cdCadastre', attribute JUROL. BC Assessment database – table 'tblValuation', columns Land_1 to Land_10, Improvements_1 to Improvements_10. • BC Assessment database – table 'tblActualUse', columns Actual_Use and Type_Of.

3. Results

3.1 Sea Level Rise Focus Areas

A total of 24 SLR Focus Areas were defined (Table 8). These include at least one area for all regional municipalities and electoral areas apart from the City of Langford and the District of Highlands (Table 9). The location of these SLR Focus Areas is mapped in Figure 3.

Table 8 - List of SLR Focus Areas and their municipality or electoral area

#	Name	Municipality / Electoral Area
1	Port Renfrew	Juan de Fuca Electoral Area
2	Jordan River	Juan de Fuca Electoral Area
3	Highway 14 south of Shirley	Juan de Fuca Electoral Area
4	Milnes Landing	District of Sooke
5	Albert Head Lagoon	District of Metchosin
6	Esquimalt Lagoon	City of Colwood
7	Gorge – View Royal	Town of View Royal
8	Gorge – Saanich	District of Saanich
9	Gorge Industrial and Redevelopment Land	City of Victoria
10	Esquimalt DND Naval	Township of Esquimalt
11	Gorge - Esquimalt	Township of Esquimalt
12	Inner Harbour	City of Victoria
13	Ogden Point	City of Victoria
14	Dallas Road	City of Victoria
15	Oak Bay Windsor Park Area	District of Oak Bay
16	Cadboro Bay	District of Saanich
17	Island View Beach	District of Central Saanich
18	Patricia Bay	District of North Saanich
19	South Sidney	Town of Sidney
20	Tsehum Harbour – Sidney	Town of Sidney
21	Tsehum Harbour – North Saanich	District of North Saanich
22	Fulford Harbour	Salt Spring Island
23	Central Ganges	Salt Spring Island
24	Galliano – north of Sturdies Bay	Southern Gulf Islands

Table 9 - Count of SLR Focus Areas in each municipality and electoral area

Municipality or Electoral Area	Count	Municipality or Electoral Area	Count
City of Victoria	4	Town of View Royal	1
Juan de Fuca Electoral	3	District of Oak Bay	1
Salt Spring Island	2	District of Metchosin	1
Town of Sidney	2	City of Colwood	1
Township of Esquimalt	2	District of Central Saanich	1
District of North Saanich	2	Southern Gulf Islands	1
District of Saanich	2	City of Langford	0
District of Sooke	1	District of Highlands	0

3.2 Inundation Mapping

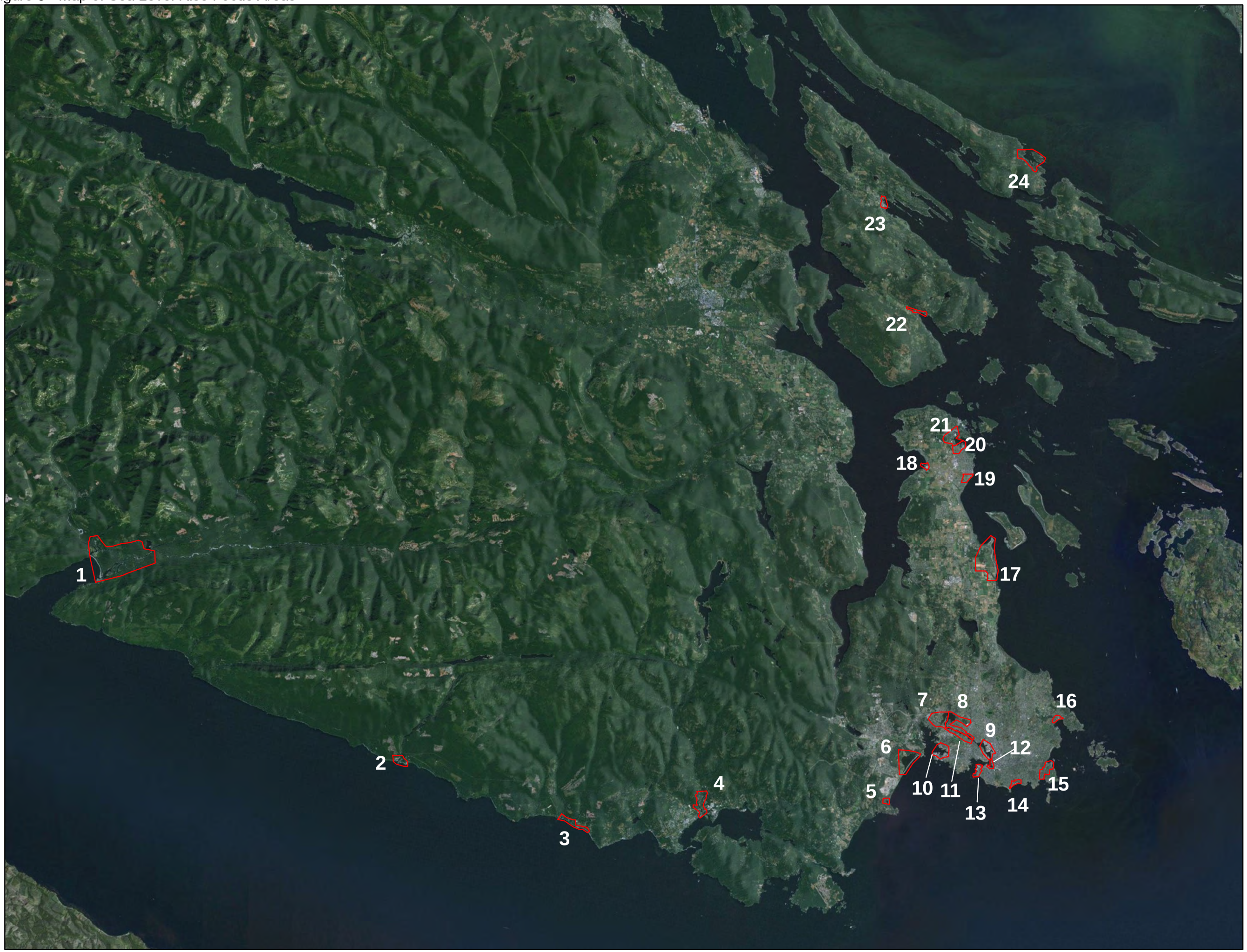
Example inundation maps for the Oak Bay Windsor Park Area are provided in Figure 4 with the full series of maps for all Focus Areas provided in Appendix A Map Book. Figure 4 is a series of maps for the different scenarios, presented in the following order:

- HHWLT + 0.5m SLR (year 2050 scenario)
- HHWLT + 0.5m SLR (year 2050 scenario) + 1.3m storm surge (500-year).
- HHWLT + 1m SLR (year 2100 scenario)
- HHWLT + 1m SLR (year 2100 scenario) + 1.3m storm surge (500-year).
- HHWLT + 2m SLR (year 2200 scenario)
- HHWLT + 2m SLR (year 2200 scenario) + 1.3m storm surge (500-year).

For the purposes of the land use and economic analysis (see sections 2.5 to 2.9) and calculation of inundation depths (see Table 10), the maps for the HHWLT + 1m SLR (year 2100 scenario) + 1.3m storm surge (500-year) scenario show a 'Economic Impact Analysis Area' polygon that gives the lateral definition of the SLR Focus Area, as described in Section 2.4. The polygon is generally drawn alongside or from roads and road junctions that are present close to but outside of the inundation line. Where this is not possible (e.g. lack of road infrastructure close to the inundation line) other land features have been used to provide the definition for this area.

Table 10 describes the inundation depths that would occur within the inundation line for the selected year 2100 + 500-year storm surge scenario.

Figure 3 - Map of Sea Level Rise Focus Areas



Capital Regional District
Inundation Mapping

Focus Areas

1 - Port Renfrew
2 - Jordan River
3 - Highway 14
4 - Milnes Landing
5 - Albert Head Lagoon
6 - Esquimalt Lagoon
7 - Gorge View-Royal
8 - Gorge View-Saanich
9 - Gorge View-Industrial Land
10 - Esquimalt DND
11 - Gorge View-Esquimalt
12 - Inner Harbour
13 - Ogden Point
14 - Dallas Road
15 - Oak Bay Windsor Park
16 - Cadboro Bay
17 - Island View Park
18 - Patricia Bay
19 - South Sidney
20 - Tsehum Harbour-Sidney
21 - Tsehum Harbour-North Saanich
22 - Fulford Harbour
23 - Central Ganges
24 - Galliano Island

N

0 2,700 5,400 10,800 Meters

CAPITAL REGIONAL DISTRICT

AECOM

Projection:
UTM Zone 10N, North American Datum 1983

Date: 5/5/2014

Figure 4 - Inundation maps for the Oak Bay Windsor Park Area SLR Focus Area

Provided as a separate document due to large file size.

Table 10 - Level of inundation for each SLR Focus Area (2100 + 500-year storm surge scenario)

			Area inundated by each depth interval (square km)								
Focus Area	Low-lying Disconnected Area (square km)	Total Area Inundated (square km)	0 - 50 cm	50 - 100 cm	100 -150 cm	150 - 200 cm	200 - 250 cm	250 - 300 cm	300 - 350 cm	350 - 400 cm	> 400 cm
Port Renfrew	0.01	7.78	1.06	0.41	1.91	0.65	2.67	0.19	0.47	0.05	0.37
Jordan River	0.00	0.37	0.08	0.12	0.05	0.03	0.02	0.02	0.02	0.03	0.00
Highway 14	0.00	0.53	0.03	0.05	0.08	0.03	0.02	0.02	0.02	0.00	0.00
Milnes Landing	0.01	0.49	0.05	0.06	0.06	0.06	0.10	0.09	0.07	0.00	0.00
Albert Head Lagoon	0.00	0.11	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Esquimalt Lagoon	0.00	0.33	0.03	0.05	0.09	0.05	0.04	0.03	0.04	0.00	0.00
Gorge View Royal	0.00	0.25	0.06	0.07	0.06	0.03	0.02	0.01	0.00	0.00	0.00
Gorge Saanich	0.00	0.23	0.05	0.05	0.05	0.03	0.03	0.02	0.00	0.00	0.00
Gorge Industrial Land	0.01	0.17	0.07	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.00
Esquimalt DND Naval	0.00	0.27	0.06	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.10
Gorge Esquimalt	0.00	0.10	0.03	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.00
Inner Harbour	0.00	0.03	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Ogden Point	0.00	0.14	0.11	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dallas Road	0.00	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oak Bay Windsor Park	0.00	0.38	0.11	0.15	0.09	0.03	0.00	0.00	0.00	0.00	0.00
Cadboro Bay	0.00	0.17	0.02	0.02	0.02	0.03	0.06	0.00	0.00	0.02	0.00
Island View Park	0.00	1.46	0.03	0.03	0.07	0.18	0.23	0.56	0.30	0.06	0.00
Patricia Bay	0.00	0.17	0.04	0.02	0.00	0.00	0.00	0.00	0.01	0.10	0.00
South Sidney	0.00	0.21	0.05	0.08	0.06	0.02	0.00	0.00	0.00	0.00	0.00
Tsehum Harbour-Sydney	0.00	0.13	0.03	0.03	0.03	0.01	0.00	0.00	0.03	0.00	0.00
Tsehum Harbour-North Saanich	0.00	0.38	0.07	0.07	0.07	0.04	0.02	0.03	0.08	0.00	0.00
Fulford Harbour	0.00	0.09	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.02
Central Ganges	0.00	0.05	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Galliano Island	0.00	0.15	0.02	0.03	0.02	0.02	0.03	0.04	0.00	0.00	0.00

3.3 Land Use, Roads and other Infrastructure

Appendix B provides the results of data analysis for actual land use, zoning, First Nation reserves, roads, transmission lines and pipelines for each SLR Focus Area. The only rail infrastructure identified was part of the E&N rail line in Focus Area number 9.

3.4 Shoreline Type and Sensitivity Rating

Appendix B provides the results of data analysis for Shoreline Type and Sensitivity Rating for each SLR Focus Area. The data show presence of a wide range of shoreline types and sensitivity ratings across the SLR Focus Areas, including different natural coastal classes as well as man-made classes. Sensitivity ratings to SLR are generally classed as Very High or High.

3.5 Identification and Valuation of Key Public Assets

The set of key public assets that were included for valuation as part of this project are listed in Table 11. This includes only those assets for which valuation data were available from CRD and municipalities and received within project reporting timescales. The basis for valuation is provided in the table and is typically replacement cost. This is one measure of asset value and does not indicate expected level of financial impact to the asset or any associated disaster recovery costs that could arise as a result of inundation. If these valuation data are used for planning purposes they should be verified and updated by CRD and / or municipalities and electoral area staff.

The key public assets that are included in this valuation and are present within the 2100 + 500-year storm surge inundation line are principally sewage and water pump stations, with a small number of buildings that provide other public services, including the City of Victoria public works yard and Ganges library. Appendix B provides a list of all key assets identified, including those for which valuation data were not available from CRD and municipalities. Within the scope of this project AECOM has not field-verified the asset data used for the study. Verification of asset locations should be completed prior to any site-specific planning or other work related to these locations.

Table 11 - List of key public assets that were included for valuation

Key public asset	SLR Focus Area #	Valuation	Basis for valuation
Port Renfrew Wastewater Treatment Plant plus 2 facilities marked as WTP disinfection facility for water	1	$654,400	Data provided for "Port Renfrew Sewage Treatment Plant". The data is for the "Cost of Reproduction New" value, as of November 2013's appraisal.
205 Portsmouth Drive Lift Station (Sewage)	6	$350,000	205 Portsmouth Drive lift station was installed in 2006 at an approximate cost of $350,000.
3301 Ocean Blvd Lift Station (Sewage)	6	$800,000	3301 Ocean Blvd lift station was installed in 2003 at an approximate cost of $800,000.
Esquimalt Lagoon Bridge	6	$2,500,000	Cost estimate of $2,500,000 to replace the entire bridge, developed in 2008.
Helmcken Park Pump Station (Sewage)	7	$275,900	2006 appraisal data.
Midwood Pump Station (Sewage)	7	$275,000	Up-to-date replacement cost estimate, but not based on formal appraisal.
Colquitz Pump Station (Sewage)	8	$265,600	Based on Cost of Reproduction New.
Dunkirk Lane Pump Station (Sewage)	8	$409,400	Based on Cost of Reproduction New.
Dysart Pump Station (Sewage)	8	$857,300	Based on Cost of Reproduction New.
Garbally Pump Station (Sewage)	9	$400,000	Installed in 1980, cost estimate of $400,000.
Harbour Pump Station (Sewage)	9	$420,000	Installed in 2007, cost estimate of $420,000.
Lower Public Works Yard	9	$4,887,000	Not all of this property would be inundated for this scenario. Replacement Land value for 417 Garbally, estimated in 2008. Buildings not included in valuation.
Craigflower Pump Station (Sewage)	11	$2,806,700	The data is for the "Cost of Reproduction New" value, as of November 2013's appraisal.
Memorial Pump Station (Sewage)	14	$300,000	Installed in 1974, cost estimate of $300,000.
Currie Lift Station Pump Station (Sewage)	15	$662,800	Not provided.
Penhryn Lift Station and Booster Pump Station (Sewage)	16	$3,206,900	Data provided for "Penrhyn Station". The data is for the "Cost of Reproduction New" value, as of November 2013's appraisal.
Gyro beach and park (valuation is for washrooms only)	16	$251,000	Based on Cost of Reproduction New.

Key public asset	SLR Focus Area #	Valuation	Basis for valuation
Island View Beach campground (valuation is for **toilet building and information kiosk** only**)**	17	$43,929	"Island View Beach – Toilet Building" valued at $27,033 and an "Island View Beach – Information Kiosk" valued at $16,896. Note: the available data could not be used to confirm if these specific facilities were in the part of the Island View beach that would be within the inundation line.
Sidney Pump Station (Sewage)	19	$3,952,800	The data is for the "Cost of Reproduction New" value, as of November 2013's appraisal.
Manson Road Pump Station (Sewage)	23	$154,400	The data is for the "Cost of Reproduction New" value, as of November 2013's appraisal.
Ganges Library	23	$6,200,000	Not provided. Part of this building may be outside of the inundation line.

3.6 Economic Valuation

Table 12 provides a summary of the total assessed value determined by BC Assessment for land and improvements that exist within the inundation line for the 2100 + 500-year storm surge scenario for each SLR Focus Area. Across the 24 SLR Focus Areas, residential property has the highest total assessed value, followed by commercial and then civic, institutional and recreational land uses. The SLR Focus Areas with the highest assessed values within this inundation line are:

- Oak Bay Windsor Park area, with $330million of assessed value, principally for residential property.
- Gorge Industrial and Redevelopment area, with $112million of assessed value, principally for the commercial and industrial categories.
- Esquimalt Naval, South Sidney and Tsehum North Saanich, each having total assessed values of close to $100million.

Table 12 - Summary of economic valuation (2014 BC Assessment data) for each SLR Focus Area ($Million)

SLR Focus Area Number and Name	Residential	Commercial	Civic, Institutional and Recreational	Transportation, Communication and Utility	Industrial	Farm	Mining and Allied Industry	Unclassified	Total
1. Port Renfrew	14.6	1.5	2.6	0.6	0.2	0.0	0.0	0.0	19.5
2. Jordan River	2.5	0.6	1.9	0.0	0.3	0.0	0.0	0.0	5.2
3. Hwy 14 Shirley	14.5	0.1	0.0	0.0	0.0	0.2	0.0	0.0	14.8
4. Milnes Landing	7.2	0.1	2.0	0.0	0.0	0.7	0.0	0.0	10.0
5. Albert Head	2.6	0.0	0.7	0.0	0.0	0.0	0.0	0.0	3.4
6. Esq Lagoon	13.5	2.8	9.1	0.0	0.0	0.0	0.0	0.0	25.4
7. Gorge View Royal	68.8	0.0	5.8	0.2	0.0	0.0	0.0	0.0	74.8
8. Gorge Saanich	31.9	2.1	12.2	0.0	0.0	0.0	0.0	0.0	46.2
9. Gorge Industrial	11.7	56.1	14.9	7.0	21.6	0.0	1.1	0.0	112.4
10. Esq DND Naval	0.0	0.0	45.8	13.2	35.1	0.0	0.0	4.5	98.5
11. Gorge Esquimalt	29.8	3.5	3.6	0.0	0.0	0.0	0.0	0.0	36.8
12. Inner Harbour[4]	16.0	20.5	1.9	23.2	0.0	0.0	0.0	0.0	61.6
13. Ogden Point	0.5	10.4	19.4	22.4	0.0	0.0	0.0	0.0	52.7
14. Dallas Rd	16.6	0.0	4.9	0.0	0.0	0.0	0.0	0.0	21.5
15. Oak Bay Windsor	299.2	19.3	10.6	1.0	0.0	0.0	0.0	0.0	330.1
16. Cadboro Bay	58.8	0.9	9.0	0.0	0.0	0.0	0.0	0.0	68.6
17. Island View Beach	9.4	1.9	17.9	0.0	0.0	0.3	0.0	0.0	29.5
18. Patricia Bay	0.0	0.0	5.4	0.4	0.0	0.0	0.0	0.0	5.8
19. South Sidney	68.9	2.5	14.1	8.2	0.0	0.0	0.0	0.0	93.6
20. Tsehum Sidney	52.0	19.1	5.1	0.0	0.6	0.0	0.0	0.0	76.8
21. Tsehum N Saanich	59.5	34.0	1.5	0.5	0.0	0.0	0.0	0.0	95.4
22. Fulford	1.5	2.8	0.1	1.5	0.4	0.1	0.0	0.0	6.4
23. Ganges	2.1	22.7	5.8	0.0	0.5	0.0	0.0	0.0	31.1
24. Galliano	7.9	0.0	0.0	0.1	0.1	0.0	0.0	0.0	8.1
Total	789.6	200.7	193.9	78.5	58.8	1.3	1.1	4.5	1328.3

Source: Data provided by CRD using 2014 BC Assessment data

Note: The Forestry and Allied Industry classification is not reported in this table as the total valuation for this classification was negligible. See Appendix B for data for this category.

[4] The Inner Harbour SLR Focus Area includes a number of high value parcels within the inundation line for this scenario. This includes water lots and a number of residential suite properties that exist as part of a parcel of land within the inundation line.

3.7 Service Disruption

3.7.1 Summary of Case Study Results

Table 13 summarizes the quantitative findings of the three case studies. For each case study, the Total Economic Impact ranges from $90,000 per day to more than $400,000 per day due to disruption from temporary inundation from storm surge events on transportation, residential community or business assets within one Focus Area. The figures can be extrapolated to give an indication of the economic impact of a permanent inundation scenario. The total daily economic impact is based on average year-round economic conditions. Considering that economic certain impacts, such as those related to tourism, will vary by season, AECOM also estimated daily impacts of service disruption during the winter months when service disruption is most likely to occur. As the table below illustrates, the daily impact of service disruption for the Victoria Inner Harbour drops by half when only winter tourism activity is considered.

A detailed explanation of the methodology used to arrive at total economic impacts can be found in Appendix C.

Table 13 - Summary of economic impacts for service disruption case studies

Case Study Type	Focus Area	Total Economic Impact per day of disruption (year-round average)	Total Daily Impact (winter months only) (1)	Focus Area Population (2)
Service Disruption Impacts on a Transportation Asset	Highway 14, south of Shirley	$92,015	$88,862	915 nearby residents
Service Disruption Impacts on a Residential Community	Oak Bay / Windsor Park	$9,979	NA	1,388 residents
Service Disruption Impacts on a Business District	Victoria Inner Harbour	$415,557	$214,322	161 workers (year-round) 125 workers (winter)

Note 1: Winter impacts were estimated only for indicators for which seasonal data was readily available. See Appendix for details on how daily impacts during the winter were calculated.

Note 2: The Focus Area population is the population of communities dependent on the transportation asset, the resident population of the residential community, and the estimated workforce of key business district employers. This population figure is meant to compare total impacts of each case study to Focus Area's size, in terms that are relevant to the type of service disruption. This does not imply that losses are only experienced by the population defined here. See Appendix C for sources of population data.

3.7.2 Transportation Disruption Case Study

3.7.2.1 Overview

The transportation disruption scenario assesses the economic impact of the temporary disruption of Highway 14, south of Shirley (Focus Area number 3). Figures for Focus Area 3 (see Appendix A Map Book) show the extent of inundation of Highway 14 for different scenarios. This case study assesses potential impacts for the scenario where storm surge events may temporarily disrupt Highway 14.

A storm surge event that inundates Highway 14 will disrupt the most direct route from Victoria to Port Renfrew (see Appendix A Map Book for relative position of these communities). Inundation of the route will result in fewer visits to the West Coast Trail and British Columbia's provincial parks, fewer riders on a popular private transportation service, longer in-bound and out-bound commute times for residents to the northwest of the Focus Area and higher costs for British Columbia's Emergency Services Unit to respond to emergencies.

3.7.2.2 Indicators and Data Metrics

Five indicators of economic impact are assessed for this case study:

- Commute costs
- Private transit costs
- Tourism costs
- Emergency services costs
- Fiscal costs

To quantify the economic impact of temporary service disruption along Highway 14, five corresponding metrics are used to determine the monetary value of the indicators. Metric calculations are intended to be replicable, meaning a similar process can be applied in determining the impacts of service disruptions to the same asset type in other areas. With this in mind, metrics rely on publically available data inputs whenever possible. These metrics, along with their data inputs, are summarized in the table below.

Table 14 – Transportation Disruption Cost Indicators

Indicator	Metric	Data Inputs
Commute Costs	Daily cost of lost time per worker	Number of vehicle trips per day
		Additional travel time required per trip from route impairment
		Average dollar value per hour of a commuter's time
Private Transit Costs	Daily cost of lost business revenue from service disruption	Average daily passengers
		Average revenue per passenger
Tourism Costs	Daily cost of lost tourism spending	Average daily visitors (provincial and national parks)
		Daily spending per visitor (provincial and national parks)
Emergency Services Costs	Daily cost of alternative emergency services	# of emergency response events per day
		Additional cost of air versus road response per event
Fiscal Costs	Daily cost of lost sales tax revenue	Output from "Tourist Costs" metric
		Provincial and general sales tax rates

3.7.2.3 Transportation Disruption Key Findings

Table 15 provides a summary of the daily economic impacts of transportation disruption caused by a storm surge that would inundate Highway 14. The final row, "Total Impacts", represents the sum of all five metrics that were used for this case study. Note that in some cases individual metrics are duplicative of others, meaning that the Total Impact reported here should be viewed as a gross, as opposed to a net measure of economic impact.[5] The rightmost column estimates the average daily impact during the winter only, when the West Coast Trail is not accessible.

In addition to total gross economic impacts, a per capita measure of economic impacts is displayed. For the transportation asset case study, the per capita economic impact is calculated by dividing total daily impacts by the estimated resident population of communities that would be most affected. For this case study these communities have been taken to be Shirley, Jordan River and Port Renfrew, which are close to or to the west of the point on the highway that would be inundated. While economic losses will be experienced by a wider population than these communities alone (including business owners and public agencies), the per capita figure places total impacts in the context of the Focus Area's size, and in terms that are relevant to the type of service disruption.

Table 15 - Transportation Disruption Total Impacts Summary

	Indicator	**Daily Impact (year round)**	**Daily Impact (winter scenario) (1)**
Transportation Disruption Impacts	Commute Costs	$52,776	$52,776
	Private transit costs	$950	$0
	Tourism Costs	$34,232	$32,325
	Emergency services cost	$298	$298
	Fiscal cost	$3,759	$3,463
	Total Impacts	**$92,015**	**$88,862**
	Population of Impacted Communities (Shirley, Jordan River, and Port Renfrew)	**915**	**915**
	Daily Impacts Per Capita	**$101**	**$97**

Note 1: Winter impacts exclude effects of West Coast Trail tourism and private transit to the West Coast trail, which is closed during the winter. Seasonal data was for provincial parks was not incorporated in the winter estimate due to data limitations.

[5] For example, private transit and tourism revenue are reported inclusive of sales tax. Fiscal impacts are also reported separately to reflect a distinct externality.

3.7.3 Community Disruption Case Study

3.7.3.1 Case Study Overview

The Community Disruption Case Study assesses the economic impacts of storm surge in the Oak Bay / Windsor Park Focus Area (see Figures for Focus Area 15 in Appendix A Map Book). A storm surge event that inundates the Oak Bay Focus Area has the potential to disrupt the life of local residents. Inundation of the neighborhood may result in disruption of utility service, longer commute times due to flooded roads, higher costs to deliver emergency services, the closure of recreation areas, and in the long run, lower property values and tax receipts because of flood risks. For some SLR and storm surge scenarios the inundation could occur in a way that makes the south-eastern portion of this area into a temporary “island”. Without any management measures in place (e.g. to maintain a corridor of unflooded roads), this could prevent access to and from this part of the area, and this would drive some of the types of community disruption that are described below.

This case study assesses the potential economic impacts resulting from storm surge events that will cause temporary disruption of the delivery of public and utility services and the operation of recreational amenities in the Focus Area.

3.7.3.2 Indicators and Data Metrics

Five indicators of economic impacts are assessed in a quantitative manner for this case study:

- Emergency services costs
- Commute costs
- Residential utility disruption costs
- Fiscal risk

Three additional indicators (business disruption, recreation disruption, and transit disruption) are assessed in qualitative terms.

Replicable metrics are assigned to each indicator to determine the economic impact of service disruption in the Focus Area. Metrics rely primarily on publically available data inputs, with the intention of establishing a replicable process. These metrics, along with their data inputs, are summarized on the following page.

Table 16 - Overview of Community Impact Indicators and Metrics

	Indicator	Metric	Data Inputs
Service Disruption Impacts	Alternative Emergency Services Costs	Daily cost of alternative emergency services	# of emergency response events per day
			Additional cost of air versus road response per event
	Commute Costs	Daily cost of lost time per worker	Number of worker residents
			Additional travel time required per trip from route impairment
	Residential Utility Service Costs	Lost utility revenues per day	Average daily household utility spending
			Number of impacted households
Fiscal Risk	Fiscal Risk	Property tax revenues at risk of decline	Value of properties in focus area
			Local property tax rate
Qualitative impacts	Public Transit Impacts	Bus routes impacted by disruption	List of bus routes and general ridership data
	Recreation Costs	Closed recreation assets	Recreation assets in Focus Area
			Visitors / revenue if known
	Business Disruption	Number of local businesses	Business licenses
			Members of business improvement district

3.7.3.3 Community Disruption Key Findings

The following is a summary of the daily economic impacts of service disruption caused by a storm surge event in the Oak Bay / Windsor Park Focus Area. The final row, “Total Impacts”, represents the sum of four of the five

quantitative metrics; the Fiscal Risk metric is considered separately from the others because the metric expresses a cumulative risk, rather than an estimate of daily economic impacts. Winter impacts were not estimated for the Community Disruption Scenario, since indicator outcomes are not heavily dependent on tourism.

In addition to total gross daily economic impacts, a per capita measure of economic impacts is displayed. For the community disruption case study, the per capita economic impact is calculated by dividing total daily impacts by the estimated resident population. While economic losses will be experienced by a wider population than residents alone, the per capita figure places total impacts in the context of the Focus Area's size, in terms that are relevant to the type of service disruption.

Table 17 – Community Disruption: Quantitative Indicators Summary

Indicator	Daily Economic Impact
Commute Costs per day	$7,059
Emergency Services Cost per day	$441
Residential Utility Disruption Cost per day	$2,479
Total Daily Impacts	$9,979
Focus Area Population	1,388
Total Daily Impacts Per Capita	$7
Property Tax Revenues at Risk	$1,567,480

The Community Disruption Case study includes three qualitative assessments in addition to the quantitative metrics above; while these three additional economic impacts to the Focus Area cannot yet be quantified because of data limitations, the study recognizes their importance and thus includes them in the analysis. These three qualitative assessments cover impacts to public transit, recreation and local business.

Transit Impacts

The Focus Area is served by three bus routes: Route 2 – Oak Bay / Willows / Downtown (roughly 25,000 daily boardings along the entire route), Route 8 – Interurban / Oak Bay (roughly 20,000 daily boardings), and Route 1 – Downtown /Richardson (less than 20,000 passengers per day) (BC Transit 2011). At 11.4%, transit's share of passenger trips in the Oak Bay District, which encompasses the Focus Area, is higher than in any other area of the CRD outside of Victoria (Victoria Rapid Transit 2011).

Shifts in commute times for residents who live in the Focus Area are already quantified using the Commute Costs indicator listed in Table 17 above, although differences in impacts between transit riders and vehicle commuters are not considered. In addition to the impacts on workers who live in the Focus Area, it is likely, though not yet quantifiable, that a storm surge event in the Focus Area could impact the commute times of other transit users who rely on bus routes that pass through the Focus Area.

AECOM understands that transportation boarding data may be available at the Focus Area level. In future analyses, transit impacts could be developed as a quantitative indicator, measured either as lost revenue to the local transit agency, or the value of longer commute times for transit riders along the system.

Recreation Impacts

The Focus Area includes several recreation assets including the Monterey Elementary School fields and Windsor Park Field. Just outside the Focus Area is the private Victoria Golf Club, whose 1,200 members pay $37 million in membership fees, according to AECOM's estimate (Victoria News 2013 and AECOM analysis). It should be acknowledged that valuing recreation assets in terms of fees charged biases the analysis toward recreation assets located in high-income areas, as well as private recreation assets. In the future, the CRD may wish to explore more sophisticated valuation methods of recreation valuation (for example, valuing the intrinsic value of recreation assets, or quantifying the positive impacts of a park on public health).

Business Disruption

During storm events businesses may be forced to close down either because of flooding of a business establishment, or because of disruption in utility services that would impair safe business operations. In either case, these impacts would lead to a reduction in business revenue. The District of Oak Bay reports 600 active business licenses in the municipality, while the local business improvement district has 92 active members (Oak Bay 2014; Oak Bay BIA 2014). Public data were not available to determine the number of these businesses located in the Focus Area, or their aggregate revenues and number of employees. . It is AECOM's understanding that the CRD's employer database could provide local business data to support future analyses. The final case study of Business Disruption, below, presents a methodology for using primary research to determine the daily economic impacts of storm surge on local businesses in terms of wages and revenue, based on publically available employer data.

3.7.4 Business Disruption Case Study

3.7.4.1 Overview of Case Study

The Business Disruption Case Study assesses the economic impact of storm surge related flooding on major businesses located in Victoria's Inner Harbour (see Figures for Focus Area 12 in Appendix A Map Book). Disruption of harbour businesses will impact the revenue of firms, wages paid to workers (or worker productivity), as well as the behavior of tourists who rely on the Inner Harbour as an entry point to Victoria.

A storm surge event that inundates the Inner Harbour will impact the activities of businesses primarily in the transportation industry. These include the sea plane service company, Harbour Air, and the ferry companies Clipper Vacations and Blackball Ferry, which both operate international ferries between Victoria and Seattle and Port Angeles. The analysis only includes impacts on these businesses.

Smaller businesses in the area include restaurants, a gift shop, and licensed street vendors, many of which operate as tenants of properties owned by the Greater Victoria Harbour Authority. Impacts to these smaller businesses are not considered here due to data limitations.

3.7.4.2 Service Disruption Indicators and Data Metrics

Four indicators of economic impacts are assessed for this case study:

- Worker Productivity Costs
- Business Revenue Costs
- Tourism Costs
- Fiscal costs

Replicable metrics are used to determine the economic impact of business disruption for each of the above indicators. Whenever possible, metrics rely on publically available data to ensure the analysis can be replicated in other Focus Areas; however, in the case of business-level data, primary interviews were often necessary to supplement public information. Each indicator's metrics and data inputs are summarized in the table below.

Table 18 – Business Disruption Indicators and Metrics

	Indicator	Metric	Data Inputs
Business Disruption Impacts	Worker Productivity Cost	Daily cost of lost wages of disrupted business establishments (experienced either as lost income or reduced productivity)	Number of workers – large firms only (gathered from interviews / review of public documents)
			Average industry wage
	Business Revenue Cost	Daily cost of lost aggregate revenue of disrupted business establishments	Number of passengers – large firms (* will change by industry)
			Revenue per passenger
	Tourism Cost	Daily cost of lost ancillary tourist spending	Number of daily passengers
			Ancillary spending per passenger
	Fiscal Cost	Daily cost of lost sales tax revenue	Outputs from the Business Revenue and Tourism Cost Metrics above.
			General sales tax rate

3.7.4.3 Summary of Costs

The following is a summary of the daily economic impacts of service disruption caused by a storm surge event in the Inner Harbour Focus Area. The final row, "Total Impacts", represents the sum of all four metrics. Note that wage and revenue impacts are duplicative of one another, as wages are paid out of revenue. The Total Impacts row should therefore be viewed as a gross as opposed to a net economic impact. The rightmost column estimates the daily impact of service disruption during the winter months only, based on seasonal passenger data reported by Blackball Ferry only.

In addition to total gross economic impacts, a per capita measure of economic impacts is displayed. For the business disruption case study, the per capita economic impact is calculated by dividing total daily impacts by the estimated workforce population (including only those firms that publically report workforce data). While economic losses will be experienced by a wider population than workers alone, the per capita figure places total impacts in the context of the Focus Area's size, and in terms that are relevant to the type of service disruption.

Table 19 – Business Disruption Total Costs Summary

Indicator	Daily Impact (year-round)	Daily Impact (winter months) (1)
Wages / Productivity cost	$34,937	$27,023
Revenue cost	$160,373	$130,596
Tourism cost	$192,035	$45,598
Fiscal cost	$28,212	$11,105
Total Impacts	$415,557	$214,322
Worker Population of Focus Area (Blackball Ferry and Harbour Air)	161	125
Total Daily Impacts Per Capita (workforce)	$2,581	$1,714

Note 1: Winter impact uses winter ridership and winter tourist spending figures for Blackball Ferry. Winter employment for Blackball Ferry was also implied from these figures. For all other businesses, winter impacts were assumed to be constant (as seasonal data was not publically available).

4. Conclusions

The mapping and analysis developed as part of this project were used to draw the following conclusions:

a. As a result of varying topography there are different levels of inundation that may occur across the CRD coastline for the SLR and storm surge scenarios that were considered as part of this project. Many of the lower lying areas that may have higher levels of inundation coincide with developed and populated areas, leading to the potential for infrastructure damage, safety risk and service disruption.

b. The study of distinct coastal areas for SLR planning purposes requires that the provincial guidelines for floodplain mapping be applied along with a means for *laterally* defining these areas, i.e. applying the land-ward limit <u>and</u> a limit on the intersecting axis. By applying a set of principles for this lateral definition the project identified 24 SLR Focus Areas that have relatively high levels of expected future inundation and / or key community assets that are present in those areas. These are not the only areas of the CRD that may experience inundation for these scenarios, but were selected as key areas for which analysis could be conducted within the scope of this project, and which would help support CRD's longer term work in SLR risk management.

c. Almost all electoral areas and municipalities within the CRD have areas that contain at least one key community, transportation or business asset that would be inundated for the selected scenario of year 2100 + 500-year storm surge. These areas of inundation also include lands that are currently used for residential, commercial, civic / institutional and industrial purposes. The confirmed presence of these assets and land uses reinforces the need for CRD's work in identifying the potential risks that may arise from SLR and the appropriate management measures for the region.

d. The analysis provided in this report focuses on the assets that would be temporarily inundated under storm surge conditions for the selected scenario of SLR for year 2100 + 500-year storm surge. This does not imply long-term effect or destruction of this land or infrastructure. It does however identify the type and scale of assets that may be at risk from SLR. The key assets that would be at least partially inundated for this selected scenario are principally network structures for water and wastewater (pump stations, treatment plants), a library, a public works yard and some road bridges. There is the potential for some large businesses to be at least partially inundated for this scenario, with some of their operations (e.g. ferry, float plane) being regionally important for the tourism sector. There are also a large number of marine docks that are within the inundation line for this scenario, though it has not been assumed that infrastructure damage would necessarily occur to the dock structures themselves. Shoreline classification data show presence of a wide range of shoreline types and sensitivity ratings across the SLR Focus Areas, including different natural coastal classes as well as man-made classes. Sensitivity ratings to SLR are generally classed as Very High or High.

e. One of the main areas of Highway within the inundation line for the year 2100 + 500-year storm surge scenario is at Highway 14 between Sooke and Port Renfrew. This area was used as a case study for transportation service disruption. There are a small number of locations along this section that would be at least temporarily inundated during storm surge conditions for this scenario. As alternative routing in this area is limited, this inundation would disrupt movement of traffic between the Greater Victoria area and communities out to Port Renfrew, and could require re-routing via Lake Cowichan. As well as disruption to local residents this inundation could have effects for emergency response and for visitors accessing recreational sites and trails in this area.

f. Temporary inundation from storm surge also has the potential to disrupt other aspects of life for local residents. The case study of inundation in the Oak Bay / Windsor Park area shows extra costs incurred for emergency services, commuting, residential utility disruption, and recreation as well as fiscal risk from declining property tax.

g. For the 24 Focus Areas used for this project the total valuation of land and improvements within the year 2100 + 500-year storm surge inundation line ranges from $330 million (Oak Bay Windsor Park SLR Focus Area) to $3.4million (Albert Head SLR Focus Area). Across the 24 SLR Focus Areas, residential property has the highest total assessed value, followed by commercial and then civic, institutional and recreational land uses. The key public assets that were identified within the inundation lines and were subject to valuation in this project included pump stations (with varying valuations up to approximately $4million), and parts of the Lower Public Works yard and Ganges Library that may be subject to inundation and as a whole have multi-million dollar valuations.

h. This project has developed and applied a method for defining SLR Focus Areas, for characterising existing land uses, for identifying and valuing key public assets and for valuing land and infrastructure. While specific data sets may vary for other jurisdictions these methods will have relevance for assessing SLR risks for other areas.

5. Recommendations

The following recommendations are made:

a. That CRD use the analysis and mapping conducted for the 24 Focus Areas as an evidence base for the identification and appraisal of options for a future model bylaw that deals with SLR management for the CRD. In particular, the analysis provided in this project demonstrates the types of land use, key assets, services and indicative economic values that exist in areas at inundation risk and this evidence will help to develop the objectives for and assess the impacts of different management options.

b. That the digital files produced by this project for the entire CRD region are used for future work by the CRD and regional municipalities / electoral areas to assess areas not covered by the 24 Focus Areas. This application of data and the assessment methods applied by this project will be useful if a more localised and detailed review of SLR risks is undertaken by CRD or regional municipalities / electoral areas.

c. That CRD consider opportunities to communicate the approaches used in this project to other municipalities or Regional Districts that would benefit from identifying SLR risk in their coastal areas. The methods and data sets used for this project are not yet fully standardised or represented in guidelines and so this project may have value as a concept demonstrator for other local governments.

d. That CRD consider the value in assessing inundation risk that could occur from flooding of drainage and other water systems. This recommendation is based on feedback received by regional municipalities / electoral areas during the project that water could enter coastal outfalls and create a flow of water to low-lying inland areas that would not otherwise have direct connectivity to inundated areas. The assessment of such risks was not within the scope of this project and AECOM has not reviewed the potential for this to occur. Data generated from this project could be used to create maps to show where such non-connected low-lying areas are located.

Appendix A Map Book

Sea Level Rise Focus Area Map Book

Enclosed as six separate PDF documents

A separate map book is provided for each SLR scenario, with Focus Areas listed in the order as follows:

#	Name	Municipality / Electoral Area
1	Port Renfrew	Juan de Fuca Electoral Area
2	Jordan River	Juan de Fuca Electoral Area
3	Highway 14 south of Shirley	Juan de Fuca Electoral Area
4	Milnes Landing	District of Sooke
5	Albert Head Lagoon	District of Metchosin
6	Esquimalt Lagoon	City of Colwood
7	Gorge – View Royal	Town of View Royal
8	Gorge – Saanich	District of Saanich
9	Gorge Industrial and Redevelopment Land	City of Victoria
10	Esquimalt DND Naval	Township of Esquimalt
11	Gorge - Esquimalt	Township of Esquimalt
12	Inner Harbour	City of Victoria
13	Ogden Point	City of Victoria
14	Dallas Road	City of Victoria
15	Oak Bay Windsor Park Area	District of Oak Bay
16	Cadboro Bay	District of Saanich
17	Island View Beach	District of Central Saanich
18	Patricia Bay	District of North Saanich
19	South Sidney	Town of Sidney
20	Tsehum Harbour – Sidney	Town of Sidney
21	Tsehum Harbour – North Saanich	District of North Saanich
22	Fulford Harbour	Salt Spring Island
23	Central Ganges	Salt Spring Island
24	Galliano – north of Sturdies Bay	Southern Gulf Islands

Appendix B

Focus Area Land Use and Valuation Statistics

Key to table headings:

- Actual Land Use, Zoning, First Nation Reserves:
  - Area (sq-m) – total area of land registered for each category that is within the 2100 + 500 year storm surge scenario.
  - % of total – area of land registered for the given category within the 2100 + 500 year storm surge scenario as a percentage of total area of land (registered for all categories) that is within the 2100 + 500 year storm surge scenario.
- Physical Shoreline:
  - Length (m) – total length of shoreline that is within the 2100 + 500 year storm surge scenario, for each shoreline category.
  - % of total - length of shoreline that is within the 2100 + 500 year storm surge scenario, for each shoreline category, as a percentage of the total length of shoreline (registered for all shoreline categories) that is within the 2100 + 500 year storm surge scenario.
- Land Valuation
  - Total Land Value – total value of parcel (BC Assessment data) within the 2100 + 500 year storm surge scenario. Valuation data provided by CRD using 2014 BC Assessment data.
  - Total Improvements Value – total value of Improvements (BC Assessment data) within the 2100 + 500 year storm surge scenario. Valuation data provided by CRD using 2014 BC Assessment data.
  - Total Value – total value of land and improvements (BC Assessment data) within the 2100 + 500 year storm surge scenario. Valuation data provided by CRD using 2014 BC Assessment data.
- Roads
  - Length - total length of road that is within the 2100 + 500 year storm surge scenario, for each road category.

SLR Focus Area # 1 - Port Renfrew

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	2,454,956	36%
2 ACRES OR MORE - VACANT	1,425,511	21%
INDUSTRIAL - VACANT	1,107,333	16%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	1,002,412	15%
VACANT	342,835	5%
CAMPGROUND (COMMERCIAL)	233,835	3%
2 ACRES OR MORE - SINGLE FAMILY DWELLING, DUPLEX	106,680	2%
MARINE & NAVIGATIONAL FACILITIES (INCLUDES FERRY LANDINGS, BREAKWATERS, BOAT RAMPS, LIGHTHOUSES, FORESHORE FACILITIES, ETC).	59,658	1%
SINGLE FAMILY DWELLING	53,985	1%
2 ACRES OR MORE - OUTBUILDING	39,631	1%
2 ACRES OR MORE - SEASONAL DWELLING	39,194	1%
PARKS & PLAYING FIELDS	15,926	0.2%
VACANT RESIDENTIAL LESS THAN 2 ACRES	8,449	0.1%
RESIDENTIAL OUTBUILDING ONLY	5,924	0.1%
SEASONAL RESORT	3,377	0.0%
MANUFACTURED HOME - (NOT IN MANUFACTURED HOME PARK)	1,574	0.0%
BED & BREAKFAST OPERATION LESS THAN 4 UNITS	1,083	0.0%
WATER DISTRIBUTION SYSTEMS	850	0.0%
SEASONAL DWELLING	845	0.0%
CHURCHES & BIBLE SCHOOLS	743	0.0%
STORE(S) AND LIVING QUARTERS	698	0.0%
MARINE FACILITIES - MARINA	275	0.0%
RANGER STATION	205	0.0%

Zoning

Zoning Category	Area (sq-m)	% of total
Municipal Zoning		
MP	183,039	55%
ALR	73,697	22%
CR-1	53,817	16%
CU	19,445	6%
IND	2,836	1%
JF_Zoning		
AG	3,291,454	52%
P	2,005,302	31%
RL	503,532	8%
GR	235,705	4%
MP	183,038	3%
ALR	73,697	1%
CR-1	53,817	1%
CU	18,747	0.3%
CD-2A	7,166	0.1%
IND	2,836	0.0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
Gordon River First Nation Reserve No. 2	475,653
Pacheena First Nation Reserve No. 1	387,828

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Estuary (Organics/Fines)	21,361	59%
Sand and Gravel Beach, narrow < 30m	4,425	12%
Sand Beach, wide > 30m	4,104	11%
Sand Flat, wide > 30m	2,718	8%
Sand and Gravel Flat or Fan, wide > 30m	1,841	5%
Man made, permeable	1,331	4%
Rock Ramp, narrow < 30m	131	0%
Rock Ramp with Sand and Gravel Beach, narrow < 30m	25	0%
Sensitivity Rating		
Very high sensitivity	32,587	91%
High sensitivity	3,257	9%
Low sensitivity	92	0%

Land Valuation

Category of Land	Total Land Value	Total Improv'ts Value	Total Value
Residential	$8,838,731	$5,717,155	$14,555,887
Civic, Institutional and Recreational	$2,543,496	$31,764	$2,575,259
Commercial	$856,842	$633,101	$1,489,943
Transportation, Communication and Utility	$143,799	$477,198	$620,997
Industrial	$220,880	$0	$220,880

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	7,832	770	$6,030,431
Subclass-resource Lane-2	2,014	770	$1,550,855
Subclass-collector minor Lane-2	1,375	870	$1,195,963
Subclass-recreation Lane-2	448	770	$344,796
Subclass-arterial minor Lane-2	62	1190	$73,847

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Port Renfrew Wastewater Treatment Plant and 2 facilities marked as WTP disinfection	$ 654,400
Community of Port Renfrew	
Port Renfrew Pump Station	
Deering Rd Bridge (North)	
Deering Rd Bridge (South)	
Island Rd Bridge	

SLR Focus Area # 2 - Jordan River

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
INDUSTRIAL - VACANT	109,296	28%
PARKS & PLAYING FIELDS	90,950	23%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	78,907	20%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	52,856	13%
LOGGING OPERATIONS	19,698	5%
IMPROVED	13,541	3%
MISCELLANEOUS (FOREST AND ALLIED INDUSTRY)	12,664	3%
SINGLE FAMILY DWELLING	7,370	2%
BED & BREAKFAST OPERATION LESS THAN 4 UNITS	4,932	1%
RESTAURANT ONLY	2,310	1%
VACANT RESIDENTIAL LESS THAN 2 ACRES	290	0%
2 ACRES OR MORE - VACANT	132	0%
OFFICE BUILDING (PRIMARY USE)	8	0%

Zoning

Zoning Category	Area (sq-m)	% of total
Municipal Zoning		
A	193,755	53%
B	169,857	47%
Juan de Fuca Zoning		
A	193,755	42%
No Zone	133,653	29%
RL	118,601	26%
JR-1	5,175	1%
CR-1A	4,932	1%
C-1B	4,794	1%
RR-2A	132	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)	% of total
None identified		

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline type		
Gravel Flat, wide > 30m	2,673	69%
Man made, permeable	555	14%
Gravel Beach, narrow < 30m	546	14%
Sand and Gravel Flat or Fan, wide > 30m	123	3%
Sensitivity Rating		
High sensitivity	3,351	86%
Moderate sensitivity	546	14%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$1,271,034	$1,217,198	$2,488,232
Civic, Institutional and Recreational	$1,795,918	$81,059	$1,876,977
Commercial	$146,900	$416,000	$562,900
Industrial	$38,885	$238,079	$276,964
Forest and Allied Industry	$2,000	$0	$2,000

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-highway_minor Lane-2	960	1850	$1,775,701
Subclass-recreation Lane-2	243	770	$187,347
Subclass-service Lane 2	315	770	$242,427

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
Jordan River Bridge	-
Jordan River campground	-
Log sort business	-

SLR Focus Area # 3 - Highway 14 South of Shirley

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
NO JUROL IDENTIFIER; LAND USE UNKNOWN	100,656	38%
2 ACRES OR MORE - VACANT	49,838	19%
VACANT RESIDENTIAL LESS THAN 2 ACRES	31,489	12%
SINGLE FAMILY DWELLING	26,555	10%
2 ACRES OR MORE - SINGLE FAMILY DWELLING, DUPLEX	19,873	7%
OTHER	17,870	7%
MIXED	8,646	3%
2 ACRES OR MORE - SEASONAL DWELLING	7,928	3%
BED & BREAKFAST OPERATION LESS THAN 4 UNITS	3,721	1%
SAND & GRAVEL (VACANT AND IMPROVED)	191	0%
INDUSTRIAL - VACANT	134	0%

Zoning

Zoning Category	Area (sq-m)	% of total
Municipal Zoning		
A	107,624	38%
RR-A	63,343	23%
AF	45,359	16%
AG	44,336	16%
R-4	17,252	6%
B	1,980	1%
JF_Zoning		
RR-OB	64,230	33%
A	43,038	22%
AF	39,308	20%
AG	36,902	19%
R-4	8,696	5%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)	% of total
None identified		

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline type		
Sand and Gravel Flat or Fan, wide > 30m	4,242	64%
Gravel Flat, wide > 30m	1,847	28%
Sand and Gravel Beach, narrow < 30m	520	8%
Sensitivity Rating		
High sensitivity	6,089	92%
Moderate sensitivity	520	8%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$10,386,364	$4,135,640	$14,522,003
Farm	$9,730	$208,885	$218,615
Commercial	$29,752	$27,204	$56,956
Industrial	$9,695	$0	$9,695

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-highway_minor **Lane**-2	789	1850	$1,459,370

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
Section of Highway 14	-
Muir Creek Bridge	-

SLR Focus Area # 4 -Milnes Landing

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
2 ACRES OR MORE - SINGLE FAMILY DWELLING, DUPLEX	99,365	25%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	93,641	23%
2 ACRES OR MORE - VACANT	62,671	15%
PARKS & PLAYING FIELDS	34,664	9%
CAMPGROUNDS (INCLUDES GOVERNMENT CAMPGROUNDS, YMCA & CHURCH, ETC). (EXCLUDES COMMERCIAL CAMPGROUND).	25,593	6%
GRAIN & FORAGE	20,062	5%
SINGLE FAMILY DWELLING	17,340	4%
MIXED	14,912	4%
MIXED - VACANT	11,433	3%
2 ACRES OR MORE - OUTBUILDING	6,532	2%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	6,007	1%
VACANT RESIDENTIAL LESS THAN 2 ACRES	5,624	1%
OTHER - VACANT	4,143	1%
OTHER	2,019	0%
RESIDENTIAL OUTBUILDING ONLY	594	0%
BED & BREAKFAST OPERATION LESS THAN 4 UNITS	181	0%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	102	0%
GOLF COURSES (INCLUDES PUBLIC & PRIVATE)	86	0%
MANUFACTURED HOME - (NOT IN MANUFACTURED HOME PARK)	25	0%
NEIGHBOURHOOD PUB	18	0%
DUPLEX - SINGLE UNIT OWNERSHIP	0	0%

Zoning

Zoning Category	Area (sq-m)	% of total
RU3	162,490	42%
P1	116,269	30%
RU2	90,326	23%
CD2-C	7,363	2%
R1	3,983	1%
W7	3,939	1%
RR1A	2,260	1%
M4	2,019	1%
CD2-E	224	0%
CD2-B	113	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
T'Sou-ke First Nation Reserve No. 1	2,655

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Sand and Gravel Beach, narrow < 30m	942	93%
Sand and Gravel Flat or Fan, wide > 30m	67	7%
Sensitivity Rating		
High sensitivity	1,008	100%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$5,179,015	$2,040,529	$7,219,544
Civic, Institutional and Recreational	$1,910,915	$79,323	$1,990,238
Farm	$309,428	$373,922	$683,349
Commercial	$79,977	$53,720	$133,697

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	298	770	$229,230
Subclass-arterial major Lane-2	112	1190	$133,726

Major Transmission and Pipelines

Part of the Fortis gas distribution line passes through this focus area. This is the only line shown to serve Sooke and so is classed as an important part of this system

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
Sooke Flats Campground	-
Sun River Nature Trail	-

SLR Focus Area # 5 - Albert Head Lagoon

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	70,889	77%
SINGLE FAMILY DWELLING	11,057	12%
GOVERNMENT BUILDINGS (INCLUDES COURTHOUSE, POST OFFICE, MUNICIPAL HALL, FIRE HALL, POLICE STATIONS, ETC). (EXCLUDES TYPICAL OFFICE BUILDINGS; REFER TO COMMERCIAL SECTIONS).	4,549	5%
2 ACRES OR MORE - SINGLE FAMILY DWELLING, DUPLEX	2,472	3%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	2,318	3%
VACANT RESIDENTIAL LESS THAN 2 ACRES	1,137	1%
BED & BREAKFAST OPERATION LESS THAN 4 UNITS	96	0%

Zoning

Zoning Category	Area (sq-m)	% of total
P3	75,444	79%
RR1	20,630	21%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Estuary (Organics/Fines)	854	58%
Sand and Gravel Beach, narrow < 30m	474	32%
Sand and Gravel Flat or Fan, wide > 30m	141	10%
Sensitivity Rating		
Very high sensitivity	854	58%
Moderate sensitivity	460	31%
High sensitivity	154	10%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$1,663,244	$972,633	$2,635,877
Civic, Institutional and Recreational	$663,830	$42,865	$706,695
Commercial	$15,289	$17,285	$32,574

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	154	770	$118,681

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
Regional Park	-

SLR Focus Area # 6 - Esquimalt Lagoon

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
2 ACRES OR MORE - SINGLE FAMILY DWELLING, DUPLEX	110,682	35%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	62,562	20%
SCHOOLS & UNIVERSITIES, COLLEGE OR TECHNICAL SCHOOLS (INCLUDES PRIVATE KINDERGARTENS).	42,177	13%
2 ACRES OR MORE - VACANT	41,485	13%
STORE(S) AND SERVICE - COMMERCIAL	14,689	5%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	8,293	3%
VACANT RESIDENTIAL LESS THAN 2 ACRES	7,876	3%
SINGLE FAMILY DWELLING	6,366	2%
RECREATIONAL & CULTURAL BUILDINGS (INCLUDES CURLING RINK ARENA, SWIMMING POOLS, MUSEUMS, HISTORICAL BUILDINGS, ART GALLERY, LIBRARIES) (EXCLUDE PARKS, GOLF COURSES & GOVERNMENT CAMPGROUNDS).	5,934	2%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	4,134	1%
GOVERNMENT BUILDINGS (INCLUDES COURTHOUSE, POST OFFICE, MUNICIPAL HALL, FIRE HALL, POLICE STATIONS, ETC). (EXCLUDES TYPICAL OFFICE BUILDINGS; REFER TO COMMERCIAL SECTIONS).	3,244	1%
BED & BREAKFAST OPERATION LESS THAN 4 UNITS	2,822	1%
GOVERNMENT RESERVES (INCLUDES GREENBELTS (NOT IN FARM USE), BIRD SANCTUARIES, ECOLOGY RESERVES, ETC).	1,793	1%
DUPLEX - SINGLE UNIT OWNERSHIP	1,448	0%

Zoning

Zoning Category	Area (sq-m)	% of total
P4	1,417,542	86%
R1	132,040	8%
AG1	75,988	5%
CD6	15,764	1%
AG2	3,103	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Sand Flat, wide > 30m	8,255	54%
Estuary (Organics/Fines)	6,756	44%
Sand and Gravel Beach, narrow < 30m	330	2%
Sensitivity rating		
Very high sensitivity	15,011	98%
Moderate sensitivity	330	2%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$10,139,377	$3,402,061	$13,541,438
Civic, Institutional and Recreational	$3,096,454	$5,969,448	$9,065,902
Commercial	$1,776,735	$975,014	$2,751,749

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	2,364	770	$1,820,374
Subclass-local Lane 1	501	620	$310,517
Subclass-collector minor Lane-2	102	870	$88,313

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Royal Roads University grounds	-
Ocean Blvd (road)	-
3301 Ocean Blvd Lift Station (Sewage)	$ 800,000
205 Portsmouth Drive Lift Station (Sewage)	$ 350,000
Bldg 32 Pump Station (Sewage)	-
Esquimalt Lagoon Bridge	$ 2,500,000

SLR Focus Area # 7 - Gorge View Royal

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
SINGLE FAMILY DWELLING	73,518	34%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	32,100	15%
MULTI-FAMILY - GARDEN APARTMENT & ROW HOUSING	26,106	12%
PARKS & PLAYING FIELDS	25,752	12%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	23,501	11%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	21,317	10%
SCHOOLS & UNIVERSITIES, COLLEGE OR TECHNICAL SCHOOLS (INCLUDES PRIVATE KINDERGARTENS).	4,131	2%
GARBAGE DUMPS, SANITARY FILLS, SEWER LAGOONS, ETC.	4,003	2%
RAILWAY	1,846	1%
WATER DISTRIBUTION SYSTEMS	955	0%
VACANT RESIDENTIAL LESS THAN 2 ACRES	755	0%
PROPERTY SUBJECT TO SEC 19(8)	729	0%
RESIDENTIAL OUTBUILDING ONLY	274	0%

Zoning

Zoning Category	Area (sq-m)	% of total
VIEW ROYAL Residential 3	171,137	72%
VIEW ROYAL Residential 6	34,629	15%
P-1	25,386	11%
VIEW ROYAL Institutional Use 3	4,132	2%
VIEW ROYAL Institutional Use 1	1,898	1%
A-1	586	0%
VIEW ROYAL Residential 4	55	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Estuary (Organics/Fines)	2,093	37%
Man made, permeable	1,575	28%
Rock Ramp, narrow < 30m	1,391	25%
Rock Cliff, narrow < 30m	300	5%
Sand Beach, narrow < 30m	280	5%
Sensitivity Rating		
Very high sensitivity	5,611	100%
High sensitivity	27	0%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$44,429,035	$24,323,435	$68,752,470
Civic, Institutional and Recreational	$4,361,202	$1,435,784	$5,796,986
Transportation, Communication and Utility	$179,073	$41,154	$220,226

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	1,252	770	$964,201
Subclass-arterial minor Lane-2	259	1190	$307,668
Subclass-recreation Lane-2	78	770	$59,908
Subclass-restricted Lane 2	64	770	$49,292
Subclass-arterial_minor Lane 1	51	1530	$77,982

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Midwood Pump Station (Sewage)	$ 275,000
Helmcken Park Pump Station (Sewage)	$ 275,900

SLR Focus Area # 8 - Gorge Saanich

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	119,505	57%
SINGLE FAMILY DWELLING	41,916	20%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	13,807	7%
RECREATIONAL & CULTURAL BUILDINGS (INCLUDES CURLING RINK ARENA, SWIMMING POOLS, MUSEUMS, HISTORICAL BUILDINGS, ART GALLERY, LIBRARIES) (EXCLUDE PARKS, GOLF COURSES & GOVERNMENT CAMPGROUNDS).	9,628	5%
GOVERNMENT BUILDINGS (INCLUDES COURTHOUSE, POST OFFICE, MUNICIPAL HALL, FIRE HALL, POLICE STATIONS, ETC). (EXCLUDES TYPICAL OFFICE BUILDINGS; REFER TO COMMERCIAL SECTIONS).	8,486	4%
VACANT RESIDENTIAL LESS THAN 2 ACRES	4,936	2%
DUPLEX	2,415	1%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	2,006	1%
SHOPPING CENTRE - REGIONAL	1,410	1%
PARKS & PLAYING FIELDS	1,081	1%
MOTEL & AUTO COURT	857	0%
TRIPLEX	829	0%
RECREATIONAL CLUBS, SKI HILLS	660	0%
MULTI-FAMILY - APARTMENT BLOCK	303	0%
STORES AND/OR OFFICES WITH APARTMENTS	269	0%
SCHOOLS & UNIVERSITIES, COLLEGE OR TECHNICAL SCHOOLS (INCLUDES PRIVATE KINDERGARTENS).	188	0%
MARINE & NAVIGATIONAL FACILITIES (INCLUDES FERRY LANDINGS, BREAKWATERS, BOAT RAMPS, LIGHTHOUSES, FORESHORE FACILITIES, ETC).	138	0%
BED & BREAKFAST OPERATION LESS THAN 4 UNITS	133	0%
MULTI-FAMILY - GARDEN APARTMENT & ROW HOUSING	98	0%

Zoning

Zoning Category	Area (sq-m)	% of total
P-1	598,581	72%
P-4N	111,615	13%
P-4	46,303	6%
RS-6	36,062	4%
RS-12	23,220	3%
A-1	11,105	1%
RS-13	4,673	1%
C-3	1,935	0%
RD-1	1,265	0%
C-10	1,003	0%
RA-1	852	0%
RA-3	345	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Man made, permeable	3,221	46%
Rock Ramp, narrow < 30m	2,260	32%
Estuary (Organics/Fines)	1,126	16%
Sand and Gravel Beach, narrow < 30m	271	4%
Sand Beach, narrow < 30m	197	3%
Sensitivity Rating		
Very high sensitivity	6,514	92%
High sensitivity	560	8%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$24,239,226	$7,624,736	$31,863,962
Civic, Institutional and Recreational	$10,957,980	$1,228,534	$12,186,515
Commercial	$1,090,338	$1,054,790	$2,145,128
Transportation, Communication and Utility	$2,000	$0	$2,000

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-arterial major Lane-2	918	1190	$1,092,577
Subclass-Local Lane-2	341	770	$262,224
Subclass-arterial minor Lane-2	105	1190	$124,971
Subclass-collector minor Lane-4	20	1530	$29,923

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Colquitz Pump Station (Sewage)	$ 265,600
Dunkirk Lane Pump Station (Sewage)	$ 409,400
Dysart Pump Station (Sewage)	$ 857,300

SLR Focus Area # 9 - Gorge Industrial and Redevelopment Land

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
ELECTRICAL POWER SYSTEMS (INCLUDING NON-UTILITY COMPANIES)	24,374	12%
STORAGE & WAREHOUSING - CLOSED	21,235	10%
SHIPYARDS	20,456	10%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	19,387	9%
METAL FABRICATING INDUSTRIES	15,455	7%
GOVERNMENT BUILDINGS (INCLUDES COURTHOUSE, POST OFFICE, MUNICIPAL HALL, FIRE HALL, POLICE STATIONS, ETC). (EXCLUDES TYPICAL OFFICE BUILDINGS; REFER TO COMMERCIAL SECTIONS).	15,325	7%
INDUSTRIAL - VACANT	12,348	6%
CONCRETE MIXING PLANTS	12,314	6%
MISCELLANEOUS (TRANSPORTATION & COMMUNICATION)	9,026	4%
MARINE FACILITIES - MARINA	8,189	4%
STORE(S) AND OFFICES	7,904	4%
VACANT	5,485	3%
WORKS YARDS	5,037	2%
MISCELLANEOUS (MINING AND ALLIED INDUSTRIES)	4,775	2%
STORAGE & WAREHOUSING - OPEN	4,383	2%
AUTOMOBILE PAINT SHOP, GARAGES, ETC.	4,279	2%
MULTI-FAMILY - VACANT	4,243	2%
ASPHALT PLANTS	2,928	1%
OFFICE BUILDING (PRIMARY USE)	2,821	1%
PARKING - LOT ONLY, PAVED OR GRAVEL	2,220	1%
DOCKS & WHARVES	1,624	1%
COMMERCIAL STRATA-LOT	1,325	1%
STORE(S) AND SERVICE - COMMERCIAL	1,108	1%
MISCELLANEOUS & (INDUSTRIAL OTHER)	1,092	1%
AUTOMOBILE SALES (LOT)	951	0%
RECREATIONAL & CULTURAL BUILDINGS (INCLUDES CURLING RINK ARENA, SWIMMING POOLS, MUSEUMS, HISTORICAL BUILDINGS, ART GALLERY, LIBRARIES) (EXCLUDE PARKS, GOLF COURSES & GOVERNMENT CAMPGROUNDS).	808	0%
SAND & GRAVEL (VACANT AND IMPROVED)	796	0%
PARKS & PLAYING FIELDS	555	0%
RAILWAY	258	0%
NEIGHBOURHOOD PUB	243	0%
STRATA-LOT RESIDENCE (CONDOMINIUM)	121	0%
MULTI-FAMILY - APARTMENT BLOCK	41	0%
CEMENT PLANTS	12	0%
TRANSPORTATION EQUIPMENT INDUSTRY (INCLUDING AIRCRAFT, MOTOR VEHICLE, TRUCK BODY, RAILROAD, SHIPBUILDING, BOATBUILDING, AND REPAIR OF SAME).	0	0%

Zoning

Zoning Category	Area (sq-m)	% of total
M-3	132,412	49%
CD-9	21,018	8%
S-PH	17,758	7%
SD-1	17,594	6%
VHP	16,182	6%
CD-1	13,099	5%
M-2	12,139	4%
M-3S	8,931	3%
CA-W	6,281	2%
MS-4	4,676	2%
CA-19	4,257	2%
M2-G	3,909	1%
SD-2	3,832	1%
CD-5	3,827	1%
M-G	1,850	1%
CA-3C	1,326	0%
M2-I	1,265	0%
CA-34	633	0%
M3-C	289	0%
R-2	209	0%
S-3	191	0%
M-4	91	0%
T-1	48	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
New Songhees First Nation Reserve No. 1A	453

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Man made, permeable	5,091	89%
Sand and Gravel Beach, narrow < 30m	348	6%
Rock Ramp, narrow < 30m	262	5%
Sensitivity Rating		
High sensitivity	3,783	66%
Very high sensitivity	1,919	34%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Commercial	$26,640,747	$29,473,019	$56,113,766
Industrial	$17,486,908	$4,137,422	$21,624,332
Civic, Institutional and Recreational	$12,916,527	$1,934,424	$14,850,951
Residential	$9,318,163	$2,396,053	$11,714,216
Transportation, Communication and Utility	$6,224,427	$797,847	$7,022,273
Mining and Allied Industry	$1,081,636	$4,829	$1,086,465

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	1,108	770	$853,345
Subclass-arterial major Lane-2	176	1190	$209,496
Subclass-collector major Lane-3	139	1180	$163,820
Subclass-collector major Lane-4	25	1530	$37,575

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Point Hope dockyard	
Dockland Green private power facility	
Point Ellice Bay St road bridge (note: elevation above water level for this scenario)	
Concrete plant	
Steel facility	
Lower Public Works Yard	$ 4,887,000
Jutland Business District	
Harbour Pump Station (Sewage)	$ 420,000
Garbally Pump Station (Sewage)	$ 400,000
Johnson St Bridge (road bridge, 133m of E&N rail though this was not identified as operational, Galloping Goose regional trail) (note: elevation of bridge above water level for this scenario)	
Selkirk Trestle: Galloping Goose regional trail (note: bridge elevation above water level for this scenario)	

SLR Focus Area # 10 - Esquimalt DND Naval

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
DOCKS & WHARVES	129,192	56%
GOVERNMENT BUILDINGS (INCLUDES COURTHOUSE, POST OFFICE, MUNICIPAL HALL, FIRE HALL, POLICE STATIONS, ETC). (EXCLUDES TYPICAL OFFICE BUILDINGS; REFER TO COMMERCIAL SECTIONS).	84,173	36%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	11,359	5%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	6,949	3%

Zoning

Zoning Category	Area (sq-m)	% of total
ESQUIMALT Institutional Use 2	102,542	58%
ESQUIMALT Commercial 4	74,624	42%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Man made, permeable	4,757	91%
Sand and Gravel Beach, narrow < 30m	196	4%
Rock Ramp with Gravel Beach, narrow < 30m	175	3%
Rock Ramp, narrow < 30m	113	2%
Sensitivity Rating		
High sensitivity	5,042	96%
Very high sensitivity	122	2%
Moderate sensitivity	78	1%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Civic, Institutional and Recreational	$19,297,826	$26,470,416	$45,768,242
Industrial	$22,043,840	$13,053,082	$35,096,922
Transportation, Communication and Utility	$13,186,000	$0	$13,186,000
Unclassified	$1,372,417	$3,098,353	$4,470,770

Roads

Road Category	Length (m)	Valuation
No registered roads in this Focus Area	-	-

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
DND Naval Base	
Federal land leased to Seaspan (shipyard)	
Pump Station No 2 (Sewage)	
Rainbow Pump Station (Sewage)	
Signal Hill Pump Station No 2 (Sewage)	
Lift Station from Bldg 126 Pump Station No 2 (Sewage)	
Pump Station No 11 (Sewage)	
Graving Dock Lift Station No 14 (Sewage)	
North Wharf Lift Station No 15 (Sewage)	

SLR Focus Area # 11 - Gorge Esquimalt

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
NO JUROL IDENTIFIER; LAND USE UNKNOWN	101,830	68%
SINGLE FAMILY DWELLING	23,412	16%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	7,687	5%
HOTEL	7,203	5%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	2,136	1%
Code 300 (not defined by BC Assessment)	1,942	1%
VACANT RESIDENTIAL LESS THAN 2 ACRES	1,569	1%
STRATA-LOT RESIDENCE (CONDOMINIUM)	1,094	1%
MULTI-FAMILY - APARTMENT BLOCK	1,059	1%
DUPLEX - UP & DOWN	996	1%
BED & BREAKFAST OPERATION 4 OR MORE UNITS	706	0%
NURSING HOME	329	0%
BED & BREAKFAST OPERATION LESS THAN 4 UNITS	98	0%
TRIPLEX	62	0%
DUPLEX	59	0%
ROW HOUSING - SINGLE UNIT OWNERSHIP	56	0%
MARINE & NAVIGATIONAL FACILITIES (INCLUDES FERRY LANDINGS, BREAKWATERS, BOAT RAMPS, LIGHTHOUSES, FORESHORE FACILITIES, ETC).	16	0%
DUPLEX - SINGLE UNIT OWNERSHIP	3	0%

Zoning

Zoning Category	Area (sq-m)	% of total
ESQUIMALT Recreation 1	48,562	33%
Data layer gives no attribute data; unknown zoning	42,347	28%
ESQUIMALT Residential 3	30,575	21%
P-1	12,326	8%
ESQUIMALT Mixed Use 4	7,160	5%
ESQUIMALT Residential 4	5,336	4%
ESQUIMALT Residential 6	2,487	2%
VIEW ROYAL Recreation 2	71	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Man made, permeable	1,456	49%
Estuary (Organics/Fines)	870	29%
Rock Ramp, narrow < 30m	479	16%
Sand Beach, narrow < 30m	192	6%
Sensitivity Rating		
Very high sensitivity	2,265	76%
High sensitivity	732	24%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$20,196,783	$9,566,472	$29,763,254
Civic, Institutional and Recreational	$3,551,542	$26,897	$3,578,439
Commercial	$2,947,500	$511,227	$3,458,727
Transportation, Communication and Utility	$2,000	$0	$2,000
Unclassified	$1	$0	$1

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	179	770	$137,900
Subclass-collector minor Lane-4	21	1530	$32,175
Subclass-recreation Lane-2	36	770	$27,352
Subclass-arterial major Lane-2	102	1190	$121,155

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Forshaw Pump Station (Sewage)	-
Craigflower Pump Station (Sewage)	$ 2,806,700
Sewage Storage Chamber (Sewage)	-

SLR Focus Area # 12 - Inner Harbour

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
MARINE FACILITIES - MARINA	54,168	45%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	26,772	22%
MARINE & NAVIGATIONAL FACILITIES (INCLUDES FERRY LANDINGS, BREAKWATERS, BOAT RAMPS, LIGHTHOUSES, FORESHORE FACILITIES, ETC).	18,500	15%
PARKING - LOT ONLY, PAVED OR GRAVEL	16,634	14%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	2,337	2%
PARKS & PLAYING FIELDS	701	1%
VACANT	490	0%
STORE(S) AND OFFICES	339	0%
STORE(S) AND SERVICE - COMMERCIAL	309	0%
STRATA-LOT RESIDENCE (CONDOMINIUM)	261	0%
OFFICE BUILDING (PRIMARY USE)	113	0%
COMMERCIAL STRATA-LOT	8	0%

Zoning

Zoning Category	Area (sq-m)	% of total
IH-PARK	22,813	19%
IHT2	22,711	19%
IHBA	21,002	18%
IHSN	18,084	15%
IHT3	14,432	12%
IHSS	7,174	6%
IHR	6,050	5%
IHM	5,947	5%
IHF	398	0%
IHH	307	0%
CA-W	18	0%
IHB	2	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Man made, permeable	1,806	100%
Sensitivity rating		
High sensitivity	1,806	100%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Transportation, Communication and Utility	$14,856,683	$8,389,913	$23,246,596
Commercial	$16,688,285	$3,795,523	$20,483,807
Residential	$10,581,483	$5,412,753	$15,994,236
Civic, Institutional and Recreational	$1,904,378	$7,290	$1,911,668

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-ferry Lane-2	229	1190	$272,460
Subclass-Local Lane-2	17	770	$13,157

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
Coho ferry terminal	
Clipper terminal	
Customs facilities	
Marina and floating docks	
Harbour Air terminal	

SLR Focus Area # 13 - Ogden Point

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
MARINE FACILITIES - MARINA	191,238	75%
GOVERNMENT BUILDINGS (INCLUDES COURTHOUSE, POST OFFICE, MUNICIPAL HALL, FIRE HALL, POLICE STATIONS, ETC). (EXCLUDES TYPICAL OFFICE BUILDINGS; REFER TO COMMERCIAL SECTIONS).	57,668	23%
OFFICE BUILDING (PRIMARY USE)	5,375	2%
VACANT	905	0%
TRIPLEX	297	0%
SINGLE FAMILY DWELLING	267	0%
HOTEL	51	0%
STRATA LOT - PARKING RESIDENTIAL	32	0%
COMMERCIAL STRATA-LOT	3	0%

Zoning

Zoning Category	Area (sq-m)	% of total
M-2	109,123	61%
M-S-1	64,602	36%
VHP	3,909	2%
MS-3	73	0%
R3-L	41	0%
MS-2	32	0%
R2-36	30	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Man made, permeable	3,327	97%
Rock Cliff, narrow < 30m	86	3%
Sensitivity Rating		
High sensitivity	2,754	81%
Very high sensitivity	659	19%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Transportation, Communication and Utility	$12,880,410	$9,565,011	$22,445,420
Civic, Institutional and Recreational	$16,557,211	$2,844,532	$19,401,739
Commercial	$6,291,010	$4,067,099	$10,358,108
Residential	$327,988	$206,572	$534,560

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-collector major Lane-2	29	870	$24,976
Subclass-Local Lane-2	11	770	$8,455

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
Fishermens Wharf (tourism attraction and houseboats)	-
Greater Victoria Harbour Authority, Helijet and Coastguard facilities	-
Cruise ship terminal	-

SLR Focus Area # 14 - Dallas Road

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	70,478	83%
CEMETARIES (INCLUDES PUBLIC OR PRIVATE).	6,502	8%
SINGLE FAMILY DWELLING	2,653	3%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	2,499	3%
TRIPLEX	922	1%
DUPLEX	778	1%
DUPLEX - UP & DOWN	532	1%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	272	0%
MULTI-FAMILY - APARTMENT BLOCK	188	0%
STRATA-LOT RESIDENCE (CONDOMINIUM)	88	0%
STRATA LOT - PARKING RESIDENTIAL	88	0%
DUPLEX - SINGLE UNIT OWNERSHIP	7	0%

Zoning

Zoning Category	Area (sq-m)	% of total
R1-B	23,525	68%
R3-2	1,717	5%
R-J	8,936	26%
R1-G	408	1%
R1-18	84	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Sand and Gravel Beach, narrow < 30m	1,503	73%
Gravel Beach, narrow < 30m	431	21%
Rock Ramp, narrow < 30m	69	3%
Rock Platform with Sand and Gravel Beach, wide > 3	62	3%
Sensitvity Rating		
High sensitivity	1,634	79%
Very high sensitivity	431	21%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$12,127,760	$4,513,012	$16,640,773
Civic, Institutional and Recreational	$4,861,478	$274	$4,861,752

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-arterial minor Lane-2	596	1190	$709,310
Subclass-local Lane 1	191	620	$118,521
Subclass-Local Lane-2	161	770	$124,084

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Dallas Road (key road route) and seawall	-
Ross Bay cemetery	-
Memorial Pump Station (Sewage)	$ 300,000

SLR Focus Area # 15 - Oak Bay Windsor Park Area

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
SINGLE FAMILY DWELLING	160,287	51%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	35,581	11%
MARINE FACILITIES - MARINA	30,824	10%
No JUROL identified; land use is unknown	17,143	5%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	16,825	5%
PARKS & PLAYING FIELDS	14,990	5%
MARINE & NAVIGATIONAL FACILITIES (INCLUDES FERRY LANDINGS, BREAKWATERS, BOAT RAMPS, LIGHTHOUSES, FORESHORE FACILITIES, ETC).	10,338	3%
MULTI-FAMILY - APARTMENT BLOCK	6,296	2%
DUPLEX	5,748	2%
GOVERNMENT BUILDINGS (INCLUDES COURTHOUSE, POST OFFICE, MUNICIPAL HALL, FIRE HALL, POLICE STATIONS, ETC). (EXCLUDES TYPICAL OFFICE BUILDINGS; REFER TO COMMERCIAL SECTIONS).	4,675	1%
STORE(S) AND LIVING QUARTERS	3,931	1%
MULTI-FAMILY - HIGH-RISE	2,666	1%
DUPLEX - UP & DOWN	1,589	1%
BED & BREAKFAST OPERATION 4 OR MORE UNITS	1,351	0%
SCHOOLS & UNIVERSITIES, COLLEGE OR TECHNICAL SCHOOLS (INCLUDES PRIVATE KINDERGARTENS).	1,336	0%
MULTI-FAMILY - MINIMAL COMMERCIAL	1,177	0%
MULTI-FAMILY - CONVERSION	754	0%
TRIPLEX	580	0%
STORE(S) AND SERVICE - COMMERCIAL	515	0%

Zoning

Zoning Category	Area (sq-m)	% of total
RS5	240,501	42%
P4	146,432	26%
P1	82,026	14%
CS2	34,765	6%
RS4	15,795	3%
RM3	14,762	3%
RM4	13,423	2%
C2	12,300	2%
RM8	4,877	1%
P2	2,074	0%
C1	1,731	0%
RM2	904	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Man made, permeable	557	26%
Sand and Gravel Flat or Fan, wide > 30m	511	24%
Sand and Gravel Beach, narrow < 30m	347	16%
Rock Ramp with Sand and Gravel Beach, narrow < 30m	331	15%
Rock Ramp with Gravel Beach, narrow < 30m	219	10%
Rock Ramp, narrow < 30m	98	5%
Man made impermeable	92	4%
Sensitivity Rating		
High sensitivity	1,424	66%
Very high sensitivity	639	30%
Moderate sensitivity	92	4%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$217,274,200	$81,915,177	$299,189,377
Commercial	$13,216,215	$6,059,947	$19,276,162
Civic, Institutional and Recreational	$9,504,596	$1,079,701	$10,584,297
Transportation, Communication and Utility	$277,521	$747,488	$1,025,009

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	3,434	770	$2,644,059
Subclass-Collector Minor Lane-2	1,452	870	$1,263,269
Subclass-arterial minor Lane-2	659	1190	$783,868

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
East-west road routes that connect to residential areas and golf course	
Windsor Park	
St Christopher's school	
Currie Lift Station Pump Station (Sewage)	$ 662,800

SLR Focus Area # 16 - Cadboro Bay

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
SINGLE FAMILY DWELLING	60,671	46%
PARKS & PLAYING FIELDS	24,457	19%
GOVERNMENT BUILDINGS (INCLUDES COURTHOUSE, POST OFFICE, MUNICIPAL HALL, FIRE HALL, POLICE STATIONS, ETC). (EXCLUDES TYPICAL OFFICE BUILDINGS; REFER TO COMMERCIAL SECTIONS).	16,352	12%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	11,509	9%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	7,392	6%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	4,822	4%
VACANT RESIDENTIAL LESS THAN 2 ACRES	4,390	3%
DUPLEX	1,276	1%
BED & BREAKFAST OPERATION LESS THAN 4 UNITS	248	0%
STRATA-LOT RESIDENCE (CONDOMINIUM)	13	0%
VACANT	8	0%
MULTI-FAMILY - CONVERSION	7	0%
ROW HOUSING - SINGLE UNIT OWNERSHIP	6	0%

Zoning

Zoning Category	Area (sq-m)	% of total
RS-10	62,379	36%
P-4	58,519	34%
P-1	27,323	16%
RS-12A	18,592	11%
RD-1	1,892	1%
P-2	1,442	1%
C-2	650	0%
RS-8	456	0%
RS-16	159	0%
RS-6	85	0%
RT-3	0	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Sand Flat, wide > 30m	1,402	90%
Rock Ramp with Sand Beach, wide > 30m	159	10%
Sensitivity Rating		
Very high sensitivity	1,402	90%
High sensitivity	159	10%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$44,884,263	$13,876,980	$58,761,243
Civic, Institutional and Recreational	$6,050,999	$2,942,000	$8,992,999
Commercial	$756,625	$130,653	$887,278

Roads

Road Category	Total Length	Unit cost	Valuation
Subclass-Local Lane-2	655	770	$504,104
Subclass-Collector Major Lane-2	93	870	$80,987

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Gyro beach and park (valuation for washrooms only)	$ 251,000
Penhryn Lift Station and Booster Pump Station (Sewage)	$ 3,206,900

SLR Focus Area # 17 - Island View Park

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	514,491	40%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	465,656	36%
VACANT	79,773	6%
OTHER	58,518	4%
VEGETABLE & TRUCK	48,684	4%
VEGETABLE & TRUCK - VACANT	46,934	4%
2 ACRES OR MORE - SINGLE FAMILY DWELLING, DUPLEX	22,494	2%
SINGLE FAMILY DWELLING	17,438	1%
INDUSTRIAL - VACANT	14,523	1%
MISCELLANEOUS (FOREST AND ALLIED INDUSTRY)	14,523	1%
PARKS & PLAYING FIELDS	12,876	1%
TELEPHONE	3,096	0%
VACANT RESIDENTIAL LESS THAN 2 ACRES	1,666	0%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	1,114	0%

Zoning

Zoning Category	Area (sq-m)	% of total
W1	689,175	45%
P2	552,620	36%
A1	259,108	17%
RE2	18,284	1%
RE5	16,763	1%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
East Saanich First Nation Reserve No. 2	458,553

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Sand and Gravel Flat or Fan, wide > 30m	2,960	33%
Estuary (Organics/Fines)	2,753	31%
Sand Flat, wide > 30m	2,177	24%
Sand and Gravel Beach, narrow < 30m	961	11%
Rock Platform with Sand and Gravel Beach, wide > 3	102	1%
Rock Ramp with Sand and Gravel Beach, narrow < 30m	58	1%
Sensitivity Rating		
Very high sensitivity	8,459	94%
High sensitivity	553	6%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Civic, Institutional and Recreational	$17,847,127	$37,500	$17,884,627
Residential	$6,160,559	$3,284,218	$9,444,777
Commercial	$1,899,960	$0	$1,899,960
Farm	$24,780	$246,525	$271,305
Industrial	$4,757	$0	$4,757
Transportation, Communication and Utility	$1,253	$0	$1,253
Forest and Allied Industry	$386	$0	$386

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	1,798	770	$1,384,647

Major Transmission and Pipelines

Major electric transmission line of 371m length

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Regional park	
Island view campground (value for toilet and kiosk only)	$ 43,929
Tsawout Pollution Control Centre (Sewage)	

SLR Focus Area # 18 - Patricia Bay

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
AIRPORTS, HELIPORTS, ETC.	137,289	63%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	49,617	23%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	20,221	9%
GOVERNMENT RESEARCH CENTRES (INCLUDES NURSERIES & FISH HATCHERIES).	11,899	5%

Zoning

Zoning Category	Area (sq-m)	% of total
P-3	135,510	61%
AP-1	49,858	23%
M-6	25,061	11%
P-1	8,806	4%
P-4	1,622	1%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Man made, permeable	674	58%
Sand Flat, wide > 30m	445	39%
Rock Platform with Sand and Gravel Beach, wide > 3	34	3%
Sensitivity Rating		
Very high sensitivity	904	78%
High sensitivity	249	22%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Civic, Institutional and Recreational	$1,285,301	$4,159,603	$5,444,904
Transportation, Communication and Utility	$359,741	$38,108	$397,850

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	144	770	$110,562

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
Float plane terminal	
Institute of Ocean Sciences Pump Station (Sewage)	

SLR Focus Area # 19 - South Sidney

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
SINGLE FAMILY DWELLING	46,723	29%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	37,566	23%
MARINE & NAVIGATIONAL FACILITIES (INCLUDES FERRY LANDINGS, BREAKWATERS, BOAT RAMPS, LIGHTHOUSES, FORESHORE FACILITIES, ETC).	26,965	17%
STORE(S) AND OFFICES	18,961	12%
GARBAGE DUMPS, SANITARY FILLS, SEWER LAGOONS, ETC.	7,804	5%
DUPLEX - SINGLE UNIT OWNERSHIP	5,223	3%
STRATA-LOT RESIDENCE (CONDOMINIUM)	5,125	3%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	3,351	2%
MOTEL & AUTO COURT	2,861	2%
ROW HOUSING - SINGLE UNIT OWNERSHIP	2,163	1%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	1,233	1%
DUPLEX	1,100	1%
BED & BREAKFAST OPERATION LESS THAN 4 UNITS	962	1%
MULTI-FAMILY - CONVERSION	384	0%
VACANT RESIDENTIAL LESS THAN 2 ACRES	338	0%
VACANT	258	0%
CHURCHES & BIBLE SCHOOLS	191	0%
PARKS & PLAYING FIELDS	37	0%

Zoning

Zoning Category	Area (sq-m)	% of total
R1.2	71,874	30%
P1	60,455	25%
U2	32,068	13%
W3	15,509	6%
R1.1	14,693	6%
R2	8,670	4%
RM5.2	8,254	3%
C5.2	5,994	2%
U1	5,821	2%
U3	5,077	2%
RM4	4,590	2%
CD	3,642	2%
RM1.2	3,338	1%
I2	425	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Man made, permeable	1,058	61%
Man made impermeable	460	26%
Sand and Gravel Flat or Fan, wide > 30m	220	13%
Sensitivity Rating		
High sensitivity	1,518	87%
Very high sensitivity	220	13%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$48,498,382	$20,406,380	$68,904,762
Civic, Institutional and Recreational	$9,747,230	$4,306,116	$14,053,346
Transportation, Communication and Utility	$7,147,251	$1,064,971	$8,212,222
Commercial	$1,981,057	$494,665	$2,475,722

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	2,739	770	$2,108,806
Subclass-recreation Lane-2	75	770	$57,632
Subclass-collector major Lane-2	665	870	$578,893
Subclass-strata Lane 2	88	770	$67,378

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Sidney to Anacortes Ferry Terminal	
Sidney Pump Station (Sewage)	$3,952,800

SLR Focus Area # 20 - Tsehum Harbour Sidney

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	21,248	23%
MARINE FACILITIES - MARINA	19,701	21%
ROW HOUSING - SINGLE UNIT OWNERSHIP	17,140	18%
STRATA-LOT RESIDENCE (CONDOMINIUM)	10,344	11%
SINGLE FAMILY DWELLING	7,689	8%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	6,102	6%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	5,419	6%
DUPLEX - SINGLE UNIT OWNERSHIP	2,176	2%
PARKS & PLAYING FIELDS	1,676	2%
STORE(S) AND LIVING QUARTERS	1,526	2%
SHIPYARDS	599	1%
OFFICE BUILDING (PRIMARY USE)	442	0%

Zoning

Zoning Category	Area (sq-m)	% of total
W3	193,907	42%
W1	168,691	37%
P1	23,588	5%
R2	18,710	4%
RM3	17,116	4%
RM5.2	16,278	4%
W2	12,767	3%
M-6	4,127	1%
R1.1	1,157	0%
C5	389	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Sand Flat, wide > 30m	795	27%
Man made impermeable	633	21%
Man made, permeable	536	18%
Rock Ramp, narrow < 30m	241	8%
Rock Ramp with Sand and Gravel Beach, narrow < 30m	217	7%
Sand and Gravel Beach, narrow < 30m	155	5%
Rock Ramp with Sand and Gravel Beach, wide > 30m	146	5%
Rock Cliff with Sand and Gravel Beach, narrow < 30	126	4%
Rock Platform with Sand and Gravel Beach, wide > 3	98	3%
Sensitivity Rating		
High sensitivity	1,707	58%
Very high sensitivity	1,240	42%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$34,262,731	$17,781,588	$52,044,319
Commercial	$13,793,916	$5,331,022	$19,124,937
Civic, Institutional and Recreational	$5,040,067	$10,315	$5,050,382
Industrial	$389,903	$220,342	$610,245
Unclassified	$1	$0	$1

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-strata Lane 2	574	770	$442,360
Subclass-Local Lane-2	533	770	$410,754
Subclass-collector minor Lane-2	355	870	$308,719

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
Large marina facilities	
Harbour Pump Station (Sewage)	

SLR Focus Area # 21 - Tsehum Harbour N Saanich

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
SINGLE FAMILY DWELLING	99,006	40%
MARINE FACILITIES - MARINA	85,160	34%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	21,439	9%
MULTI-FAMILY - GARDEN APARTMENT & ROW HOUSING	14,128	6%
VACANT RESIDENTIAL LESS THAN 2 ACRES	8,283	3%
MARINE & NAVIGATIONAL FACILITIES (INCLUDES FERRY LANDINGS, BREAKWATERS, BOAT RAMPS, LIGHTHOUSES, FORESHORE FACILITIES, ETC).	5,259	2%
RESIDENTIAL OUTBUILDING ONLY	4,697	2%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	4,145	2%
No JUROL identified; land use is unknown	2,675	1%
ROW HOUSING - SINGLE UNIT OWNERSHIP	2,482	1%
STRATA-LOT RESIDENCE (CONDOMINIUM)	1,213	0%
SCHOOLS & UNIVERSITIES, COLLEGE OR TECHNICAL SCHOOLS (INCLUDES PRIVATE KINDERGARTENS).	337	0%
2 ACRES OR MORE - SINGLE FAMILY DWELLING, DUPLEX	125	0%

Zoning

Zoning Category	Area (sq-m)	% of total
M-6	545,843	60%
M-3	119,128	13%
R-2	117,559	13%
M-4	50,275	6%
M-2	40,143	4%
P-4	16,726	2%
RM-2	14,128	2%
P-1	1,274	0%
M-5	688	0%

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Mud Flat, wide > 30m	3,211	40%
Sand Flat, wide > 30m	1,652	20%
Man made impermeable	893	11%
Man made, permeable	601	7%
Rock Ramp, narrow < 30m	463	6%
Rock Platform with Sand Beach, wide > 30m	433	5%
Rock Ramp with Sand and Gravel Beach, narrow < 30m	405	5%
Rock Ramp with Sand and Gravel Beach, wide > 30m	233	3%
Rock Platform with Sand and Gravel Beach, wide > 3	80	1%
Rock Cliff, narrow < 30m	80	1%
Sand Beach, narrow < 30m	77	1%
Sensitivity Rating		
Very high sensitivity	5,768	71%
High sensitivity	2,361	29%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$36,386,822	$23,118,092	$59,504,913
Commercial	$24,805,685	$9,161,787	$33,967,472
Civic, Institutional and Recreational	$1,284,227	$167,459	$1,451,686
Transportation, Communication and Utility	$504,000	$0	$504,000

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	1,153	770	$888,023
Subclass-collector minor Lane-2	264	870	$229,925
Subclass-strata Lane 2	140	770	$107,571

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
Large marina facilities	

SLR Focus Area # 22 Fulford Harbour

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
2 ACRES OR MORE - SINGLE FAMILY DWELLING, DUPLEX	19,769	23%
DOCKS & WHARVES	15,566	18%
MARINE & NAVIGATIONAL FACILITIES (INCLUDES FERRY LANDINGS, BREAKWATERS, BOAT RAMPS, LIGHTHOUSES, FORESHORE FACILITIES, ETC).	13,224	16%
MIXED	9,684	11%
2 ACRES OR MORE - SEASONAL DWELLING	8,048	9%
MOTEL & AUTO COURT	7,162	8%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	2,819	3%
SINGLE FAMILY DWELLING	2,147	3%
MARINE FACILITIES - MARINA	1,637	2%
MIXED - VACANT	1,379	2%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	1,072	1%
RESTAURANT ONLY	590	1%
CHURCHES & BIBLE SCHOOLS	467	1%
INDUSTRIAL - VACANT	452	1%
SEASONAL DWELLING	316	0%
VACANT RESIDENTIAL LESS THAN 2 ACRES	291	0%
STORE(S) AND LIVING QUARTERS	287	0%
RESIDENTIAL OUTBUILDING ONLY	184	0%
TELEPHONE	126	0%
STORE(S) AND SERVICE - COMMERCIAL	27	0%

Zoning

Zoning Category	Area (sq-m)	% of total
No Municipal Zoning data for this Focus Area		

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Sand and Gravel Flat or Fan, wide > 30m	825	46%
Rock Cliff with Sand and Gravel Beach, narrow < 30	523	29%
Man made, permeable	270	15%
Rock Ramp with Sand and Gravel Beach, wide > 30m	58	3%
Rock Cliff, narrow < 30m	47	3%
Rock Platform with Sand and Gravel Beach, wide > 3	36	2%
Sand and Gravel Beach, narrow < 30m	24	1%
Sensitivity Rating		
High sensitivity	1,136	64%
Low sensitivity	565	32%
Moderate sensitivity	82	5%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Commercial	$1,483,232	$1,296,204	$2,779,436
Residential	$1,146,810	$372,054	$1,518,864
Transportation, Communication and Utility	$1,101,048	$410,198	$1,511,246
Industrial	$308,338	$57,692	$366,029
Farm	$12,693	$99,520	$112,213
Civic, Institutional and Recreational	$67,307	$700	$68,007

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	127	770	$97,882
Subclass-collector minor Lane-2	310	870	$269,844
Subclass-ferry Lane-2	225	1190	$268,097

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
Main road to / from Fulford Harbour	
Fulford marina and ferry terminal	
Fulford-Ganges Rd Bridge	

SLR Focus Area # 23 - Central Ganges

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
NO JUROL IDENTIFIER; LAND USE UNKNOWN	69,957	41%
DOCKS & WHARVES	42,761	25%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	19,066	11%
STORE(S) AND SERVICE - COMMERCIAL	14,400	8%
STORE(S) AND OFFICES	6,347	4%
MARINE FACILITIES - MARINA	4,095	2%
VACANT RESIDENTIAL LESS THAN 2 ACRES	3,205	2%
Code 300 (not defined by BC Assessment)	1,985	1%
RESIDENTIAL OUTBUILDING ONLY	1,823	1%
VACANT	1,573	1%
BED & BREAKFAST OPERATION 4 OR MORE UNITS	1,439	1%
GOVERNMENT BUILDINGS (INCLUDES COURTHOUSE, POST OFFICE, MUNICIPAL HALL, FIRE HALL, POLICE STATIONS, ETC). (EXCLUDES TYPICAL OFFICE BUILDINGS; REFER TO COMMERCIAL SECTIONS).	1,287	1%
SINGLE FAMILY DWELLING	1,167	1%
STORE(S) AND LIVING QUARTERS	804	0%
BANK	792	0%
SEASONAL DWELLING	620	0%
2 ACRES OR MORE - SINGLE FAMILY DWELLING, DUPLEX	283	0%
SERVICE STATION	265	0%
ROW HOUSING - SINGLE UNIT OWNERSHIP	108	0%
SINGLE FAMILY DWELLING WITH BASEMENT SUITE	96	0%
STORAGE & WAREHOUSING - CLOSED	8	0%

Zoning

Zoning Category	Area (sq-m)	% of total
No Municipal Zoning data for this Focus Area		

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Man made impermeable	892	33%
Man made, permeable	543	20%
Rock Ramp, narrow < 30m	392	14%
Rock Ramp with Sand and Gravel Beach, narrow < 30m	278	10%
Rock Platform with Sand and Gravel Beach, wide > 3	222	8%
Sand and Gravel Beach, narrow < 30m	201	7%
Sand and Gravel Flat or Fan, wide > 30m	105	4%
Sand Flat, wide > 30m	85	3%
Sensitivity Rating		
Very high sensitivity	1,333	49%
High sensitivity	927	34%
Moderate sensitivity	457	17%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Commercial	$9,619,565	$13,110,649	$22,730,214
Civic, Institutional and Recreational	$2,294,376	$3,476,728	$5,771,105
Residential	$1,688,764	$443,717	$2,132,481
Industrial	$302,016	$148,845	$450,861
Unclassified	$2	$0	$2

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	257	770	$97,882
Subclass-collector minor Lane-2	121	870	$269,844
Subclass-strata Lane 2	51	1	$225

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets; see main report for basis for valuation]

Asset Name	Valuation where available
Fire hall	
Library	$6,200,000
Main road to / from Ganges	
Manson Road Pump Station (Sewage)	$154,400

SLR Focus Area # 24 - Galliano Island

Actual Land Use

Actual Land Use Category	Area (sq-m)	% of total
ELECTRICAL POWER SYSTEMS (INCLUDING NON-UTILITY COMPANIES)	41,836	27%
SEASONAL DWELLING	25,311	17%
TELEPHONE	18,374	12%
2 ACRES OR MORE - SINGLE FAMILY DWELLING, DUPLEX	17,143	11%
VACANT RESIDENTIAL LESS THAN 2 ACRES	14,340	9%
RESIDENTIAL OUTBUILDING ONLY	9,507	6%
SINGLE FAMILY DWELLING	7,278	5%
2 ACRES OR MORE - VACANT	6,182	4%
DOCKS & WHARVES	5,216	3%
CIVIC, INSTITUTIONAL & RECREATIONAL - VACANT	3,911	3%
NO JUROL IDENTIFIER; LAND USE UNKNOWN	1,675	1%
LOGGING OPERATIONS	1,256	1%
2 ACRES OR MORE - SEASONAL DWELLING	354	0%
2 ACRES OR MORE - MANUFACTURED HOME	53	0%

Zoning

Zoning Category	Area (sq-m)	% of total
No Municipal Zoning data for this Focus Area		

First Nation Reserves

Reserve name (First Nation)	Area (sq-m)
None identified	

Physical Shoreline

Physical Shoreline Category	Length (m)	% of total
Shoreline Type		
Rock Ramp, wide > 30m	1,167	19%
Rock Platform, wide > 30m	1,164	19%
Rock Ramp with Sand Beach, narrow < 30m	886	15%
Rock Cliff, narrow < 30m	752	12%
Sand Flat, wide > 30m	511	8%
Gravel Beach, narrow < 30m	383	6%
Sand and Gravel Beach, narrow < 30m	309	5%
Rock Ramp, narrow < 30m	302	5%
Sand and Gravel Flat or Fan, wide > 30m	298	5%
Rock Ramp with Sand Beach, wide > 30m	187	3%
Man made, permeable	136	2%
Sensitivity Rating		
High sensitivity	3,593	59%
Moderate sensitivity	1,410	23%
Low sensitivity	579	10%
Very high sensitivity	511	8%

Land Valuation

Category of Land	Total Land Value	Total Improve'ts Value	Total
Residential	$5,784,325	$2,112,262	$7,896,587
Industrial	$59,955	$40,693	$100,648
Transportation, Communication and Utility	$56,788	$0	$56,788
Civic, Institutional and Recreational	$22,088	$0	$22,088

Roads

Road Category	Length (m)	Unit cost	Valuation
Subclass-Local Lane-2	184	770	$97,882

Major Transmission and Pipelines

No major assets identified

Key Assets

[valuation given for selected public assets]

Asset Name	Valuation where available
No Key Assets identified. This area was included as a Focus Area as representative of shoreline residential for Southern Gulf Islands Electoral Area	

Appendix C
Methods for service disruption case studies

1. Transportation Disruption Case Study - Method

1.1 Commute Costs

The Commute Costs metric is defined as the daily cost of lost time per worker resulting from longer commutes. These costs may be borne by workers in the form of lost personal time or by firms in the form of lower productivity. The Commute Costs metric is calculated according to the following steps:

1. Vehicle Trips Per Day: The number of vehicles traveling the Focus Area per day is derived from BC Ministry of Transportation traffic data.
2. Travel Time Increase: A typical increase in travel time per trip that would result from temporary disruption is estimated. AECOM used travel time data from Google Maps to estimate the net increase in travel time required to reach Victoria by an alternate route from various points along Highway 14, north of the focus area (Shirley, Jordan River, and Port Renfrew). The assumed additional travel time required per trip is an average of these time estimates, weighted by the share of the population that lives in each of these communities, according to Census and CRD population estimates.
3. Increase in Commute Hours: The number of vehicle trips per day is multiplied by the additional travel time per trip to determine the total increase in commute hours per day resulting from the transportation disruption.
4. Daily Cost of Transportation Disruption: The Increase in Commute Hours output is multiplied by the average value of a person's time (assumed to be the average hourly wage in British Columbia) to yield the daily cost of the disruption.
5. Winter Impact: AECOM did not have access to data regarding the seasonality of traffic in the Focus Area. Therefore, winter impacts were not calculated for this indicator.

Table C1 summarizes the results of the commute costs calculation and the primary data sources.

Table C1 - Commute Costs Calculator

Commute impact area	# of passenger vehicles per day	Additional travel time per trip (hours)	Average value of a worker's time per hour	Cost of disruption / day
Highway 14, south of Shirley	1,348	1.6	$24.47	$52,776
Source:	BC Ministry of Infrastructure and Transportation 2012	AECOM Estimate, Google Maps	Statistics Canada 2014	

1.2 Private Transit Costs

The Private Transit Costs metric is defined as the daily cost of lost business revenue from service disruption borne by private transportation companies – in this case, the West Coast Trail Express, a shuttle bus service that runs from Victoria to the trailheads of the West Coast Trail[6]. The Private Transit Costs metric is calculated according to the following steps:

1. Number of Daily Passengers: The number of daily passengers was determined from a direct interview with the transit company. In this case, the West Coast Trail Express representative provided an estimate of annual passenger volume, which was converted to a daily figure. Note that the daily estimate is an average of the entire year, not only the months when the shuttle is in operation.
2. Transit Revenues: Passenger ticket costs are presumed to be the sole source of revenue, and are drawn from the West Coast Trail Express website. Full price, no-discount ticket prices are assumed.
3. Average Daily Cost of Service Disruptions: The business' estimate of average daily passengers is multiplied by the price per ticket to yield the average daily cost of service disruption on private transit revenue.
4. Winter Impact: The West Coast Trail Express only runs during the summer months. The winter daily impact is therefore zero.

Table C2 below, summarizes the results of the private transit costs calculation and the primary data sources.

Table C2 - Private Transit Costs Calculator

Private Transit impact	Average daily passengers	Price per passenger ticket	Cost of disruption / day
West Coast Trail Express (year round average)	10	$95	$950
West Coast Trail Express (winter)	0	$95	$0
Source:	West Coast Trail Express 2014a	West Coast Trail Express 2014b	

1.3 Emergency Services Costs

The Emergency Services Costs metric is defined as the daily cost of providing alternative emergency services to areas that are temporarily inaccessible by road. This metric relies on the assumption that emergency responders will reach residents of the focus area by airplane or helicopter during a storm event instead of by less expensive road transport. The Emergency Services Cost metric is calculated according to the following steps:

1. Number of Daily Emergency Response Events: The number of emergency response events per day in communities northwest of the Focus Area is determined by multiplying the daily number of emergency events per capita (as reported by BC Ambulance Services) by the population of communities impacted by the highway disruption. For purposes of this case study, impacted communities are defined as those communities immediately north of the Focus Area situated along Highway 14 whose route to Victoria would significantly change due to inundation of the Focus Area.

[6] For analysis of public transit costs in Focus Areas where public transportation is more prevalent, a similar calculation can determine the cost of service disruption to public transportation agencies.

2. Increase in Cost for Emergency Response: The increase in costs per emergency event for ground versus air services is determined by taking the difference between the unsubsidized fee for BC Ambulance emergency response by road and the average of helicopter and airplane response fees.[7]
3. Daily Cost to Provide Alternative Emergency Services: The number of emergency events per day in the focus area multiplied by the increase in costs per emergency for air response represents the daily cost to provide alternative emergency services.
4. Winter Impacts: Winter-only impacts were not calculated for this indicator.

Table C3 below, summarizes the results of alternative emergency services costs calculation and the primary data sources.

Table C3 - Emergency Services Costs Calculator

Alternative Emergency Services impact	Number of emergency response events per day	Additional cost per emergency event (air vs. ground service)	Cost of disruption / day
Service to Highway 14 communities, Shirley – Port Renfrew	0.25	$1,193	$298
Source:	AECOM analysis of BCAS Annual Report 2009 and CRD Population Estimates 2013	AECOM analysis of BCAS Fee Schedule 2014	

1.4 Tourism Costs

The Tourism Costs metric is defined as the daily costs of lost tourism spending caused by service disruption. Highway 14 is the primary thoroughfare from Victoria to reach popular tourist destinations such as the West Coast Trail and the Juan de Fuca Trail. This metric assumes that disruption of Highway 14 would deter tourists from traveling to destinations north of the Focus Area. The Tourism Costs metric is calculated according to the following steps:

1. Average Daily Visitors: Total average daily visitors to provincial and national parks north of the study area (i.e., from Shirley to the West Coast Trail) is determined using BC Provincial Parks and Pacific Rim Park data.
2. Average Tourist Spending per Visit: Average tourist spending per visit is drawn from prior economic studies of the parks and weighted according to the share of daily visitors who go to the provincial and national parks, respectively. The Bank of Canada's inflation calculator is used to adjust tourism spending figures to current prices.
3. Lost Tourism Spending: The number of daily visitors is multiplied by average daily tourist spending to determine the daily cost of lost tourism spending.
4. Winter Impacts: Winter Impacts exclude visits to the West Coast Trail, which is closed in the winter. Visits to the provincial parks were assumed to be constant (as seasonal data was not available at the time of the study).

[7] Fees are based on those charged to non-beneficiaries of the BC Medical Services Plan. These fees, according to BC Ambulance Services, represent the "unsubsidized cost of providing these services."

Table C4 below, summarizes the results of the tourism costs calculation and the primary data sources.

Table C4 - Tourism Costs Calculator

Tourism impact	Average Daily Visitors	Tourist spending per visit	Cost of disruption / day
BC provincial parks	1,188	$27.21	$32,325
West Coast trail	12	$158.88	$1,907
Total impact (year-round)	-	-	$34,232
Winter scenario (excludes West Coast Trail visitors)			$32,325
Source:	BC Provincial Parks 2013; Pacific Rim Park 2009	BC Ministry of Water, Land and Air Protection 2001; Canadian Parks Council 2009	

1.5 Fiscal Costs

The Fiscal Costs metric is defined as the daily cost of lost provincial tax revenue resulting from transportation disruption. The Fiscal Costs metric is dependent on the outcomes of the Tourist Costs and Transit Revenue Costs metrics. The Fiscal Costs metric is calculated according to the following steps:

1. Reduction in Business Revenue: The Tourist Costs and Transit Costs metrics are summed to arrive at a total reduction in local business revenue.
2. Reduction in Tax Revenue: The outcome of Reduction in Business Revenue is divided by 1 + goods and services (GST) and provincial sales (PST) tax rates to derive the pretax value of business sales.[8] The difference between pretax and final sales represents the daily loss in provincial sales tax revenue.[9]
3. Winter Impacts: The winter impacts calculation excludes sales related to the West Coast Trail, which is closed during the winter.

Table C5 - Fiscal Impacts Calculator

Fiscal impact	Lost tourist and transit revenue / day	Sales tax rate	Cost of disruption / day
Sales taxes (year round)	$35,087	12%	$3,759
Sales taxes (winter)	$32,325	12%	$3,463
Source:	Private Transit and Tourism indicators	BC Government 2014	

[8] Both prior metrics include sales tax in their outputs.

[9] *Other data inputs might not require this conversion, in which case business revenue would be multiplied by the sales tax rate to determine lost sales tax revenue.*

2. Community Disruption Case Study - Method[10]

2.1 Emergency Services

The Emergency Services Costs metric is defined as the daily cost of providing alternative emergency services to areas that are temporarily inaccessible by road ambulances. It is calculated in the same way as the Transportation Case Study's Emergency Services Metric. The metric is repeated here to illustrate how transportation impacts can be included among a broader set of community impacts. As described in the Transportation Case Study, the metric relies on the assumption that emergency responders will reach residents of the Focus Area by airplane or helicopter in the aftermath of a storm event instead of by less expensive road transport. The Emergency Services Cost metric is calculated according to the following steps:

1. Emergency Responses Per Day: The number of emergency response events per day in the focus area is determined by multiplying the daily number of emergency events per capita times the population of the Focus Area.
2. Emergency Response Cost Increase: The increase in costs per emergency event for ground versus air services is determined by taking the difference between the unsubsidized fee for emergency response by ambulance and the average of helicopter and airplane response fees.
3. Increase in Daily Costs to Provide Emergency Response: The number of emergency events per day in the focus area multiplied by the increase in costs per emergency for air response services represents the daily cost to provide alternative emergency services.

Table C6 below, summarizes the results of the Emergency Services metric and the primary data sources.

Table C6 - Emergency Services Costs Calculator

Alternative Emergency Services impact	Number of emergency response events per day	Additional cost per emergency event. air vs. ground service	Cost of disruption / day
Service to Oak Bay / Windsor Park	0.37	$1,193	$441
Source:	AECOM analysis of BCAS Annual Report 2009, BC Census 2011 and GIS parcel data	AECOM analysis of BCAS Fee Schedule 2014	

2.2 Commute Impacts

The Commute Impacts metric is defined as the daily cost of lost time per worker. As with Emergency Services, the Commute Impacts metric also appears as a metric in the Transportation Asset case study. As traffic count data were not available for the Oak Bay Windsor Park Focus Area, the Commute Impacts metric methodology was adjusted. The metric is thus an example of how methodologies may need to shift when conducting impact assessments in other Focus Areas. For this Community Impact Case Study, the Commute Costs metric is calculated according to the following steps:

1. Number of Daily Commuters: The number of daily commuters traveling from the Focus Area per day is determined by estimating the total number of workers who live in the Focus Area. This calculation is done by

[10] Winter-only *daily* impacts were not calculated for the Community Disruption case study, since indicator outputs are not significantly dependent on tourism.

multiplying the region's ratio of employment to working age population (79%, per Stats Canada 2014a) by an estimate of the Focus Area's working age population. The Focus Area population was estimated by multiplying the number of dwelling units times the number of people per dwelling unit reported by the Census. The working age population was determined by multiplying this output times the share of working age adults reported by the Oak Bay District for the neighborhood contained by the Focus Area.

2. Increase in Travel Time per Trip: A typical increase in travel time per trip that would result from road disruption during a storm event is assumed based on the Focus Area's characteristics. As the Focus Area is a relatively dense community close to downtown Victoria, AECOM conservatively assumed a 15 minute increase in commute times each way as a result of flooded roads. This is an illustrative figure assuming reduced capacity of existing travel routes, pending a more detailed traffic study.
3. Increase in Commute Hours: The number of daily commuters is multiplied by the additional, round-trip travel time per day to determine the total increase in commute hours per day of service disruption.
4. Cost of Commute Disruption: The Increase in Commute Hours output is multiplied by the average value of a person's time (assumed to be the average hourly wage in British Columbia) to yield the cost of the disruption.

Table C7 below, summarizes the results of the commute costs calculation and the primary data sources.

Table C7 – Commute Impact Calculator

Commute impact	Total workforce living in area	Additional round-trip travel time per day (hours)	Average value of a person's time per hour	Cost of disruption / day
Oak Bay / Windsor Park	577	0.5	$24.47	$7,059
Source:	AECOM analysis of GIS parcel data; Stats Canada 2014a; Oak Bay District 2010	AECOM Estimate, Google Maps	Statistics Canada 2014b	

2.3 Electric Utility Impacts

The Electric Utility Impacts metric is unique to the Community Disruption Case Study, and is defined as lost electric utility revenues per day from the disruption of electricity services, which may result from storm events. The economic cost is expressed in daily terms, though as more is learned about the likely length of utility disruption, the daily cost may be adjusted downward by the hours per day that a disruption is expected. Note that this quantitative metric only considers impacts from lost revenue due to disrupted service residential customers. Costs associated with restoring lost service are not considered. Disruptions to business customers are described qualitatively due to a lack of available data.

Table C8 summarizes the results of the utility impacts calculation and the primary data sources.

Table C8 – Electric Utility Costs Calculator

Residential Utility Impact	Daily utility spending per household	Number of homes in area	Cost of disruption / day
Oak Bay / Windsor Park – loss of residential electric service	$3.91	634	$2,479
Source:	AECOM analysis of BC Hydro 2013	GIS analysis	

2.4 Fiscal Risk

The final quantitative metric of Fiscal Risk is defined as residential property tax revenues at risk of decline in the event of severe storm events. This metric does not arrive at a daily operational cost and is therefore considered separately from prior quantitative methods and excluded from the calculation of gross economic impact. The Fiscal Risk metric assumes that with an increase in storm events, residential property values may decrease in response to the risk of property damage and/or increases in insurance premiums and reductions in coverage, thus impacting tax revenues. Tax revenue from other properties (commercial, industrial) and other tax revenues (e.g. school taxes) have not been included within the scope of this Fiscal Risk metric. Fiscal Risk is calculated according to the following steps:

1. Residential Property Values: The aggregate value of land and improvements in the Focus Area was determined through GIS parcel data.
2. Property Tax Value Decline Risk: The aggregate value of residential property is multiplied by the applicable local property tax rate to derive total property tax revenues at risk of decline.

Table C10 summarizes the results of the fiscal impacts calculation and the primary data sources.

Table C10 – Property Tax Impact Calculator

Fiscal impact	Aggregate value of residential land and improvements in focus area	Local residential property tax rate per dollar of property values	Annual property tax revenues at risk
Property taxes – Oak Bay / Windsor Park	$263,000,000[11]	0.00596	$1,567,480
Source:	GIS	BC Ministry of Community Development 2014	

3. Business Disruption Case Study - Method

3.1 Productivity Costs

The Worker Productivity Cost metric is defined as the daily cost of wages paid by disrupted business establishments. In many cases these costs will be borne by firms, as wages may still be paid to employees when

[11] *Based on AECOM analysis using 2013 data. This differs slightly to the subsequent analysis by CRD reported in section 3.6, which was based on an updated cadastral data layer and 2014 BC Assessment data.*

business is disrupted by an inundation event. Because wages paid during a disruption represent a loss in productivity, these costs could eventually lead firms to reduce staffing or wages, ultimately impacting employees as well as their firms. Estimating worker productivity costs requires an understanding of firms' existing staffing, which was not possible to identify through publically available data in the cases of Harbour Air and Victoria Clipper. In a phone interview with AECOM, Harbour Air provided an estimate of their total workforce based at the Inner Harbour; Victoria Clipper was contacted by AECOM but chose not to participate in this analysis. *AECOM understands that the CRD may have access to an employer database that can provide more accurate estimates of total employees by firm. In future rounds of analyses, the CRD may wish to draw on this database to estimate economic impacts.*

The Worker Productivity Costs metric is calculated according to the following steps:

1. Number of Workers: The number of workers is determined for each major firm in the Focus Area. This is done, where possible, through the review of an existing economic impact study, or through primary research. Note that employee totals are annual averages and do not take into account seasonality in the workforce. Employers were asked to report employment data only for Inner Harbour establishments; the CRD may wish to verify whether these estimates are accurate based on its employer database.
2. Daily Wages: The number of workers is multiplied by the average daily industry-specific wage reported by BC Statistics to arrive at the total daily wages of potentially impacted firms. In this case, the average wage for the transportation industry is used.
3. Winter Impacts: Winter employment at Blackball Ferry is reduced proportional to the estimated reduction in ticket sales during the winter (see Revenue Indicator). Employment for Harbour Air is held constant as seasonal passenger data was not available at the time of this study. Daily wages at both firms are assumed to be constant.

Table C11 below, summarizes the results of the productivity costs calculation and the primary data sources.

Table C11 - Productivity Costs Calculator

Lost Productivity	Average daily industry wage	Number of workers	Lost wages per day of disruption
Blackball Ferry	$217	61	$13,237
Victoria Clipper Ferry	$217	NA	NA
Harbour Air	$217	100	$21,700
Total (year round impacts)		161	$34,937
Blackball Ferry (winter)	$217	25	$5,323
Total (winter impacts)		125	$27,023
Sources:	*BC Stats 2014*	*Tourism Victoria 2007; Harbour Air 2014a*	

3.2 Revenue Costs

The Business Revenue Costs metric is defined as the daily cost of lost revenue of disrupted business establishments during a storm event. As firms were generally not willing to share revenue data, this metric relies on reported passenger and fare data to approximate business revenue. Alternative methodologies (such as an estimate

of revenue per employee) would have to be developed to apply this metric to other Focus Areas where transportation is not the dominant industry. Of the two firms without a publically available impact study, Harbour Air provided a passenger estimate; Victoria Clipper Ferry did not. As with the productivity matrix, Victoria Clipper is excluded from the calculation because of lack of data. The Business Revenue metric is calculated according to the following steps:

1. Number of Daily Passengers: The number of daily passengers is determined for each transportation business based on interviews or a publically available economic impact study. Daily passengers represent annual averages.
2. Lost Daily Revenues: The daily passenger volume is multiplied by current passenger fees to estimate, by an order of magnitude, the lost business revenue per day of disruption. Where prices vary by destination (in the case of Harbour Air), rate information for the most common route is used. Where prices vary by fare type (auto or passenger) posted fares were weighted according to the share of passengers boarding by foot or auto. *Note that other forms of passenger revenue, such as food and beverage sales, are excluded from this preliminary economic analysis.*
3. Winter Impacts: Blackball Ferry's winter impact is estimated according to January – March ridership data. Harbour Air's impact is assumed to be constant (as seasonal data was not available for this preliminary study).

Table C12 below, summarizes the results of the productivity impacts calculation and the primary data sources.

Table C12 – Revenue Impact Calculator

Lost Revenues	Number of daily passengers (inbound and outbound)	Revenue per passenger	Lost revenue per day of disruption (estimated)
Blackball Ferry	1,124	$51	$57,324
Victoria Clipper Ferry	NA	$83	NA
Harbour Air	685	$157	$107,545
Total (year round impacts)			$160,373
Blackball Ferry (winter)	456	$51	$23,051
Total (winter impacts)			$130,596
Sources:	*Tourism Victoria 2007; Harbour Air 2014a*	*Blackball 2014; Clipper 2014; Harbour Air 2014b*	

3.3 Tourism Costs

The Tourism Costs metric is defined as the daily cost of lost ancillary tourist spending. All three of the major businesses in the Focus Area are patronized by tourists, who rely on plane or ferry service to reach destinations in the Capital Regional District. The Tourism Costs metric assumes that in the event of a disruptive storm, spending by

tourist customers would decline. Business proprietors are generally unaware of how much their customers spend in the regional economy, unless they have conducted an economic impact study. Tourism Victoria's impact study of Blackball Ferry Blackball Ferry from 2007 was used to estimate the spending behavior of its passengers; Harbour Air is currently undertaking a similar study that will not be available until October 2014. For Victoria Clipper, an estimate of spending per passenger is publically available (in the Blackball impact study) but Victoria Clipper's total passenger volume is not. Consequently, Victoria Clipper and Harbour Air are excluded from this metric's calculation, pending the availability of required data inputs.

The Tourism Costs metric is calculated according to the following steps:

1. Number of Daily Passengers: The number of daily passengers (inbound only) is determined from available data.
2. Share of Passengers Who Are Tourists: The share of passengers considered tourists is determined from available data.
3. Average Spending per Passenger: The average spending per passenger is determined from available data.
4. Lost Daily Tourism Spending: The lost ancillary tourism spending per day of disruption is calculated by multiplying daily passengers times the share who are tourists times average spending per tourist.
5. Winter Impacts: Blackball Ferry's winter impact is estimated according to January – March ridership and January – March per capita tourism spending, as reported in the 2007 economic impact study.

Table C13 below, summarizes the results of the tourism costs calculation and the primary data sources.

Table C13 – Tourism Costs Calculator

Tourism Impact	Number of daily passengers (inbound)	Share of passengers considered tourists	Average spending per passenger	Lost tourism spending per day of disruption
Blackball Ferry	562	85%	$402	$192,035
Blackball Ferry (winter)	228	85%	$237	$45,598
Victoria Clipper Ferry	NA	NA	$294	NA
Harbour Air	342	NA	NA	NA
Total (year round)				$192,035
Total (winter)				$45,598
Sources:	*Tourism Victoria 2007; Harbour Air 2014a*	*Tourism Victoria 2007*	*Tourism Victoria 2007*	

3.4 Fiscal Costs

The final metric, Fiscal Costs, is defined as the provincial tax revenue lost daily resulting from the service disruption. The Fiscal Costs metric is dependent on the outcomes of the Tourist Costs and Business Revenue Costs metrics. The Fiscal Costs metric is calculated according to the following steps:

1. Lost Business Revenue: 100% of Tourist Spending (above) is assumed to be taxable by the provincial sales tax (PST) and the goods and services sales tax (GST). The majority of Business Revenue output is

assumed to be taxable only by the goods and services (GST) tax. A 50% factor is applied to business revenue of Blackball Ferry on the basic assumption that only half of its passenger ticket sales are taxed locally. (In other words, Port Angeles in the United States is the point of sale for the remaining ticket sales).

2. Lost tax Revenues: The Lost Business Revenue output is divided by 1 + the applicable tax rate to derive the pretax value of business sales.[12] The difference between pretax and final sales represents the daily loss in applicable sales taxes.
3. Winter Impacts: Daily Winter Impacts follow the same methodology but based on winter-only Tourism Spending and Business Revenue estimates, calculated above.

Table C14 - Fiscal Costs Calculator

Fiscal impact	Local share of lost tourist and transit revenue / day	Sales tax rate	Cost of disruption / day
Tourism sales taxes – goods and services (year round)	$192,035 (A)	12% (B)	20,575
Transportation sales taxes (year round)	$160,373	5%	$7,637
Total sales taxes (year round)			$28,212
Sales taxes – goods and services (winter)	$45,598	12%	$4,886
Sales taxes – transit only (winter)	$130,596	5%	$6,219
Total sales taxes (winter)			$11,105
Source:	Business Revenue and Tourism indicators	BC Government 2014	A – [A / (1 + B)]

[12] Tourism and Business Revenue metrics include sales tax in their outputs.

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Agenda Item 7
for Information

ISSUE ANALYSIS PAPER AND POSITION STATEMENT

Land Application of Biosolids

Adopted by the BCWWA Board of Directors

October 2016

Table of Contents

Section 1: Introduction

Biosolids are produced following the wastewater treatment process. They consist of a nutrient rich solid that has been stabilized to reduce or eliminate pathogens and manage volatile organic solids. Over the past year, there has been increased public attention to the practice of applying biosolids to land. The BC Water & Waste Association (BCWWA) has developed this issue analysis paper to address the question:

Under what conditions can biosolids be safely applied to land?

Treated biosolids are a plentiful, renewable resource that offer a variety of benefits through their use as a soil amendment. When applied to land, biosolids can improve crop yields through fertilization, increase soil water storage, improve soil quality, avert greenhouse gas emissions, and accelerate carbon sequestration (by improving the capacity of the soil to store carbon) *(Brown & Trlica, 2013)*. However, the benefits of recycling residuals from wastewater are not always obvious and can be accompanied by considerable concern and controversy; recycling nutrients and organic matter through the land application of biosolids represents such a case.

Biosolids represent only a small fraction of the total annual production of organic residuals and are the most processed and regulated, yet they are the most controversial with respect to beneficial use *(International Water Management Institute, 2010)*. The BCWWA recognizes that public uncertainty around the land application of biosolids can arise, driven by concerns focused on the potential impacts to human health and the receiving environment (including soil, surface water, groundwater and air) from the following constituents and traits potentially found in biosolids:

- Pathogens potentially present in biosolids and aerosols potentially generated through biosolids management;
- Trace element content in biosolids; and,
- Emerging substances of concern (ESOCs), such as pharmaceuticals, personal care products, and other materials which may be found in biosolids.

Provincial regulation and national policy recognize that the benefits of biosolids as a soil amendment are well known, and that potential risks arising from their management as a soil amendment are effectively managed to the degree that the risks are understood. This is the basis for existing regulation.

This paper outlines the BCWWA's analysis of the conditions under which biosolids can be safely applied to land.

The issue analysis paper concludes with a "position statement" that is intended to guide our members' actions around biosolids production and land application, as well as our members' engagement with First Nations, stakeholders, and the public. The position encompasses best management practices, recent science, and an ongoing commitment to continuous improvement and sustainability.

Section 2: Context & Background

The following subsections provide an understanding of the types of biosolids typically produced in North America, basic information about their physical characteristics and a background to how they are managed, monitored and regulated in British Columbia and Canada.

2.1 What are biosolids?

Biosolids originate as sludge, a liquid by-product of municipal wastewater or septage treatment processes. The sludge is processed using elevated temperature and biological processes (aerobic or anaerobic) over an extended period of time to stabilize the organic matter and reduce pathogen content and vector (i.e., disease-spreading insect or parasite) attraction. It is only when the sludge meets defined quality standards for trace elements, pathogen reduction, and vector attraction reduction that it can be considered "biosolids". Sludge processing is accomplished by a variety of methods, with aerobic and anaerobic digestion being the most common. Anaerobic digestion generates methane gas which, if captured, can be employed in heating or energy production at the wastewater treatment plant, generating an additional beneficial use from this material.

The biosolids may be dewatered to various degrees to achieve the following types, which are categorized based on the amount of water which remains in the product and the product's subsequent properties:

Biosolids Type	Solids Content	Characteristics
Thickened	12%	Viscous liquid
Dewatered	18 to 30%	Solid (wet soil)
Dried	50 to 90% or higher	Very dry (granular)

Processed sludge that does not meet regulatory quality requirements is not considered to be biosolids; it is understood to be treated sewage sludge. Under BC regulation, treated sewage sludge does not meet the standards required for land application under the BC Organic Matter Recycling Regulation (OMRR) (see Section 2.1.2); therefore, it is not considered for the purposes of this issue analysis paper.

2.1.1 Land application

The beneficial use of human wastes through land application has been practiced for millennia, as has the use of animal and vegetable wastes. Human wastes or "night soil" have been utilized as fertilizer in China since at least 1,000 BC, and in the United States for more than 150 years. It has been estimated that about 200 million farmers worldwide grow crops in fields fertilized with variants of human waste including biosolids *(American Society for Microbiology, 2011)*.

In context, however, biosolids and human excrement represent less than 1% of all fertilizing agents used throughout North America, with chemical fertilizers and animal manures being the most prevalent forms of fertilizers and soil amendments. By comparison, however, biosolids are a highly monitored and regulated product.

Biosolids can be applied to land in one of the following ways:

- With conventional agricultural equipment or specialized application systems to the soil surface;
- With conventional construction equipment (usually in the case of mine reclamation);
- Injection (usually in liquid form) just below the soil surface; and,
- With a side-slinger application system (usually to treed or forested environments).

During land application, biosolids may or may not be incorporated into the soil, depending on the biosolids type as well as the agricultural, forestry, or reclamation management strategy and other key environmental factors.

Biosolids are applied to land for the following purposes:

- Soil amendment and aiding plant growth on agricultural lands;
- Enhanced tree growth and increased yield in forestry and silviculture;
- Land reclamation and remediation (e.g. disturbed land/mine site and landfill closure);
- Wetland restoration;
- Erosion control and slope stabilization; and
- Roadside aesthetic improvement.

Biosolids can also be used as an ingredient in creating value-added products such as compost, soil amendment mixes, and landscaping soils. These products are used in a variety of applications, including urban landscaping, park and greenway projects, community gardens, and roadside aesthetic restoration.

2.1.2 Provincial regulation of the land application of biosolids

In BC, land application of municipal biosolids is regulated by the Ministry of Environment (MoE) through the *Organic Matter Recycling Regulation* (OMRR). The OMRR was enacted in 2002 to replace a system of permits and authorizations, and falls under the authority of the *Environmental Management Act* and the *Public Health Act*, with minor amendments carried out in 2007 by the MoE. Biosolids used within the Agricultural Land Reserve must also be considered through the *Agricultural Land Commission Act.*

The OMRR was created to provide clarity on how biosolids can be produced, how to effectively use biosolids while protecting soil quality and water resources, and who is qualified to ensure biosolids are applied according to best management practices. The regulation was promulgated following a six-year development process, involving a peer evaluation group of experts selected for their knowledge from throughout North America. The regulation used a significant amount of knowledge and risk assessment information developed from other jurisdictions, including the use of the rigorous US EPA biosolids risk assessment, which was finalized in the mid 1990's. The regulation outlines two classes of biosolids—Class A and B—and sets maximum quality criteria for pathogens and trace elements, as well as storage requirements and management requirements for land application. The OMRR does not currently regulate emerging substances of concern (ESOCs) that may be present in both classes.

Under OMRR, the Ministry of Environment (MoE) requires the production of a site assessment and suitability document known as a Land Application Plan (LAP). This plan must describe the land application site, the quality of biosolids and receiving soils, the rate of biosolids application, and site features requiring buffering (i.e., setback distances to applied biosolids). LAPs must also contain information on site signage, biosolids stockpiling, the requirement for environmental monitoring, and predicted post-application soil concentrations of regulated trace elements. Post-biosolids application soil quality standards contained in the OMRR are based on the identified land use (e.g., agricultural land, urban park land, residential land, commercial land, and industrial land), soil pH, and site-specific factors unique to the land application site (e.g., groundwater flow to aquatic life, soil ingestion by

grazing animals, toxicity to soil invertebrates, etc.). In addition to the preparation of the LAP, at least 30 days before the land application of biosolids, notification must be given to the: Waste Manager in the regional MoE office; Medical Health Officer for land application to agricultural land or in a watershed; Land Reserve Commission for land application to agricultural land reserve or forest reserve land.

The regulation follows the 'professional reliance' model. This type of regulation requires a Qualified Professional (QP) with specific fields of expertise to produce and validate the LAP. The QP accepts responsibility for the quality of the LAP and the information contained therein. The intent of the regulatory process is that planning for any application requires a person qualified through education and experience, validated by a regulated profession.

To help ensure compliance with OMRR, the Ministry of Environment has produced two associated guidance documents: the *Compost Facility Requirements Guideline* (2004) and the *Land Application Guidelines for the Organic Matter Recycling Regulation and the Soil Amendment Code of Practice: Best Management Practices* (2008). The latter contains guidance on sampling and analysis as well as guidance on interpreting receiving environment conditions (such as proximity of ground and surface waters, suitable site selection, climate considerations, etc.) which aid in ensuring adherence to the regulation. It also provides best management practices for a LAP and specific details related to biosolids use in agriculture, silviculture, and reclamation.

2.1.3 National Policy – Canadian Council of Ministers of Environment

The Canadian Council of Ministers of the Environment (CCME) is comprised of 14 environment ministers from the federal, provincial and territorial governments. The CCME provides national guidelines for the beneficial use of biosolids through the *Canada-wide Approach for the Management of Wastewater Biosolids* (the Approach). The **best management principles** outlined in the Approach are:

- Municipal biosolids, municipal sludge, and treated septage contain valuable nutrients and organic matter that can be recycled or recovered as energy.
- Adequate source reduction and treatment of municipal sludge and septage should effectively reduce pathogens, trace metals, vector attraction, odours, and other substances of concern.
- The beneficial use of municipal biosolids, municipal sludge, and treated septage should minimize net greenhouse gas (GHG) emissions.
- Beneficial uses and sound management practices of municipal biosolids, municipal sludge, and treated septage must adhere to all applicable safety, quality, and management standards, requirements, and guidelines.

Further, the CCME recommends that following factors be considered:

- Characteristics of the material (e.g., water content, nutrients, organic matter, trace metals and pathogens);
- Utility and value of the residual (e.g., nutrient availability, soil amendment potential, and energy value);
- Air quality management (e.g., stack emissions from thermal treatment, odor generated during handling);
- Suitability of the application site (e.g., soil quality prior to municipal biosolids application and proximity to sensitive water resources, local air shed issues);
- Transportation to the application site (e.g., number of transport vehicles required, availability of access roads);
- Application site environmental setbacks (e.g., distance of the proposed beneficial use site from features such as residences, water resources, roads); and,
- Social considerations (e.g., community perception and level of acceptance of the beneficial use option, marketability of municipal biosolids or treated septage products).

The Approach also supports continuous improvement, such as the ongoing research related to ESOCs.

Section 3: Analysis of the Issue

Determining the BCWWA position on the land application of biosolids requires careful consideration to weigh the benefits and implications for sustainability against potential risks. It is important that environmental benefit and potential risk be clearly understood through evidence-based science, so that both may be clearly demonstrated and communicated to all stakeholders in the biosolids process. Further, understanding the research and rigor behind existing provincial regulation and national management guidelines will help ensure compliance and protect public health and the environment.

3.1 Benefits of land application

The benefits of biosolids use are understood with a high degree of certainty and scientific evidence. The land application of biosolids is supported by BC's provincial regulation, recommended by the Canadian Council of Ministers of Environment (CCME), and promoted by BCWWA-affiliated associations such as the Canadian Water Network (CWN) and the Canadian Water and Wastewater Association (CWWA).

Biosolids are primarily comprised of organic matter, a material naturally present in the soil that affects structure and functionality. Soil organic matter can be lost as a result of intensive agriculture, grazing, forestry, and mining activities; the land application of biosolids provides a way to replace this lost organic matter. The organic matter contained in biosolids improves overall soil quality, including:

- Soil tilth (i.e., ease of cultivation and overall physical condition of soil to support plant growth);
- Water-holding capacity;
- Nutrient retention;
- Soil carbon; and,
- Habitat for soil biota (microbiology and invertebrates).

In addition to improving soil quality through increased organic matter, biosolids contribute a full suite of micro and macro plant nutrients. This reduces or replaces the need for commercial or chemical fertilizers. Biosolids are primarily a residual derived from foods (containing micro and macro plant nutrients) and as the foods we eat are grown to ensure their nutritional value, many of these nutrients are transferred to the biosolids. These micro and macro nutrients are renewable, as opposed to their mineral and chemical fertilizer counterparts, which may be mined, derived from oil and gas, or be energy intensive in their production.

Biosolids use in agriculture, forestry, and mining provides other tangible benefits to land managers such as improved forage quality, increased yield/biomass, drought protection and vegetation establishment on otherwise degraded sites. These benefits and others represent the reason why land managers use biosolids. Additional benefits, however, exist even beyond the borders of an individual land application site.

By applying biosolids to land, a flow of nutrients and organic matter is established, providing closed-loop recycling of nutrients and carbon. Cereals from the prairies, beef from BC's grasslands, and fruit from the Okanagan all represent nutrient and organic matter flows from the rural environment to urban centres. The ideal recycling process returns those materials back to their sources in the rural agricultural landscape. While economics likely precludes the ability to return nutrients proportionally to their soils of origin, beneficial use of biosolids through their application to agricultural soils, or in other soil-building systems, represents an important mechanism for maximizing the use of our available renewable nutrient pools. The return of carbon from biosolids to the soil also

represents a mechanism of soil carbon sequestration, which aids in greenhouse gas (GHG) mitigation by offsetting increased carbon in the atmosphere, positively impacting climate change. Field investigations of the impact of biosolids land application have demonstrated the high potential of soil carbon (C) sequestration, with soil C significantly correlated with the biosolids application rate. In fields where biosolids applications ceased for many years, soil organic C was still much higher than initial levels in the soils and were higher as compared to the fertilizer controls (Tian, et al., 2009).

3.2 Biosolids constituents

In addition to water, biosolids are composed of several important chemical constituents that fall into the following general categories and content ranges:

- Organic matter, similar in structure and function to soil humus (between 60 and 80% of total dry mass);
- Inorganic matter which may include inert sand, silt and clay particles (between 5 and 30% of total dry mass);
- Nutrients and trace elements (8-15% of total dry mass) including:
    - Plant macronutrients (nitrogen, phosphorus, potassium, calcium, magnesium, sodium, sulphur)
    - Plant micronutrients (iron, cobalt, copper, iodine, manganese, molybdenum, zinc,
    - Non-essential trace elements (aluminum, lead, mercury, nickel, silver, gold, vanadium, beryllium)
- ESOCs, also known as microconstituents (less than one per cent of total dry mass).

In contrast to the established benefits of some biosolids constituents as detailed in Section 3.1, there are also potential risks arising from other constituents. Although many risks are well understood and carefully managed, there are some risks (such as ESOCs) which are not as well understood. The following sections identify these potential risks, review the current understanding of the constituents, and mechanisms for management of potential risks.

3.2.1 Biology and Pathogens

Biosolids, as it is derived largely from human fecal matter, contains a diversity of micro-organisms. The micro-organisms have their origin in the human digestive system, and this ecosystem contributes to the ecosystem at work in the Wastewater Treatment Plant (WWTP) which breaks down wastewater solids during the process of wastewater treatment. Although the vast majority of biosolids biology is benign or environmentally beneficial, there is a small but important subset of the biological organism contribution to the wastewater treatment system which can cause disease in humans: these are known as the pathogens. Potential pathogens include specific strains of bacteria, viruses, fungi, parasites, or proteinaceous infective particles (prions, discussed in the next section).

This diversity of micro-organisms (both beneficial and pathogenic) is significantly reduced during the treatment of wastewater sludge to produce biosolids. The OMRR requires that biosolids be treated to reduce pathogens to levels specified for Class A and B designations. While the OMRR does not specifically regulate any specific pathogen, the quality criteria for pathogen reduction are based on levels of fecal coliform bacteria, which are not themselves pathogenic, but which are well established as an indicator of pathogen concentrations. For example, OMRR Class A biosolids are subject to the most stringent quality and treatment process criteria: fecal coliforms must be reduced to less than 1,000 “most probable number per gram” (MPN/g), a level at which pathogens are considered to be almost undetectable (Yanko, 1988). As a result, Class A biosolids are subject to less stringent land application criteria due to their lower risk. On the other hand, OMRR Class B biosolids, which must attain a fecal coliform density of less than 2,000,000 MPN/g (a level at which some pathogens are expected to persist), must be managed during land application in such a way as to limit human exposure to pathogens by delaying harvesting

post-application and minimizing public encroachment on lands with applied biosolids. Best management practices for both classes, such as effective site management (fencing) and signage informing the public of the project also assist in reducing the opportunity for exposure to potential pathogen risk.

The levels of concern over biosolids may be disproportionate when biosolids are compared to other managed fertilizers and soil amendments. Few other residuals are treated to reduce pathogens and the volume of land application of other residuals, including industrial and agricultural sources, far exceeds that of biosolids. As a comparative example, regulations also govern the land application of animal manure, and it is noteworthy that there are currently no requirements for treatment or stabilization of animal manures to reduce pathogen levels. Although information on agricultural and industrial residuals is limited, a US study noted levels of indicator bacteria in untreated manures are significantly higher than in biosolids, with fecal coliforms in manure ranging from five million to 30 million MPG/g (*Water, Env. & Tech., 2002*).

Microflora naturally present in soil can also help reduce the risk of pathogens from the land application of biosolids. A gram of soil typically contains many billions of organisms. Although a minute fraction of these organisms can cause harm in humans, animals and plants, the majority are overwhelmingly beneficial. These beneficial microorganisms, as well as other soil conditions, outcompete and inactivate fecal pathogens that might be introduced via land application of biosolids *(American Society for Microbiology, 2011)*.

Recent risk assessment measures the potential for illness from Class B biosolids land application to be less than one in one million, and in some cases less than one in one billion, per exposure. Typically, an appropriate baseline used for risk assessment purposes is one in ten thousand and biosolids fall far below this, suggesting that that risk of biological harm, while possible, is extremely low being between one hundred and ten thousand times lower than what is considered 'acceptable risk' *(American Society for Microbiology, 2011)*.

3.2.2 Prions

Despite strong regulation and safeguards in place to reduce the risk of pathogens to human health and the environment, there remains public concern in respect to the potential risk to public health from biological agents, and in particular, prions.

Prions are a particular type of infectious misfolded protein particle. Different particle types or strains are capable of replication in animal tissue and have an associated pathogenicity. While proteins are an important particle in all facets of animal and plant biology, prions are abnormal, infectious and transmissible in their misfolded pathogenic forms. They are understood to be the pathogenic cause for spongiform encephalopathies which include "mad cow disease" in cattle, chronic wasting disease (CWD) in deer and elk, and Creutzfeldt-Jakob (CJD) in humans. Prions as a concept underlying cause are also being explored in the understanding of Alzheimer's and Parkinson's diseases. To date, this exploration of prions does not include a consideration or transmissibility, and the model has not yet gained broad acceptance (*Goedert, 2015*).

The cases of known transmissible prion disease in North America are very low (1 in 300,000) *(Hinckley, et al., 2008)*. The risk of prions (infectious or not) entering the wastewater system through animal tissue is lower still, as abattoir waste (i.e. meat waste, including brain and spinal cord) is considered a specified risk material and is not discharged to the sewer in BC. To date, it does not appear that researchers have been able to isolate prions from wastewater biosolids, presumably due to the lack of presence or the exceptionally high dilution in the wastewater stream.

Significant advances in our knowledge of prions and their associated public health risks have been made in the past 10 years and continue to evolve in the context of biosolids. Recent methodological improvements have only very recently been able to isolate prions from human urine at exceptionally low concentrations. These concentrations appear to be several orders of magnitude lower than the infectious dose (IU_{50}) for known prion diseases, which are then further diluted by other waters entering the wastewater system and the contributions from the non-infected population, which is conservatively estimated as an additional dilution of 6 orders of magnitude within the sewer system *(Hinckley, et al., 2008)*.

The desire to understand more about prions, combined with the inability to isolate prions from biosolids or wastewater, has meant that researchers have required the use of wastewaters spiked with recoverable quantities of traceable prions, in order to understand the potential fate and mobility of prions in the treatment system and the environment. Earlier spiked trials indicated that infectious prions may be resistant to many forms of conventional wastewater and sludge treatment *(Epstein & Beecher, 2005)*, however, recent work by Miles *et al.* suggests otherwise. Their research documented significant reductions in prion infectivity when prions from spiked wastewater were recovered from biosolids at the temperatures associated with wastewater treatment digestion processes *(Miles, Takizawa, Gerba, & Pepper, 2011)*.

The potential for prions to be transmitted via aerosolization has been explored by Stitz and Aguzzi, again using spiked materials to explore the possibility. They reference studies in which prions were experimentally transferred via aerosol between mice and theorize about the potential for infection of swine abattoir workers, but also concede that "it is understood that the airborne transmission of prions has thus far only been observed under extreme conditions" *(Stitz & Aguzzi, 2011)*. Given the expectation of very low prion concentrations in wastewater and biosolids, the potential for aerosolized transmission from prions both at the wastewater treatment and in biosolids land application situations is likely very low.

The potential to consume the volume of materials required for prion infection is extremely small once applied to land. Current calculations assume a daily ingestion rate of soil from biosolids amended fields for 70 years, and even at this rate, the quantity of prion potentially available to be ingested remains below the infective dose (IU_{50}) *(Hinckley, et al., 2008)*.

Based on the current information, the threat of infectious prion transmission to humans or grazing animals via the land application of biosolids appears to be negligible. Source control is recommended as the most effective method for managing infectious prions, in particular, by enforcing existing guidelines for non-domestic facilities that may handle contaminated tissue, such as abattoirs, laboratories, hospitals, and mortuaries.

3.2.3 Trace elements

Similar to manure and commercial fertilizers, biosolids contain variable concentrations of trace elements (sometimes referred to as trace metals or heavy metals). These trace elements enter the waste water stream from multiple sources (both domestic and industrial) and are present in measurable concentrations in biosolids. The OMRR currently regulates 11 trace elements that, at certain concentrations, are considered to be detrimental, can bio-accumulate in the food chain thereby posing a risk to human and animal health, and are persistent in soils. These regulated elements are: arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), and zinc (Zn).

A large body of knowledge has been developed about the behaviour and fate of trace elements in biosolids and biosolids-amended soils both in the US and Canada. In the US, the Environmental Protection Agency (EPA) conducted a comprehensive review of the fate and effects of trace elements in biosolids using a risk assessment

approach that began in 1984 with the identification of approximately 200 'pollutants of concern', which was then further assessed by expert panels, from which approximately 50 of the 200 pollutants were recommended for further study. The EPA examined multiple exposure pathways and analyzed risks to humans, animals, plants, and soil microorganisms based on hundreds of peer-reviewed research articles on toxicity, ecotoxicity, and environmental fate and transport. The risk assessments were in turn reviewed by dozens of scientists in the fields of toxicology, soil science, and agriculture. Based on this review, limits for ten trace elements (cobalt was not identified by the EPA, but was subsequently regulated in BC) were recommended, developed, and following three subsequent rounds of review, the EPA concluded that the concentration limits specified for these ten trace elements are highly conservative, very protective, and that the risk posed by trace elements in biosolids adhering to these limits is minimal.

The quality criteria for trace elements in Class A biosolids in the OMRR directly references the Canadian Food Inspection Agency (CFIA) metal standards for fertilizers, while quality criteria for trace elements in Class B biosolids are also partially derived from the US EPA standards, which conform to the *BC Contaminated Site Regulation* (CSR). In general, the OMRR trace element standards are more stringent than the limits set by the US EPA. The CFIA metal standards are based on maximum acceptable cumulative metal addition to soils. These acceptable levels are calculated using the standard maximum addition to soil over a period of 45 years (which are fixed per metal) and the annual application rate of the product. The CFIA's standards (except copper and chromium standards) have also been incorporated into the CCME's *Guidelines for Compost Quality*. Some OMRR biosolids trace element criteria are higher than risk-based limits determined by the EPA, but OMRR is considered a more conservative regulation as it also regulates the quality of the soil environment receiving biosolids applications.

	BC OMRR		USEPA 503	
	Class A Biosolids	Class B Biosolids	Class B Biosolids	Exceptional Quality (EQ) * Biosolids
Trace elements (mg/kg)				
Arsenic	75	75	75	41
Cadmium	20	20	85	39
Chromium	-	1,060	3,000	2,000
Cobalt	150	150	-	-
Copper	-	2,200	4,300	1,500
Lead	500	500	840	300
Mercury	5	15	57	17
Molybdenum	20	20	75	-
Nickel	180	180	420	420
Selenium	14	14	100	36
Zinc	1,850	1,850	7,500	2,800

USEPA EQ Biosolids can be freely distributed in bulk, or sold or given away to the public (i.e. no permit or Land Application Plan required)

OMRR soil trace element concentration criteria are harmonized with the BC *Contaminated Sites Regulation* (CSR) soil standards. The CSR soil quality standards are also based on a risk assessment approach that calculated soil standards based on defined exposure scenarios for specific land uses (e.g. agricultural, residential, parkland,

industrial, commercial) and toxicity information. Soils where biosolids have been land applied, meet the specified land use scenario of the CSR soil quality standards for the OMRR regulated trace elements following the biosolids application.

There are several trace elements which are not regulated by the OMRR, and it should be acknowledged that there is a general lack of data on concentrations of non-regulated trace elements in biosolids across Canada (e.g., antimony, beryllium, thallium, titanium, and vanadium). The consensus amongst regulators and experts is that non-regulated trace elements do not pose a significant risk to humans or the environment because of their low concentrations (based on limited data) compared to other trace elements, and because the characteristics of biosolids reduce their availability. However, both the CCME and the EPA acknowledge that further research is required due to a lack of source data. As part of their *Targeted National Sewage Sludge Survey*, the EPA has gathered sufficient biosolids source data to evaluate five trace elements (barium, beryllium, manganese, molybdenum[1], and silver) to determine if they should be regulated. The evaluation has not been released to date, but was expected by late 2015 (United States Environmental Protection Agency, 2009).

3.2.4 Emerging substances of concern

In following similar recommendations from the US EPA, the BC Ministry of Environment expert panel for the development of OMRR found that potential risks from organic contaminants were generally low, their occurrence was not frequent, and that in many cases, the potential pollutants were 'legacy compounds' no longer produced or used, meaning that the concentrations were anticipated to slowly decrease over time in line with degradation. Emerging substances of concern (ESOC) in wastewater residuals have more recently become a focus of related research in Canada and internationally. There is no consensus definition of ESOCs, but the term refers to a broad range of substances that households and industry may send down the drain to the wastewater treatment facility and potentially may be present in biosolids:

- Pharmaceuticals (e.g. Non-steroidal anti-inflammatory medication [e.g. Ibuprofen], antibiotics [e.g. Ciprofloxacin], steroids, narcotics, etc.)
- Personal Care Products (e.g. toothpaste, deodorant)
- Perfluorinated compounds (e.g., perfluorooctanoic acid [PFOA], Teflon, non-stick coating on cookware, fluorotelomers)
- Plasticizers (e.g. reusable food and drink containers)
- Quaternary Ammonium Compounds (commercial disinfectant, e.g. Quat)
- Polychlorinated alkanes and napthalenes
- Surfactants (e.g. dish detergent, alkyl phenol ethyloxylate [APE])
- Polybrominated Diphenyl Ethers (Flame retardants, commonly used on textiles, furnishings, children's sleepwear)
- Steroidal compounds, hormones and their mimics (e.g. nonylphenol, testosterone, estrogen)
- Dioxins and furans (e.g. created during production of pesticides, dyes, disinfectants; produced in combustion processes such as forest fires, or in vehicle exhaust)
- Nanoparticles (e.g. nanosilver used in athletic clothing)

Some of these compounds may occur naturally in the environment; however, the majority are from human sources (Canadian Council of Ministers of the Environment, 2012).

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[1] Molybdenum is being re-evaluated using updated information to determine the need for a revised numerical standard in land-applied biosolids.

Research has shown that some ESOCs degrade rapidly in soils, or simply dissolve in water and do not end up in the biosolids product or receiving soils (Canadian Council of Ministers of the Environment, 2012). Those ESOCs found in wastewater residuals are in very low concentrations, and detection does not necessarily imply a risk to human health and the environment. Detection and quantification of ESOCs in municipal biosolids simply serves as an initial step in determining the risks that these compounds might pose.

Many ESOCs have been assessed and their impacts have been calculated, tested, or inferred. Through the 1990s and the first decade of the millennium, science focused on a quantitative understanding of a handful of the ESOCs considered to have the greatest potential for environmental impact. The *Canadian Environmental Quality Guidelines* recommended guidelines for several hundred substances which rely on quantitative calculation to provide concentrations for no predicted effects or no observable effects. However, a recent review of the risks associated with land application of biosolids (Ryerson University, 2015) has identified successes and limitations of this approach.

Limitations to the single-substance approach include difficulty in apprehending the sheer number of substances that are potentially found in biosolids, the significant amount of time and resources required to assess each, and an inability to detect potential combinations of substances. An alternative is a holistic assessment of biosolids using live organisms to measure potential toxicity. These toxicological assessments use organisms found within the ecosystem to which biosolids are applied and measure their performance and any lifecycle impacts. This approach is unable to provide specific numerical standards for individual substances, but may produce results that can indicate overall environmental suitability of biosolids. The review by Ryerson University (2015) has identified the likelihood that a mixed science approach, combining holistic and single-substance approaches, is currently the best method to assess the impact of ESOCs.

The Ryerson University review indicated that ESOCs had little to no negative impact on test plants, insects, bacteria and fungi present in agricultural land.

- Plant studies show the positive effects of fertilization after the land application of biosolids with low or no adverse impacts on growth, germination, or seed yield.
- Laboratory studies of hexapods (Springtail *Collembola*) demonstrate very few to no adverse effects from exposure to biosolids. While some assessments using higher than agronomic rates of biosolids application began to show negative impacts to reproductive capability, field studies showed no changes in total abundance or diversity, and certain species experienced population increases.
- Studies assessing earthworm growth in agricultural soils amended with biosolids have shown no or some positive growth with amendment. Studies examining higher rates of biosolids application, or rates in reclaimed soils with higher metals content, demonstrated mixed results and some declines in earthworm productivity, which have been related to salinity, pH, and trace elements found in the native soils to be reclaimed. It is challenging to interpret these results, as many of these studies have been undertaken on a species of worm (*Eisinia fetida*) which is not native to agricultural soils; other studies using agriculturally relevant worms (*Lumbricus terrestris*) tend to be less sensitive. Land application bioassays using relevant worm species and relevant amendment rates appear to demonstrate benefit to the worms.
- Nematodes (microscopic worm-like soil fauna) demonstrated no significant trends or decreases in population density through several biosolids field trials.
- Soil bacteria populations increased in response to biosolids application, resulting in positive changes to soil respiration rates and enzymatic activity. In a few trials, biosolids applications showed no effect on microbial biomass or respiration.
- Trials examining the impact of biosolids on fungal communities have demonstrated positive, neutral, and decreased productivity.

In addition to the above findings, the review acknowledges the "lack of data" and that the "potential impact to public and environmental health is not well understood." (Ryerson University, 2015). More research is warranted to access the potential impacts of ESOCs on environmental and human health.

Continued research using both holistic and single-substance approaches is underway in Canada, and is expected to provide published conclusions within the next two years. Preliminary results have indicated that biosolids applied at agronomic rates do not have a deleterious effect on ecologically relevant plants nor soil biota studied to date, and demonstrate significant benefits despite the presence of ESOCs (Ryerson University, 2015).

3.3 Regulatory conditions

Municipal, provincial, and national policy is key to minimizing potential risks to human health and the environment and maximizing the benefits of the land application of biosolids.

3.3.1 Source control

Before municipal wastewater is recycled to produce biosolids, steps can be taken to minimize potential environmental and health risks by monitoring and enforcing what enters into the sewage system. According to the *National Guide to Sustainable Municipal Infrastructure* (InfraGuide, 2003), the elements of **best practices for a source control program** are:

- Enactment of a bylaw;
- Monitoring and enforcement;
- Education and awareness;
- Codes of practice;
- Wastewater rates; and,
- Pollution prevention programs.

The CCME suggests that all wastewater facility owners with appropriate legislative authority give serious consideration to establishing a sewer-use bylaw to control what is discharged to their systems by non-domestic (industrial/commercial) wastewater generators (Canadian Council of Ministers of the Environment, 2009). By implementing source control initiatives for non-domestic wastewater producers, municipalities have observed a reduction of trace element concentrations in biosolids quality data (Canadian Council of Ministers of the Environment, 2012). For example, some municipalities have observed a more than 50 per cent decrease in mercury concentration within one to two years of implementing treatment requirements for dental operations (SYLVIS, 2007).

Source control programs are not universally applied, but are generally used in the restriction of key wastes containing pathogens, trace elements, and ESOCs through the prohibition of specific wastes or wastes from specific industries from entering the sewers, such as:

- Metalworks and electroplating facilities;
- Specified risk materials (including wastes from slaughterhouses, abattoirs, mortuaries, and hospitals);
- Heavy industry (ports, industrial terminals, coal terminals, oil and gas facilities); and,
- Wastewater with high organic matter or oxygen demand (brewing waste, dairy waste).

The effectiveness of source control initiatives can vary. The following table summarizes mercury concentration trends in jurisdictions that have implemented dental amalgam (i.e., a method of removing mercury from removal of fillings in dentist office wastewater) program initiatives and bylaws.

Mercury Concentration Trends in Biosolids (reported in mg/kg dry weight)

Jurisdiction (Location)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Trend
Metro Vancouver (Lions Gate)							**5.7**	4.6	2.9	2.7	2.1	2.1	2.0	1.9	Decreasing
Metro Vancouver (Annacis)							**2.8**	2.5	2.6	2.0	1.7	1.8	1.9	1.6	Stable
Metro Vancouver (Lulu)							**3.1**	3.3	2.9	1.9	1.8	1.6	1.2	1.4	Stable
City of Abbotsford (JAMES)									**3.7**	2.6	2	2	2	1.8	Decreasing
King Country (West Point)	**2.35**	2.1	2.1	1.3	1.5	1.3	1.5	1.2	1.0	.9	1.1	.75	1.0	.75	Stable

Notes:

- **Metro Vancouver, King County and City of Abbotsford concentrations extrapolated from available charted data**
- **Data in bold font indicates enactment of source control program initiatives for dental operations**

Furthermore, education and awareness initiatives can be used to target domestic sources of wastewater and help reduce the amount of trace elements and ESOCs entering the wastewater system. Examples of outreach campaigns are:

- The *I Don't Flush* campaign in Ontario encourages the proper disposal of pharmaceuticals, personal hygiene products and household hazardous wastes to reduce wastewater contamination (Ontario Clean Water Agency and the Clean Water Foundation, 2015).
- The *Flushing Awesome – Protecting Water Quality Starts with Each of Us* campaign in King County, Washington, offered in five languages, uses a humorous approach to promoting the protection of the environment and sewer infrastructure.
- *Adult Toilet Training* is Metro Vancouver's campaign to encourages proper disposal of wipes; additional information on how to properly dispose of pharmaceuticals and other household wastes are also provided at *Prevent Problems in the Pipes*
- As part of the City's Source Control program, Abbotsford has developed Sewer Savvy, an educational campaign targeted at domestic sources. The campaign materials are in development and set to be released soon.

3.3.2 Regulatory rigor

As discussed in Section 2.1.2, BC's OMRR (2002) was intended to enable biosolids beneficial use, while protecting human health and the environment. The OMRR outlines treatment and management requirements for pathogen reduction processes, vector attraction reduction, pathogen attraction limits, quality criteria, sampling and analysis (protocols and frequency) as well as record-keeping for each class of biosolids. The OMRR also specifies the maximum allowable trace element concentrations for each biosolids class, as well as in the soil following land application of the biosolids. Treatment and management requirements are based on a large body of scientific information and effectively reduce risk. Examples of some of these requirements include:

- Setbacks from surface water and domestic water sources;
- Storage restrictions (i.e., limits on the length of time that biosolids can be stored);
- Sampling of biosolids and receiving soils to estimate trace element loading rates to ensure compliance with regulated site-specific soil standards;
- Restricting harvesting of plant material from land application sites for specified periods following Class B biosolids land applications;
- Restricting livestock grazing immediately after land application to minimize any potential pathogen exposure; and
- Signage where Class B biosolids have been applied to inform the public of biosolids applications.

Other guidelines such as the Ministry of Environment's guidance document *Land Application Guidelines for the Organic Matter Recycling Regulation and the Soil Amendment Code of Practice* (BC MoE, 2008) describe other safeguards which add additional assurance of environmental protection:

- Maximum recommended number of applications (e.g., maximum of one application every five years on pastures in Southern BC);
- Fertility analysis, prior to biosolids application soil samples are collected from the proposed land application area to assess crop nutrient requirements in order to determine agronomic rates thereby reducing the risk of nutrient loading and surface run-off;
- Incorporating biosolids into soils to reduce exposure to humans, wildlife, and livestock, and to reduce the potential to enter into the air through vaporization; and,
- Public notification and consultation to inform the community of activities (i.e., hauling and shared roadways, odours, etc.).

A key component of the OMRR is the reliance on qualified professionals (QPs). A QP is a registered member of a professional organization such as the BC Institute of Agrologists, the College of Applied Biology, the Association of BC Forest Professionals, and others. The QP bears responsibility for environmental protection during biosolids beneficial use projects. The LAP – the document which lays out the rationale for an individual project – must be authored by the QP and contains information that ensures the QP is familiar with the site and its environment. Following land application of biosolids, the discharger must obtain written confirmation from a QP that the land application was done in accordance with the LAP. QPs are beholden to the professional and ethical standards of their organizations and are subject to disciplinary action by those organizations if required.

As previously mentioned in Section 3.2.3, the development of the OMRR took into consideration, and has much in common with, the EPA's regulation for biosolids, the US Federal Part 503 Rule (Environmental Protection Agency, 2014). The US National Academy of Sciences has twice evaluated the EPA Part 503 rules and biosolids quality standards and found no documented scientific evidence that the EPA Part 503 Rule has failed to protect public health. In addition, the Academy found no documentation of causal associations between biosolids exposures and adverse health outcomes, and no scientifically documented outbreaks or illnesses that have occurred from

microorganisms in treated biosolids (National Research Council, 2002). However, it is recognized that the public has a more precautionary view and does not want to wait for negative effects to occur.

The CCME's *Canada Wide Approach* (2012), discussed in Section 2.1.3, is a set of guidelines predicated on the recognized benefit of biosolids to the environment for soil development and soil quality improvements as well as vegetation production. In developing the *Canada-Wide Approach*, the CCME Biosolids Task Group undertook the following research and reviews:

- *Emerging Substances of Concern in Biosolids: Concentrations and Effects of Treatment Processes* (2009) and *Emerging Substances of Concern in Biosolids: Concentrations and Effects of Treatment Processes – Field Sampling Program* (2010) – A literature review and field survey of ESOCs in Canadian municipal biosolids including their concentrations and the effects of treatment processes. The project was designed to: review the state of the knowledge with respect to municipal biosolids science and research; identify, inventory, and quantify ESOCs that may be present in Canadian municipal biosolids through collection of municipal biosolids samples across Canada; determine the effects of wastewater residuals treatment on degrading ESOCs; identify those ESOCs that may pose a risk to the environment if land-applied; and, recommend best management practices and future research for ESOCs.
- *A Review of the Current Canadian Legislative Framework for Wastewater Biosolids* (2010) – The review outlined the regulatory framework for biosolids, summarizing and documenting the current status of wastewater biosolids regulation across Canada at the federal, provincial and territorial levels.

British Columbia's current estimated biosolids annual production is 37,700 Tonnes dry solids (Tds), and is predicted to reach 52,700 Tds by 2020, and 71,500 Tds by 2040, as municipalities implement secondary wastewater treatment to meet the federal *Wastewater Systems Effluent Regulations*. In addition to the research behind the development of the CCME Approach and the OMRR, the strength of existing regulation is supported by demonstrated success in the field. After more than 20 years of land application of biosolids in BC, there is no documented scientific evidence that the OMRR has failed to protect public health or had negative impacts on the environment. Municipalities and regional districts that have recycled organic matter and biosolids under the OMRR include: Prince George, Whistler, Squamish, Saanich, Salmon Arm, Abbotsford/Mission, Kelowna, Chilliwack, Fort St. John, Sechelt, Gibson's, Powell River, District of Kent, Regional District of Central Okanagan, Regional District of Nanaimo, City of Campbell River, Metro Vancouver, Capital Regional District, Comox-Strathcona Regional District, and many more. A range of private operators in various regions of the province also recycle biosolids or other organic matter under the regulation, creating soil amendment products that are sold under a variety of trade names at reputable home and garden centres.

In April 2016, the British Columbia Ministry of Environment announced a formal review of OMRR. It is anticipated that this review will enable the regulation to be considered in light of significant volumes of new data and information which have been produced since the previous minor review of OMRR. Within OMRR, there is a review clause that indicates that the MoE will evaluate the regulation within three years of it coming into force to determine if there are changes required.

3.3.3 Continuous improvement

Based on existing information and research, it is the view of the BCWWA that the OMRR and CCME guidelines adequately protect human health and the environment. Positions and support for the beneficial use of biosolids are based on the best available information; as information evolves, so too may the positions of regulators and professionals working with biosolids; it is incumbent upon professionals to remain current and use the best available information in their decision making processes. Both the OMRR and the CCME support continuous improvement, such as the ongoing research related to the potential impact of non-regulated trace elements and ESOCs. Several

studies are currently being conducted to determine the risks related to ESOCs in biosolids and inform practices for provincial and federal regulatory end-users.

3.4 Social conditions

In addition to environmental factors, the CCME also recommends that social factors, such as community perception and level of acceptance of the beneficial use option, be considered in the development of a biosolids management program (Canadian Council of Ministers of the Environment, 2012).

First Nations, stakeholders, and the community in proximity to the application site or production facility may understandably have a number of concerns about health and environmental impacts that must be addressed to ensure the success of biosolids beneficial use projects. The CCME suggests a range of factors that should be considered, including proposed site proximity to neighboring land uses; odour issues associated with the level of use and application timing; and cultural and historical concerns.

Communications, engagement, information sharing, and dialogue about the associated benefits and risks of the land application of biosolids is also crucial to the success of the program (Canadian Council of Ministers of the Environment, 2012). Several resources have been created to help biosolids professional in this process, including *Public Perception of Biosolids Recycling: Developing Public Participation and Earning Trust* (Water Environment Research Foundation, 2004) and the *Strategic Risk Communications Process for Outreach and Dialogue on Biosolids Land Application* from the Water Environment Research Foundation (WERF 2011). Taking steps to continuously earn the trust and respect of First Nations, stakeholders and the public through ongoing, open communications is critical to any future project.

3.5 Partner organization positions

The position of the Water Environment Federation (WEF), a BCWWA-affiliated organization, on the land application of biosolids is as follows (adopted by the WEF Board of Trustees December 2, 2011).

> The WEF supports a comprehensive approach to wastewater treatment and solids management that ensures the recycling and recovery of valuable resources including water, nutrients, organic matter, and energy. In addition, WEF recognizes that biosolids, natural by-products of the wastewater treatment process, are a renewable resource that is too valuable to waste in the context of growing needs for renewable energy and sustainability. WEF supports advancing the use of biosolids as a renewable resource and supports initiatives to ensure this expanded view of wastewater and solids management. WEF actively supports the promotion and enhancement of the beneficial recycling of biosolids that are best suited to meet the management needs of local communities, whether that use is beneficial recycling through land application, composting, energy generation, product development, landfilling, incineration, or other uses. This position is consistent with decades of scientific research and years of field practice that have clearly established the value and environmental benefits of biosolids when properly treated and managed. It is also consistent with the US Environmental Protection Agency's position and those of other federal agencies, which encourage the beneficial use of biosolids through policies and regulations, including the *Clean Water Act* (Water Environment Federation, 2015).

Section 4: Recommendation

Biosolids constituents have been the subject of much research since the beginning of beneficial use programs, and research continues today in response to the identification of new issues. However, after many years of study and risk assessment in Canada, the US, and Europe, regulatory agencies (as reviewed in Ryerson University, 2015) have concluded that biosolids should be beneficially recycled to land for their fertilizer value, and that constituents present which have the potential to pose risks to human health and the environment can be managed through source control, wastewater treatment, and regulated land application. It is recognized that there are countries and situations globally where land application is not favoured for geographical or political reasons, however land application in the BC context should be evaluated based on BC geography and a rational discourse of opportunity and risk. The BCWWA believes that current regulation in BC is protective of human health and the environment; however, we believe the regulation should be periodically reviewed and updated as necessary to reflect scientific advances and to support continuous improvement in the practice of biosolids and application.

Based on the available information, the BCWWA supports the beneficial use of biosolids land application in BC, such as in agriculture, forestry, reclamation of degraded land and mines, and the creation of value-added products such as composts and soils. However, we also recognize that the use of biosolids requires appropriate consideration in order to effectively mitigate, minimize, or eliminate risk from source to field. Biosolids may contain pathogens, trace elements, and emerging substances of concern that have the potential to be harmful to public health and the environment and thus biosolids must be managed carefully to ensure no harm or adverse impact. In addition, regardless of whether environmental and economic conditions have been met, land application of biosolids is made much more difficult without First Nations, stakeholder, and public confidence in and support for the practice. Ongoing effective communications about biosolids management and knowledge is an important component in supporting positively perceived biosolids beneficial use.

Effective biosolids beneficial use includes:

- Implementing and enforcing municipal source control and sewer-use programs.
- Strictly following the BC Ministry of Environment's *Organic Matter Recycling Regulation*, following the Ministry's recommended best management practices *Land Application Guidelines for the OMRR and the Soil Amendment Code of Practice* (2008), and strongly considering the Canadian Council for Ministers of Environment's *Guidance Document for the Beneficial Use of Municipal Biosolids, Municipal Sludge, and Treated Septage* (2012).
- Continuing research and risk assessment to stay abreast of changes in wastewater and biosolids quality and monitor the long-term impacts; and this could be supported by establishing a Canadian consortium to serve as an information clearinghouse for current research, enabling effective identification of knowledge gaps that may be addressed through additional research.
- Following community engagement best practices where possible and practicable throughout all stages of biosolids use.

The BCWWA acknowledges that positions and support for beneficial use of biosolids are based on the best available information. As information evolves, so too may the positions of regulators and the industry. As such, the BCWWA position statement on the land application of biosolids will be regularly updated every three years (or in tandem with OMRR reviews) under the direction of the Wastewater and Residuals Management Technical Advisory Committee to ensure that it accurately reflects the position of its members, and the position of regulators and evidence-based science as it pertains to BC.

Position Statement

The BC Water & Waste Association supports the land application of biosolids under the following conditions:

- That municipal sewer-use bylaws are established and enforced, and public education is carried out to control the amount of potential contaminants entering the sewage system through domestic and non-domestic sources.
- That provincial requirements detailed in the *Organic Matter Recycling Regulation* of British Columbia are adhered to.
- That management principles recommended by the Canadian Council of Ministers of Environment are strongly considered.
- That professionals working with biosolids and government demonstrate continuous information gathering and improvement through ongoing research and updates to biosolids management best practices and regulation.
- That First Nations, stakeholder, and public engagement best practices are followed throughout all stages of biosolids beneficial use.

The BC Water and Waste Association (BCWWA) prepares Position Statements to guide its members and others in the water and waste community in implementing best practices to support the safeguarding of public health and the environment as related to water and waste.

Our protocol for developing position statements begins with a well-researched and balanced analysis of the topic, which is normally drafted with support of one or more BCWWA Technical Committees who are considered to be subject matter experts on the issue. This analysis is then presented to the BCWWA Board of Directors in the form of an Issue Analysis Paper.

The Association staff present a *draft* Position Statement on the topic for review and input by BCWWA Technical Committees, the BCWWA Leadership Council, the BCWWA membership and in some cases, external stakeholders before the final Position Statement is presented to the BCWWA Board of Directors and officially adopted on behalf of the Association.

A special thank you to all those who contributed to the development of this position statement.

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BC WATER & WASTE ASSOCIATION

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Agenda Item 9
for Information

EEE 16-73

REPORT TO INTEGRATED RESOURCE MANAGEMENT SELECT COMMITTEE MEETING OF WEDNESDAY, NOVEMBER 9, 2016

SUBJECT **Advanced Integrated Resource Management Project – Request for Expressions of Interest**

ISSUE

To update the Integrated Resource Management Select Committee (IRMSC) regarding the Request for Expressions of Interest (RFEOI) process for development of an Advanced Integrated Resource Management Facility.

BACKGROUND

At its August 10, 2016 meeting, the IRMSC made the following recommendations:

That staff be directed to:

1. *retain the services of a procurement specialist to work with staff to develop a Request for Expressions of Interest (RFEOI) for an Integrated Resource Management (IRM) pilot project and bring an RFEOI document back through the Committee to the Board for approval;*

2. *retain the services of an independent IRM specialist to present information to the Board regarding the Sydney, Australia strategic IRM process and to assist with the development of an RFEOI, as outlined above.*

As directed by the IRMSC, CRD staff hired HDR Consulting as the independent IRM specialist to provide expertise regarding technologies and to bring innovative procurement approaches to the project.

The process for developing an Advanced Integrated Resource Management (AIRM) solution for the region would commence with issuing a performance-driven Request for Expressions of Interest to sound the market. This request would cover the CRD's goals for an IRM solution, evaluation of technologies, greenhouse gas reduction potential, resource and revenue opportunities, site selection and facility reference costs. The responses to the RFEOI will guide the next important step, which is RFP scope definition and laying out a multi-stage competitive and innovative procurement process. Potential ownership structure and delivery models for a new AIRM facility will be communicated as future procurement phases unfold.

In order to realize an integrated municipal solid waste (MSW)/biosolids solution, the RFEOI has been expanded to investigate a wide range of beneficial reuse opportunities of all feedstock available to the CRD. Current feedstock includes: biosolids, source-separated kitchen scraps, yard and garden waste and residual MSW. The absence of MSW flow control within the Region and the inability to guarantee tonnages raises the level of financial risk on the project and will likely be reflected in the responses to the RFEOI.

In keeping with recent Core Area Wastewater Treatment Plant Project Board recommendations and the Saanich Peninsula Wastewater Commission's desire to explore a regional approach to wastewater treatment and residuals management, the RFEOI would include a section to determine the level of private sector interest to undertake a scalable sub-regional solution on the Saanich Peninsula.

HDR consultants have provided a technical scoping summary to identify key considerations for the proposed RFEOI, attached in Appendix A. The IRM Select Committee's preference for thermal reduction processes as a potential IRM solution, including an option for a pilot, is emphasized in the RFEOI, along with a categorical exclusion around land application of biosolids/process residuals.

Once the Scoping Summary has been vetted and approved by the committee, the RFEOI will be finalized and brought back for approval. A Project Charter is also being contemplated for the project.

The economic implications of a long-term, in-region facility will only be determined once the results from the RFEOI and future RFP are available. Commitment on feedstocks supplied by municipal and private sector participants will be discussed as part of the collaborative RFP process. Outcomes of these discussions will impact processing technology selection and cost.

Any in-region facility, regardless of technology, would be subject to CRD Bylaws, MOE approvals and include environmental assessments and controls, including leachate, air emissions, odour, vector, litter and dust management plans. For location, Hartland landfill is identified as a potential site for the project and proponents will be allowed to present other suitable site options for consideration.

Potential proponents are expected to ensure alternate locations have appropriate land use designations by working directly with the appropriate municipality or electoral area.

Next Steps

Implementation of the kitchen scraps processing procurement process includes:

- Issue Expression of Interest (EOI) – November/December 2016
- Issue RFQ – February 2017
- Board selection of proponents and review of RFP documents – April 2017
- Scope Definition – May to June 2017
- Issue RFP – July 2017
- Collaboration with RFP proponents, municipalities and municipal haulers – Fall 2017
- Volume commitments and award RFP (timing dependent on technology and location)
- Finalize contracts and start construction (timing dependent on technology and location)

CONCLUSION

A scoping summary of key considerations for a Request for Expressions of Interest for an

advanced Integrated Resource Management solution has been prepared for the committee's consideration.

RECOMMENDATION

That the Integrated Resource Management Select Committee recommend to the Capital Regional District Board:

That the staff report on Advanced Integrated Resource Management Project – Request for Expressions of Interest be received for information.

Submitted by:	Joshua Frederick, P.Eng., Manager, Environmental Planning and Engineering
Concurrence:	Larisa Hutcheson, P.Eng., General Manager, Parks & Environmental Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

JF:cl

Attachment: Appendix A – Request for Expressions of Interest Scoping Summary, HDR Inc.

Request for Expressions of Interest - Scoping Overview

HDR offers the following scoping overview for the preparation of a Request for Expressions of Interest (RFEOI) when seeking to engage the market for Integrated Waste Management technologies and related services for the Capital Regional District (CRD).

Introduction and Project Understanding:

HDR understands the CRD is intending to issue an RFEOI as a part of the CRD's exploration of waste management options. Specifically, we understand the CRD desires to better understand the current market capabilities for an integrated waste management solution for the Region's existing solid and future liquid waste management facilities. To explore market capabilities, the CRD intends to engage the market through an RFEOI and a subsequent procurement process.

Solid and liquid waste management within the CRD are currently driven by different legislative authorities/requirements and under the administration of different regional committees and Boards. The CRD seeks to solicit response in the RFEOI to manage some or all of the following materials (quantities to be confirmed):

- 35,000 tonnes per year of biosolids
- 150,000 tonnes per year of municipal solid waste (MSW)
- 15,000 to 30,000 tonnes per year of source separated household organics
- 15,000 to 18,000 tonnes per year of yard and garden wastes

Further the CRD wishes to explore the possibility of integrating solid and liquid waste management interests and maximizing resource recovery through integrated processing of some or all of these materials and generating energy, recovering materials, and producing revenue. We understand the prohibition of land application of biosolids requires that a solution be found for management of this material stream. The CRD would like to demonstrate leadership, and find a solution that places them at the leading edge of resource recovery, broadening the search for technologies for those that could manage all or some of these materials in an integrated approach.

RFEOI Scoping:

Based on these understandings we suggest the CRD prepare the RFEOI employing a transparent process whereby the results are impartial and free from outside influences.

The entire procurement process should be structured to identify and manage risks, as this is most likely to result in a successful outcome. The allocation of risks should be based on which entity is best suited to manage the risk.. For example facility risks such as technology performance and facility operations are typically best allocated to private sector entities. Similarly, program risks such as policy/program adoption, payment for service, etc. are generally allocated to the public sector. Risks that could be either or even shared include site acquisition, offtake purchase commitments, etc.

Prior to issuing the RFEOI, the CRD should confirm their intentions by addressing the following key framework issues:

- What the CRD has (assets, current operations)
- What the CRD needs or wants
- What the CRD is willing to do
- What the CRD is unwilling to do

With these issues clarified, the RFEOI should convey the following information to the prospective respondents:

- Overall goals of the CRD, the purpose of the request
- Identification of issues that are not negotiable (such as finding a solution to manage biosolids).
- Feedstock material types and respective quantities
- Flow control (or the lack thereof) of each feedstock type. What are the market conditions and where do these materials go when certain parameters change (such as cost)
- Any specifics the CRD may have in terms of placing value on issues that otherwise may not be evident (resiliency/redundancy, self-determination, climate goals, greenhouse gas metrics, etc.)
- Schedule or timeline expectations
- Regulatory constraints, site constraints
- Other issues that convey the 'project' to the proponents

The RFEOI should be relatively easy for respondents to reply. Its purpose is to 'cast a wide net' in terms of capturing a response from a wide variety of firms with varying degrees of experience. The outcome of the RFEOI should provide insight into the overall interest of the market, and gauge the

capability, maturity and depth of the market without requesting information that could be seen as proprietary. At this stage, no overly onerous requests such as submitting cost proposals, bonding, or related demands should be included. The RFEOI should not have a bias in terms of possible technologies or outcomes, as there are a range of potentially applicable technologies that are capable of managing some or all of the material streams identified by the CRD. The RFEOI is not a screening tool. Later RFQ phases will be used to reduce the pool of acceptable proponents. If the CRD is intending to employ any unique procurement process in terms of innovative procurement (e.g.: flexibility in terms of risk sharing such as ownership, construction, operations, revenue sharing, etc.) those issues should be revealed. The CRD will also create a data room to provide all historical and current information related to the project.

We typically expect to request information including but not limited to:

- Experience dealing with similar feedstock source materials at throughput rates that are relevant;
- Demonstration evidence of having an existing or previous working facility, how long it has been in operation, typical feedstock, its setting (rural, industrial, urban);
- A description of the typical by-products and/or residues;
- An overview of a facility that could perform the types of functions they offer;
- An interest in participating in further conversations/explorations by the CRD;
- Ability to finance/support the financing of a project of the anticipated scope/size
- Identification of the project execution framework that best suits their capabilities and interest, e.g. Design/Finance/Build/Own/Operate, Design/Build/Operate etc.; and
- Allow respondents to express themselves, offer input, expound on things they feel may be relevant to make a project successful, including terms the proponents feel are necessary for the project to be successful. As part of this, we would propose to include a matrix outlining key project ingredients/risk elements to solicit confirmation of their willingness to take on those project elements typically allocated to the private partner.

We realize these terms may require refinement to reflect the conditions unique to the CRD. We would work with CRD staff to refine the RFEOI prior to issuance.