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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)

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July 31, 2015

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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

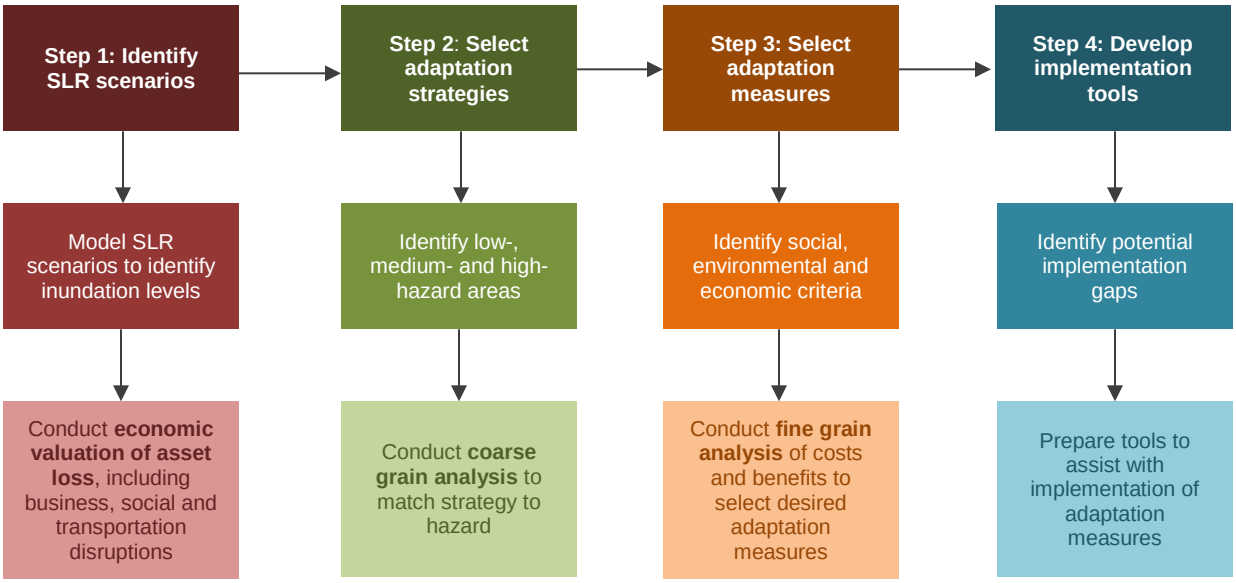
These frameworks rely on the identification of risk, hazard, vulnerability or impact for a given asset or land use. While the Phase 1 study provided valuation data for land, roads and key public assets, the data requires additional spatial resolution and evaluation in order to identify risks, hazards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