

CLIMATE & HAZARD ADAPTATION

Nanaimo is experiencing more extreme weather, which increases Nanaimo's risk for forest or brush fires, flooding, and drought. We must continue to assess risks and prepare to adapt.

Adaptation means responding to changes in our community and preparing for a successful and resilient future. In 2008, Nanaimo put targets in place to reduce greenhouse gas (GHG) emissions. However, like almost all BC municipalities, desired GHG reductions have been difficult to achieve. In 2019, Nanaimo City Council declared a climate emergency to bring a new focus to energy and emissions management.

Federal and Provincial policies, actions and incentives are increasing the focus on climate change planning, mitigation and adaptation. Nanaimo and its citizens have the opportunity to capture a share of this senior government and related private investment and encourage clean growth to provide both a resilient local environment and resilient economy.

This technical backgrounder summarizes policy status and potential gaps regarding climate change adaptation and management of natural hazards in Nanaimo.

Nanaimo is underway with climate change planning. The [Climate Change Resilience Strategy](#) presents over 60 action items to build Nanaimo's resilience.

Nanaimo's [Parks, Recreation & Culture Plan](#), [Transportation Master Plan](#), & [Trail Implementation Plan](#) lay a foundation for a connected system of street transportation, parks, greenways, and trails. For more information see the Mobility and Park, Recreation and Culture Technical Backgrounders.

Policies for changing the way we construct our buildings are important now. To reduce GHG emissions, the need for change/retrofits is urgent. For climate adaptation triggered by sea level rise or new flood risks, we can carry out adaptations gradually, as buildings or infrastructure are developed or redeveloped, or at the end of their service life.

For more information on climate mitigation, energy and buildings, see the GHG Mitigation Technical Backgrounder.

Technical expertise in this backgrounder was provided by Lanarc 2015 Consultants Ltd.

While Greenhouse Gas (GHG) mitigation and Natural Environment/Green Infrastructure is being addressed in separate documents, the topics below summarize recent progress and introduce potential next steps to manage climate change adaptation in Nanaimo:

Adapt to Changing Flood Hazard / Increased Rainfall
Adapt to Changing Drought Patterns
Adapt to Changing Heat Patterns

ADAPT TO CHANGING FLOOD HAZARD / INCREASED RAINFALL

Increased global warming is having the effect of increasing sea levels due to thermal expansion of ocean waters as well as melting of ice caps and glaciers. Sea Level Rise (SLR) will continue for centuries, with current BC provincial guidance to plan for 1.0 m SLR by about Year 2100, and 2.0 m SLR by about Year 2200. Current research recognizes a range of SLR rates, with some recent projections anticipating higher future sea levels than current BC provincial guidance.

Rainfall patterns are also predicted to change due to increased global warming. Precipitation in winter months will increase, and precipitation in summer months will decrease.

Subject areas considered under this topic include:

- Mapping of Coastal and Inland Floodplain Extents/Depth
- Modelling of Coastal Wave Effects
- Building Flood Construction Levels for new construction
- Site Flood Construction Levels for new construction
- Hard Flood Line of Defense and Protection (e.g. dikes)
- Soft Flood Line of Defense and Protection (e.g. green shores)
- Management and evacuation of floodable uses (adapt)
- Management and evacuation of future retreat areas
- Identification and protection of critical infrastructure
- Public education on flood management on private prop
- Review and upsizing of stormwater piped system
- Review stormwater source controls and stream management in face of climate change

Recent Progress in Nanaimo

Nanaimo's OCP includes the following policies for flood hazards and sea level rise:

- ▶ Objective: to provide flood protection and minimize impacts on the aquatic environment. Achieve a balance between protecting property from flood hazards and protecting the aquatic environment in terms of both water quantity and quality.
- ▶ Manage development to protect life and property from natural and human-made hazards such as steep slopes, floodplains, and abandoned mining structures.

Development Permit Areas (DPAs) support extra care in planning and design for sensitive areas. Our current DPAs include:

- ▶ Natural Hazard Lands DPAs to protect areas of bank instability and require professional engineering to guide potential modifications.

Nanaimo’s Flood Prevention Bylaw 1996 No. 5105 focuses on designated watercourses, but not coastal flood management.

The Subdivision Control Bylaw 1989 No. 3260 triggers the Manual of Engineering Standards and Specifications which specifies stormwater and landscape design and installation standards.

The Zoning Bylaw 4500 includes watercourse setback, leave area and flood control requirements. Flood control requirements follow floodplain mapping for the Nanaimo River and Millstone River and are set at 1.5 m above natural boundary of a sea or other watercourses. Where not certain, flood construction level determination may require applicants to provide a site plan certified by a Geotechnical Engineer.

For sea level rise (SLR), a first phase of planning and risk management has been completed in the Sea Level Rise Study (2019). Work to date has focussed on vulnerability and draft update to Flood Construction Levels (FCLs) which set minimum heights for habitable floors of new buildings. Recommended upcoming phases would consider refined FCLs, inundation models and flood depths in key areas such as Departure Bay, Downtown and Protection Island, and would address potential management solutions and priorities, and update to regulations (e.g. new Coastal Hazard Development Permit Area and update to Zoning Bylaw).

Coastal and stream erosion are also issues to monitor.

Estuary and riparian enhancement work have been completed with partners on Departure Bay Creek.

Potential Next Steps

The scope of the upcoming coastal flood management studies was not known at the time of writing this report. Considering other precedents (below), idealized steps to consider include:

- ▶ Reviewing and finalizing potential Flood Construction Levels for both the marine waterfront and major rivers, from current regional and provincial guidance, with a view of more recent IPCC research findings.
- ▶ Designing a ‘line of defense’ across the Nanaimo waterfront and estuaries. While it is important that the line of defense is continuous so as not to be breached through back channels or openings, this line may not always be at the existing shoreline. For example, it may move inland in select areas:
 - Port and railway areas which need to be close to tidewater, with a general permanent flood barrier perforated by limited temporary flood barriers to be installed at key gateways (e.g. rail crossings) before flood events;
 - Floodable outdoor land uses like some areas of park open space, festival space, low-use parking areas, seasonal uses;
 - Floodable habitat areas like marshes, estuaries, riparian and other wildlands, and related low use trails.
- ▶ Creating a set of best practice guidelines, including typical sections, isometric drawings and photographs, showing various methods of creating the line of defense and associated habitat or floodable land uses.

- ▶ Reviewing drainage and other underground or low-lying surface utilities to determine at what point of SLR or increased creek flooding it would be necessary to ‘raise’ the utility. In a related matter, determining when and where pump stations may be needed to move stormwater over the coastal line of defense at times of high water.
- ▶ Reviewing flood management standards for land uses upland of the line of defense. Considering application of provincial policy that would require all habitable floors to be above the flood construction level (crest level) of the line of defense in order to mitigate the high consequence of failure of the line of defense.
- ▶ Reviewing pragmatic strategies and conceptual phasing of how roads, parking areas, and adjacent site works and landscape could be raised to levels that are resilient to coastal flooding and adjacent backwater or groundwater effects. Raising of roads and sites will need to be coordinated with redevelopment of buildings to higher elevations, with considerations of reasonable access for goods and people with disabilities between buildings and sites.
- ▶ Reviewing and updating piped utility capacity and potential overages related to increased precipitation related to climate change.
- ▶ Early identification of land needs for coastal and estuary defense and habitat compensation, and determination of strategies for land / water lot acquisition.
- ▶ Community, business, development, and real estate industry engagement in the above strategies, with extensive education on the risks, potential solutions, and potential phasing as redevelopment occurs. Visualizations including dynamic visualizations of flooding and wave effects are very helpful in creating public understanding of how a design storm event could interact with the existing or future shorelines.
- ▶ Working with other utility providers (electrical, gas, communications) to ensure they are planning proactively to be resilient against coastal or creek flood risks.
- ▶ High-level costing and budgeting and phasing of solutions – with the intent to adjust financial mechanisms such as Development Cost Charges, Community Amenity Contributions, Reserve Funds or Partnership Grants / Applications to organize long-term funding for long-term and gradual adaptation.
- ▶ Cooperation with the Port and federal agencies (DFO, Environment Canada) on systematic review and approval procedures for adaptation projects.

Precedents

The following precedents are selected from a review of current published documents in the Pacific Northwest.

KEY POLICY PRECEDENTS

- ▶ [Campbell River – Rising Seas SLR Assessment Study \(2019\)](#)
 - **Purpose:** To summarize local SLR risks and evaluate the strengths and challenges of common SLR adaptation tools, providing support for updated regulations and strategies.
 - **Method:** Includes a public engagement process to provide public with background information and rationale for the planning process, and to collect feedback on public preferences and priorities.

Technical studies were completed at specific locations and planning guidelines were developed based on technical recommendations and community preferences.

- ▶ [District of North Saanich - SLR and Marine Policy Planning Studies](#)
 - **Purpose:** To better understand the impacts of SLR on land use planning, flood hazard policies, capital investment planning, and emergency preparedness strategies.
 - **Method:** Includes coastal flood inundation mapping and modelling, explores policy options for balancing risk reduction and development costs for property owners.
- ▶ [Surrey - Coastal Flood Adaptation Strategy \(2019\)](#)
 - **Purpose:** A long-term strategy to reduce climate change driven coastal flood risks.
 - **Method:** Includes proposed programs and policy actions as well as context-specific actions for planning areas, considering retreat as well as protection strategies.
- ▶ [BC FLNRO Guidelines – Dikes, Seismic Guidelines, Coastal Flood Guidelines](#)
 - **Purpose:** To reduce impacts of flooding on communities and infrastructure.
 - **Method:** Includes policies, regulations, guidelines, and funding estimates.
- ▶ [North Vancouver - Flood Assessment Study \(2010\)](#)
 - **Purpose:** To assess riparian flood hazards for specific streams in North Vancouver.
 - **Method:** Includes the development of a spatial database, hydraulic and hydrologic data collection, and production of flood depth maps. Sets out requirements for more detailed studies (that are now underway).

OTHER BACKGROUND LINKS

- ▶ [Vancouver - Coastal Flood Risk Assessment Phases 1,2,3 \(2014-2018\)](#)

ADAPT TO CHANGING DROUGHT PATTERNS

Nanaimo is in a ‘rain shadow’ with common summer drought. Climate change is likely to increase the length of summer drought patterns.

Subject areas considered in this topic include:

- Garden water conservation strategies, landscape and irrigation drought best practices
- Water use restrictions
- Water step pricing
- Drought watering strategies for public trees/plants
- Review adequacy of bulk water supply

Water for aquatic habitat is addressed in the Green Infrastructure/Nature Technical Backgrounder.

Recent Progress in Nanaimo

Nanaimo’s OCP includes the following policies for drought management:

- ▶ Objective: To ensure a sustainable water supply. Ensure that the community can continue to grow and prosper while maintaining environmental quality. This includes developing a conservation mindset towards water use.
- ▶ The City will continue a water conservation program that includes:
 - Development of policies to reduce water use per capita;
 - Public education on the benefits and methods of conserving water;
 - Advanced measures for detecting leaks in the water supply system;
 - Water conservation measures in municipal facilities;
 - Landscaping in public places and landscaping requirements for new development (for example, low-flow or drip irrigation systems, plant species and landscape designs that reduce the need for watering); and’
 - Methods of recognizing individual and corporate efforts to conserve water.

Nanaimo participates in the Water Smart program with the Regional District of Nanaimo and neighbouring local governments. Public education under that program, combined with low flow appliance incentives, seems to have been effective in substantially reducing Nanaimo’s per capita water consumption.

Climate change creates earlier springs and longer summers with associated seasonal drought. This trend has led to increased use of automatic irrigation in Nanaimo and other jurisdictions, which if not following industry best practices, can increase summer peaks in water use.

Nanaimo is undertaking a review of its Water Supply Strategic Plan. A key consideration is the potential timing of the need for additional water source. There is a direct relationship between peak water use – typically for fire flows and summer landscape watering – and the need for new supply and water storage facilities. Growth in

number of water supply users, partnerships with adjacent local and first nation governments, and the form of housing (e.g. apartment vs. low density single family) also influences water supply needs.

Nanaimo's Climate Resilience Strategy includes recommendations to improve tree resilience and planting standards in streets and parks, and restore riparian habitats using a climate lens.

Potential Next Steps

Considering other precedents (below), idealized steps to consider include:

- ▶ Updating public information materials (print, web, video) that summarize climate change resilience strategies, including water conservation issues and best practices. These include practices for landscape hydrozones (plans for areas of high, moderate, low and no summer watering), proper soil depth and quality, planting to match hydrozones, and irrigation best practices.
- ▶ Update design and performance specifications for landscape and irrigation best practices in Nanaimo engineering standards, adding consideration of climate change and resilience, recognizing that they apply to all public projects and could be referenced for private projects.
- ▶ Require the use of 'Smart' weather-based irrigation controllers on all new irrigation installations.
- ▶ Work with the development and landscape/irrigation industry to promote best practice applications (IIABC, BCNTA, BCSLA, APEGBC, AIBC, UDI, Home Builders Association).
- ▶ Create simple guidelines and worksheets for calculation of Water Budgets and establish water use targets or limits for various land use types.
- ▶ Update Development Permit language to require Water Budget and water use targets and best practices to be incorporated into development approvals and implementation.
- ▶ Consider Irrigation Permits as a supplement to stormwater management requirements for all developments, including single family and duplex.
- ▶ Review stepped water rates to encourage water conservation, and to provide an incentive for proper maintenance and programming of irrigation systems.

KEY POLICY PRECEDENTS

- ▶ City of Kelowna Landscape and Irrigation Water Demand Management, and similar Regional District of Nanaimo public information
- ▶ [Guide to Water Efficiency \(2010\)](#)
 - **Purpose:** To empower property owners to reduce potable water use for irrigation in the summer months.
 - **Method:** Includes background information and guidance on soil, mulch, plant selection, and irrigation design.
- ▶ [District of Lantzville Stepped Water Pricing](#)
- ▶ [Metro Vancouver Restrictions to use of treated drinking water](#)
 - **Purpose:** To reduce peak demands on the drinking water supply.

- **Method:** Municipalities are responsible for implementing practices to meet Metro Vancouver’s water use restrictions. City of Vancouver sets restrictions based on address, time of day, and type of water use.
- ▶ [Seattle Third Tier Water Rates](#)
 - **Purpose:** To reduce peak demands for potable water from May through September.
 - **Method:** Water utility charge rates are tiered based on volume of usage and location of use. Rates vary depending on the time of year.

OTHER BACKGROUND LINKS

- ▶ [Metro Vancouver Drinking Water Management Plan \(2011\)](#)
 - **Purpose:** To ensure that regional water needs are met safely, reliably, and affordably.
 - **Method:** The plan states that municipalities are responsible for developing: bylaws to encourage water efficiency, residential water metering programs and municipal rebate programs for water efficient fixtures/appliances, bylaws and design standards to encourage on-site rainwater capture for non-potable uses, enhanced lawn irrigation regulations.
- ▶ [Portland - Water Conservation Rate Structure Review](#)
 - **Purpose:** To explore advantages and disadvantages of various retail water rate structure alternatives, and their effectiveness at incentivizing customer water conservation.
 - **Method:** Includes a review of uniform and block rate structures, an evaluation of historical water demand under different rate structures, an assessment of the effectiveness of the current rate structure at meeting local objectives.

ADAPT TO CHANGING HEAT PATTERNS

As a parallel to Nanaimo, the City of North Vancouver has completed a *Climate Change and Impacts for the City of North Vancouver* report. An excerpt: ‘Projected increases in average summer temperature would result in a summer climate warmer than present-day Seattle by the 2050s and warmer than San Diego by the 2080s ... high temperature events that are currently expected only once every 10 or 25 years would instead occur every 3.6 or 7.8 years, respectively ‘ (Murdock et al., 2012). Nanaimo could face similar changes in temperature to North Vancouver.

Wildfire is a risk. Over the past decade, communities across BC have been threatened by wildfire. Nanaimo is fortunate to not have been heavily impacted in the past, but is vulnerable to urban interface wildfires.

Subject areas considered in this topic include:

- Wildfire management for urban forest
- Building design for solar shading
- Building design with green roof insulation
- Private / public site design to mitigate heat island effect
- Drinking Water supply to homeless
- Cooling / warming locations for public

Recent Progress in Nanaimo

Nanaimo’s OCP includes the following policies for changing heat patterns:

- ▶ Support development of innovative green spaces to reduce the urban heat island effect.

Nanaimo’s [Community Wildfire Protection Plan](#) identifies how to prepare for and manage fire risks.

Current focus in Nanaimo has been on protection of urban forest and habitat, and this remains appropriate. However, in the longer term (end of life of buildings constructed now), consideration of more shading and protection from excess heat will be very important.

Nanaimo [Climate Change Resilience Strategy](#) recommendations include:

- ▶ Develop fuel management in large parks and a community education program regarding wildfire risk.
- ▶ Develop an extreme heat response strategy.

Potential Next Steps

- ▶ Review development permit and other Nanaimo design guidelines and approval checklists to add consideration of heat island effect and provision for heat mitigation in building and urban design, as well as urban wildfire interface management.
- ▶ Continue implementation of street tree installations and replacements, with consideration of shade potential of chosen species and resilience to climate change.

- ▶ Consider update and implementation priorities of the Community Wildfire Protection Plan in concert with senior government and UBCM incentives for wildfire risk management.

KEY POLICY PRECEDENTS

- ▶ [District of North Vancouver Community Wildfire Protection Plan \(2007\)](#)
 - **Purpose:** To quantify and identify areas of wildfire risk, recommend management actions to reduce risk, and improve communication of issues to the public.
 - **Method:** Includes a risk assessment to spatially quantify fire risk, an identification of fuel types, and an outline of measures to mitigate risk.
- ▶ District of North Vancouver - Development Permit Area for wildfire risk areas
 - restrictions are put on the land title and are retained when land ownership changes.
 - Wildfire fuel management funded by grants and city budget.
- ▶ [City of Nanaimo Wildfire Management Plan](#)
 - **Purpose:** To improve public safety and reduce risk of property damage from wildfires.
 - **Method:** Includes a threat assessment and recommendations to reduce risk.
- ▶ [Georgetown Climate Centre - Adapting to Urban Heat: A toolkit for local Governments \(2012\)](#)
 - **Purpose:** To mitigate the public health impacts of increased urban heat events intensified by climate change by helping local governments adapt.
 - **Method:** Includes policy tools for encouraging cool roofs, green roofs, cool pavements, and urban tree canopy cover.
- ▶ [Toronto - Green Roof Bylaw](#)
 - **Purpose:** To encourage green roofs on public and privately owned buildings.
 - **Method:** Establishes a graduated green roof requirement for new development or additions greater than 2,000 m² gross floor area. Applies to industrial, commercial, institutional, and multifamily residential developments.
- ▶ [Philadelphia - Cool Roof Law](#)
 - **Purpose:** To decrease the urban heat island effect by encouraging reflective-coloured roofs.
 - **Method:** Requires buildings of certain types to have roofs with specified solar reflectivity values.

STEEP SLOPE & SUBSIDENCE HAZARD LANDS

Development patterns on hillsides have continuing challenges including fragmented green areas and extensive earthworks to meet safety standards.

Waterfront steep slopes and ravines can be locally unstable and increased rainfall intensity further impacts stability, leading to washouts or landslide.

Subject areas considered under this topic include:

- Management of steep and potentially unstable slopes
- Coastal erosion risks including sea level rise, and undermining of steep slopes
- Climate changes in rainfall and groundwater patterns and effect on steep slopes
- Coal workings and other risks of land subsidence
- Contaminated sites (generally under Provincial regulation)

Recent Progress in Nanaimo

Nanaimo's OCP includes the following policies for steep slopes and subsidence:

- ▶ Manage development to protect life and property from natural and human-made hazards such as steep slopes, floodplains, and abandoned mining structures.
- ▶ Limit and, if necessary, prohibit development in natural hazard areas and areas of abandoned mining works that could result in loss of property or personal injury.
- ▶ Design with nature to protect hillside character using cluster development to preserve open space.
- ▶ Control erosion during development.
- ▶ Sustain urban forests, treed areas, and wildlife trees.
- ▶ Create a network of riparian and upland corridors to link natural habitat and support wildlife movement.
- ▶ Assist the Province in regulating use and rehabilitation of contaminated sites.

The 'North Slope Stability Study (1993)' has provided guidance to address steep slopes and related development setbacks. Nanaimo's [Climate Change Resilience Strategy](#) recommends an update to that study to incorporate known climate predictions.

Nanaimo’s OCP includes two Development Permit areas that are related to hazard lands:

- ▶ Natural Hazard Lands DPAs to protect areas of bank instability or subsidence and require professional engineering to guide potential modifications.
- ▶ Steep Slope DPAs to achieve environmentally-sound, safe, and livable hillside neighbourhoods, including protection of vegetated slopes.

Potential Next Steps

- ▶ Review the North Slope Stability Study and other steep slope areas of Nanaimo to update analysis and recommendations to include climate changes in rainfall patterns, potential wildfire, coastal and watercourse erosion, groundwater seepage and related slope stability.
- ▶ Update the Hazard Land and Steep Slope Development Permit Areas and related guidelines for private development.
- ▶ Identify public infrastructure at risk from coastal or watercourse erosion, flood or landslide, and create a strategy to manage these risks associated with maintenance or replacement at end of service life.