

# COASTAL ADAPTATION PLAN

## FRASER RIVER FORESHORE



Climate change is driving some big changes along Vancouver's coastline, including the Fraser River foreshore area. In the short-term, we can expect more frequent and severe flooding from sea level rise and storm surges, while over the longer-term we can expect even greater challenges.

To help prepare Vancouver for a changing climate and help our coastal communities become more resilient, the City of Vancouver is developing a Coastal Adaptation Plan (CAP). One of the first programs of its kind in Canada, CAP is a multi-year undertaking to determine the risk, consequences and vulnerability of Vancouver to future sea level rise. It will also identify long-term adaptation options available to address the impacts and adapt to the changes climate change will bring in the future.

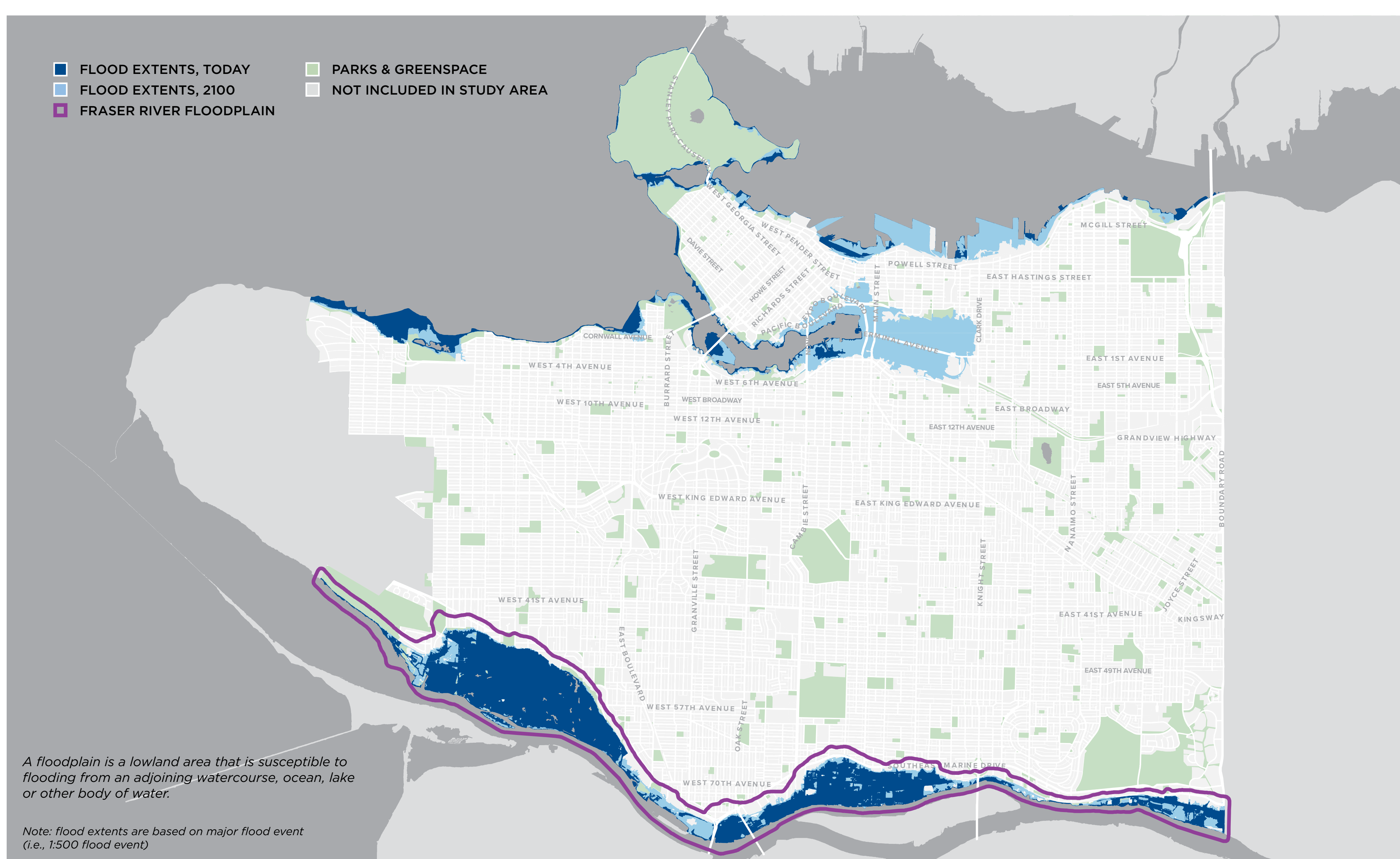
### VANCOUVER'S COASTAL FLOODPLAIN TODAY AND IN 2100

As a result of the City's work this floodplain map was created. Without flood management measures in place, areas in dark blue are vulnerable to flooding due to a major storm (1:500 year storm) today and areas in light blue are vulnerable to flooding due to a major storm and 1 metre of sea level rise by 2100.

### THE FRASER RIVER FORESHORE CAP

Today, the Fraser river floodplain (encircled in purple on the map) is the area most vulnerable to flooding in the Vancouver. The Fraser River shoreline runs from Boundary Road in the east to Musqueam in the west, crossing several Vancouver neighbourhoods. It is home to residential areas, businesses, industrial areas, and critically important habitat areas. The area is not only home to residential areas and businesses, but it also is home to critical "lifeline" infrastructure Vancouverites (and people who work in Vancouver) rely on, including water, electrical, natural gas and cellular communications systems.

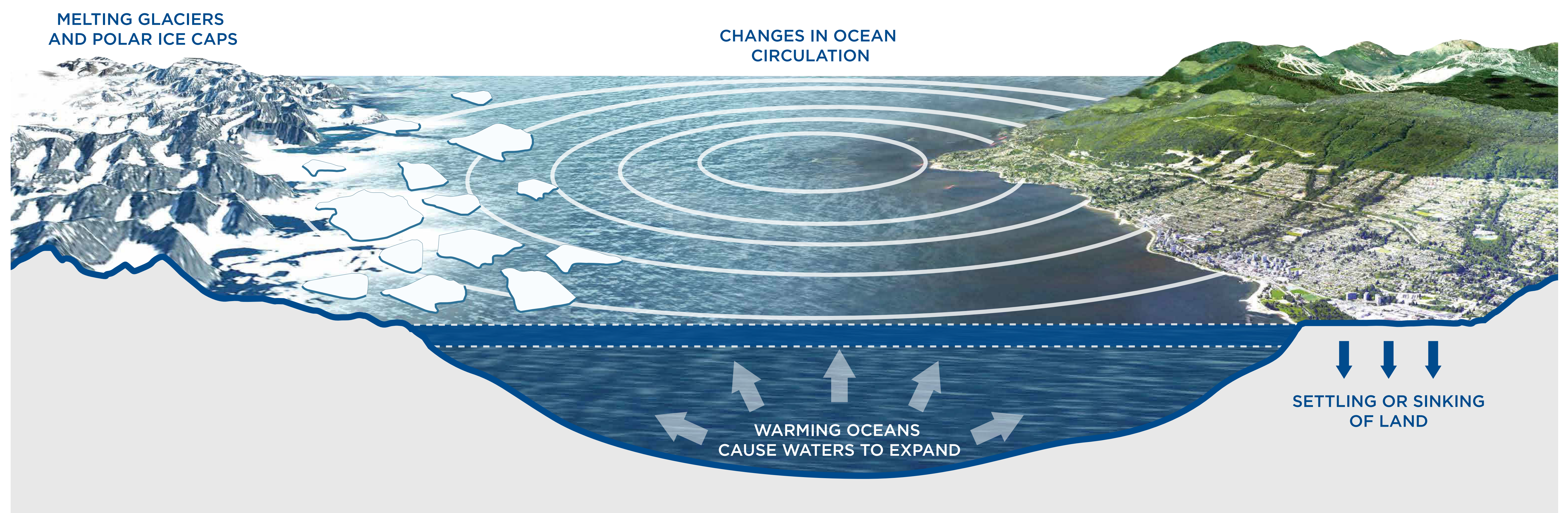
Recognizing this, the City of Vancouver launched the Fraser River Foreshore component of the larger CAP program in the spring of 2018. The project is taking a participatory approach and engaging residents, stakeholders, and other partners, including Musqueam First Nation, in identifying their values and concerns. Later work will involve developing potential adaptation options and evaluating them against both technical criteria and how well they address community concerns and values.





# CLIMATE CHANGE AND COASTAL FLOODING

As our global climate continues to warm, the ocean and the waterways and rivers that connect to it are changing, too.



Increasing temperatures are melting glaciers and polar ice caps, feeding more fresh water into the ocean. Climate change is also driving up the average temperature of ocean waters, causing them to physically expand in volume. The combined effects of these events is causing sea level rise. Based on sea level rise observations and computer modelling, the Province advised municipalities in 2011 to plan for 1 metre (3 feet) of sea level rise by 2100, and 2 metres (6 feet) by 2200.

## STORM CLOUDS AHEAD

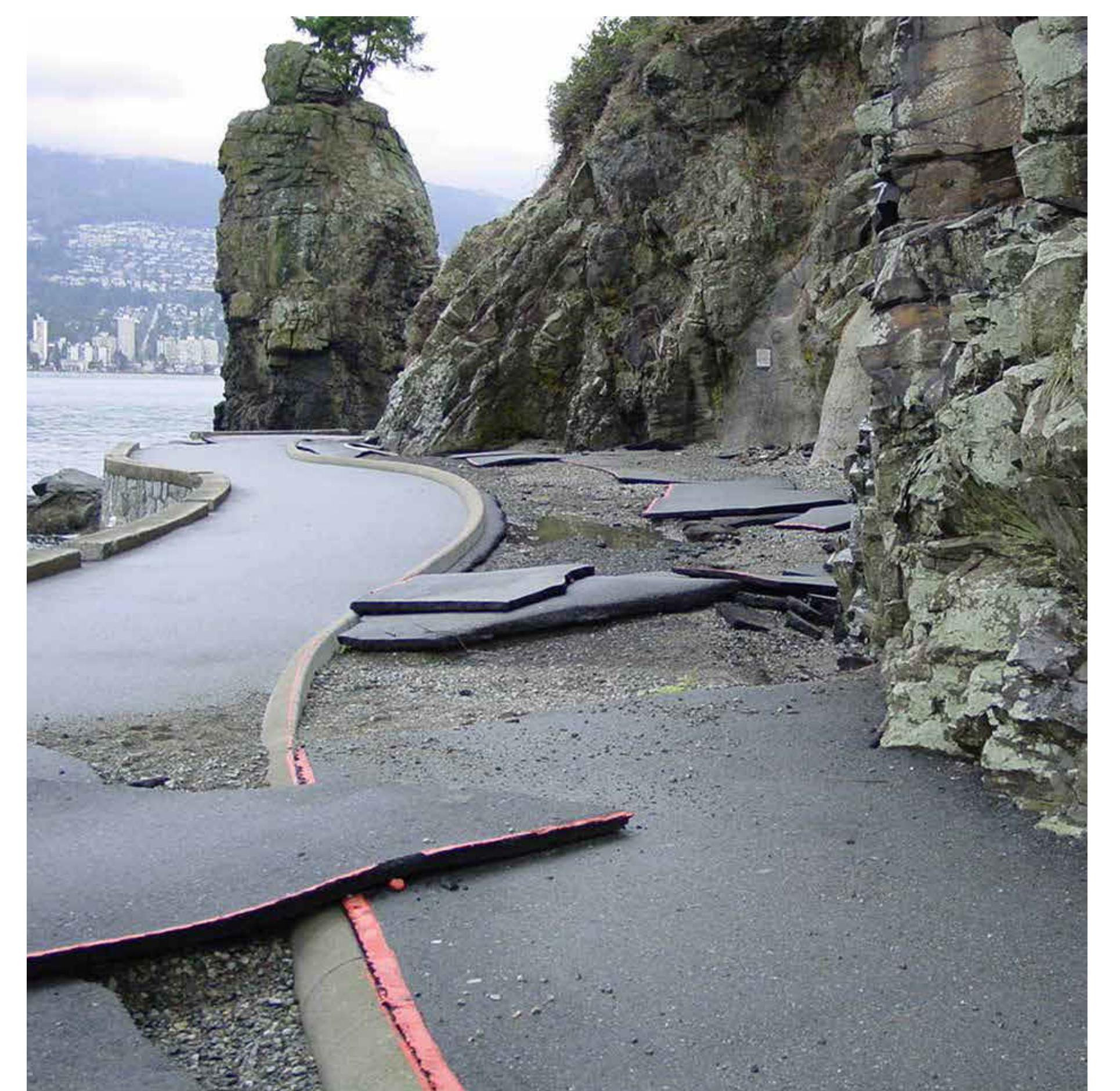
With the changing climate, a consensus of scientists and climate experts have told us to expect more extreme weather conditions.

Vancouver is expected to experience more frequent and severe winter storms with heavy precipitation. These winter storms will create powerful storm surges, driving more water up onto our shorelines and flooding low-lying areas. Unexpectedly large storm surges have already damaged some

of Vancouver's most treasured places, including the seawall in Stanley Park, which was closed for repairs after storm surges during the winters of 2012 and 2015.

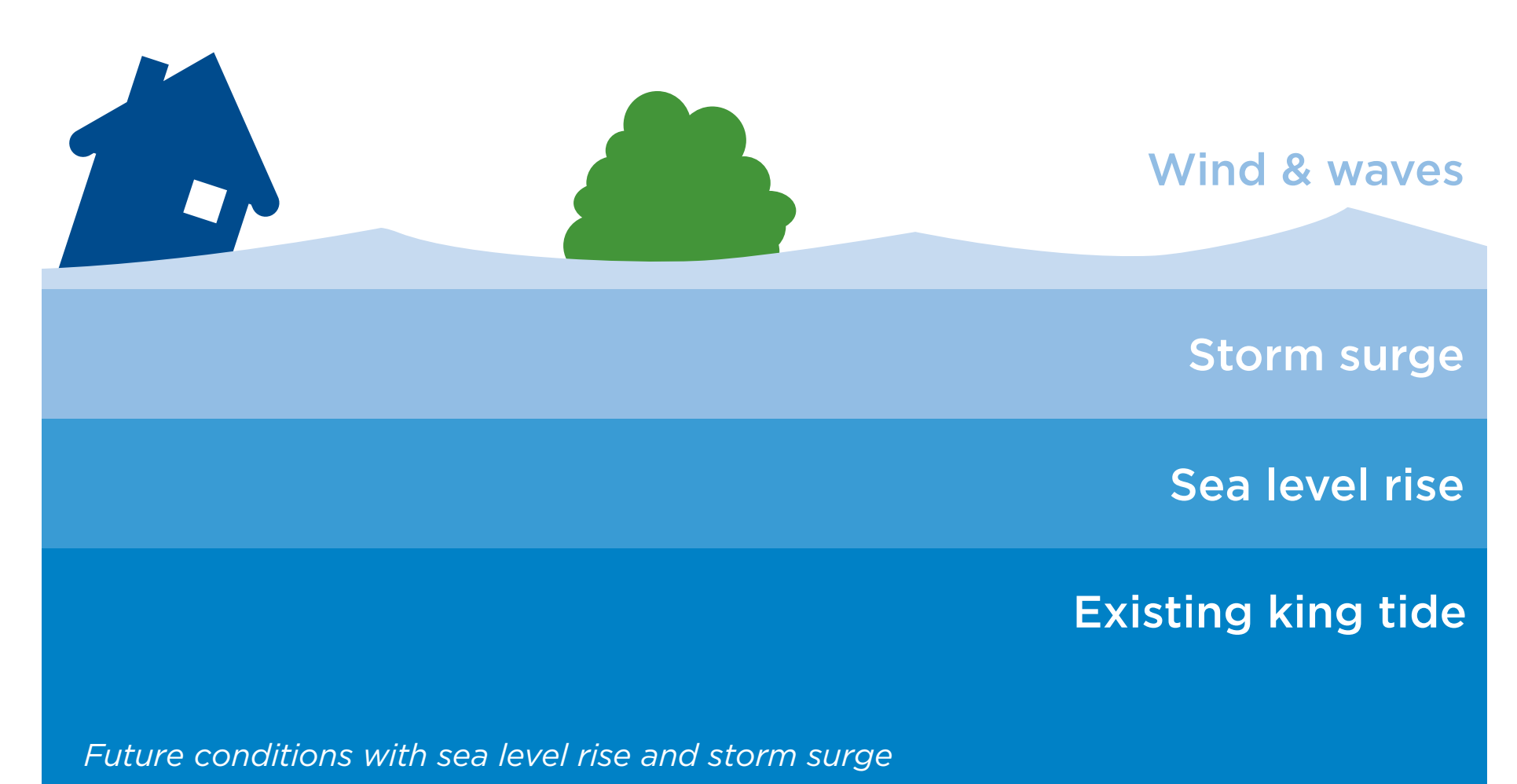
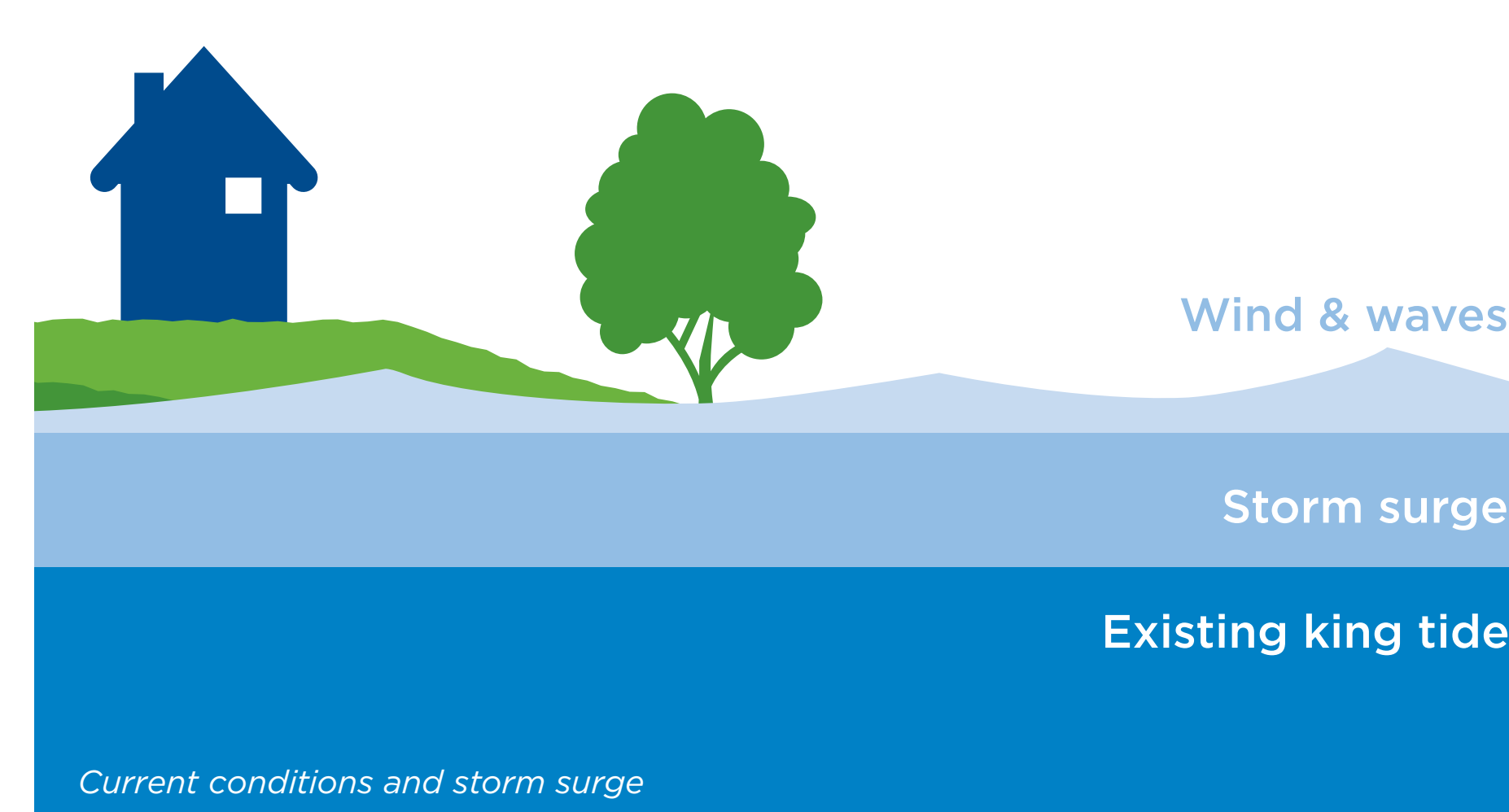
## STORM SURGES

From December to February, Vancouver regularly experiences winter storms whose winds can push water levels up anywhere from 50 cm to 100 cm above normal levels. These events are called storm surges and can generate problems when they



Stanley Park seawall damage, 2012

coincide with high seasonal tides, called king tides. King tides occur three or four times a year during the winter months and are 50 cm to 100 cm higher than regular high tides.





# COMMUNITIES & PEOPLE

The Fraser River Foreshore area is home to multifamily housing units in the eastern part of the floodplain, mostly detached homes in the Southlands neighbourhood towards the west, and a mix of dwellings within Musqueam’s principal reserve, which is also home to large number of leaseholder homes.

Beginning as an agricultural and farming community, Southlands is one of Vancouver’s most unique neighbourhoods and is the only area in the city that is in the provincial Agricultural Land Reserve. The Southlands area is where Musqueam’s principal reserve is located. It is home to hundreds of members and a range of community facilities, including Musqueam’s Administrative Office, a Cultural Centre, Musqueam Community Centre and Musqueam Golf Course.

**COASTAL FLOODING RISK IMPACTS**

Below are the community and residential impacts CAP partners and stakeholders reported being most concerned about. The feedback was collected at three community sessions, a workshop with Musqueam staff, an open house for Musqueam members, and a workshop with key project stakeholders who own and operate utilities and infrastructure in the area (e.g., Metro Vancouver, Fortis, BC Hydro, TransLink).

**WHAT DO YOU THINK?**

Please review the coastal flooding impacts below. **Take a strip of sticky dots** and use them in any combination to prioritize the impacts that are most important to you. Please use a sticky note if you have any comments or want to tell us why you voted the way you did. If an impact was missed, please use a sticky note and place it in one of the blank spaces provided.

COMMUNITIES & PEOPLE IMPACTS	PRIORITY	NOTES
People permanently displaced due to flooding		
Damage to homes from flooding		
People temporarily displaced due to flooding		
Loss of property values		
At 'risk' people adversely impacted (e.g., seniors)		
Adverse impacts to Musqueam housing and facilities		
Other:		
Other:		



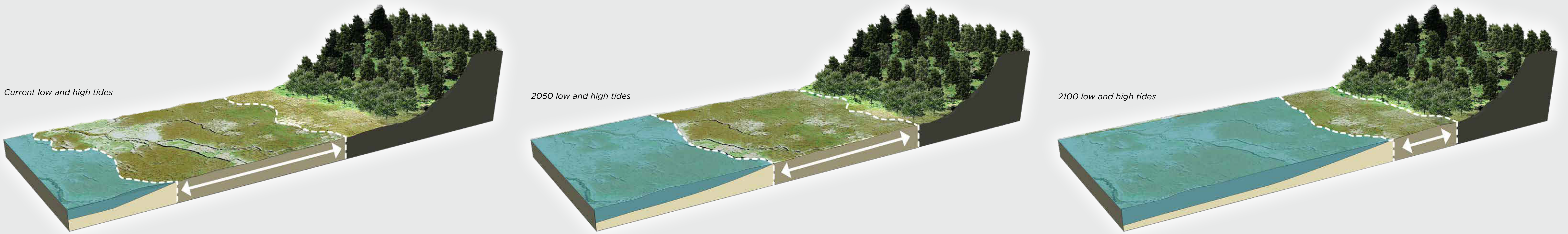
# ENVIRONMENT

The Fraser River Foreshore includes marine, inter-tidal and terrestrial habitat areas of various sizes, condition and connectivity. Individually and collectively, they provide critical habitat for juvenile salmon and migratory birds, as well as function as wildlife corridors along Vancouver’s southern border.

**IMPACTS: COASTAL SQUEEZE**

From heavily industrial waterfronts along Burrard Inlet, to relatively natural ocean shorelines between Kitsilano Beach, and Jericho Beach, and along the Fraser River estuary from Boundary Road to the marsh flats near Musqueam, our city’s coastline is as varied and dynamic as the city it surrounds.

It is Vancouver’s more natural coastlines, and the important intertidal areas they are home to, that are particularly at risk from climate change. These intertidal ecosystems will be impacted, reduced, and squeezed over time as they face permanent inundation due to rising sea levels and increased development pressure on land.



**WHAT DO YOU THINK?**

Please review the coastal flooding impacts below. **Take a strip of sticky dots** and use them in any combination to prioritize the impacts that are most important to you. Please use a sticky note if you have any comments or want to tell us why you voted the way you did. If an impact was missed, please use a sticky note and place it in one of the blank spaces provided.

ENVIRONMENT IMPACTS	PRIORITY	NOTES
Damage to and loss of intertidal habitats (mud flats, salt water marsh, intertidal areas)		
Damage to and loss of habitat on land, including shoreline habitats and wetlands		
Contaminants released into environment from flooding		
Temporary and permanent loss of access and flood damage to parks & open spaces		
Coastal squeeze and loss of intertidal ecosystems		
Other:		
Other:		



# RECREATION

From trails to and along the Fraser River for walking, cycling, horseback riding, bird watching and nature viewing, to three golf courses and many horse stables, the area is also home to multiple recreational opportunities.

**GREENSHORES™**

Adapting to sea level rise provides an opportunity to take a new made-in-Vancouver approach to managing flood risk. Softer options, like GreenShores™ dikes and other flood management approaches represent new strategies that can help protect waterfront properties while also protecting and restoring habitats and creating new recreation opportunities. We can apply Greenest City values in our adaptation work.



**WHAT DO YOU THINK?**

Please review the coastal flooding impacts below. **Take a strip of sticky dots** and use them in any combination to prioritize the impacts that are most important to you. Please use a sticky note if you have any comments or want to tell us why you voted the way you did. If an impact was missed, please use a sticky note and place it in one of the blank spaces provided.

RECREATION IMPACTS	PRIORITY	NOTES
Loss of access to trail network		
Loss of access to Fraser River		
Impacts to equestrian areas and stables		
Damage to recreational facilities (golf courses)		
Other:		
Other:		



# INFRASTRUCTURE & TRANSPORTATION

From lifeline services supporting both the local area and larger city (e.g., natural gas, hydro, cellular, water, sewer) to important transportation corridors (Kent Street) and the TransLink Transit Centre, the area is home to range of critically important infrastructure and services.

**RISK**

Reducing the risk of service disruptions to life lifeline infrastructure from a flood event is critically important to the City of Vancouver and the organizations who own and operate utilities and infrastructure in the area (e.g., Metro Vancouver, Fortis, BC Hydro, TransLink).

**RISK**

=

**LIKELIHOOD**

x

**CONSEQUENCE**

The overall potential risks over time, including the actual sea level height at any given point in time and the frequency and intensity of storms that would combine with sea levels and make coastal flooding more severe.

The chance that a particular sea level rise and coastal flooding scenario will occur.

The impacts to local shoreline areas and communities if flooding were to occur. This includes identifying the areas where the water will go (i.e., hazard areas) and identifying the specific vulnerabilities in the hazard areas (e.g., homes, businesses, community facilities, infrastructure and services, habitats, recreation areas).

**WHAT DO YOU THINK?**

Please review the coastal flooding impacts below. **Take a strip of sticky dots** and use them in any combination to prioritize the impacts that are most important to you. Please use a sticky note if you have any comments or want to tell us why you voted the way you did. If an impact was missed, please use a sticky note and place it in one of the blank spaces provided.

INFRASTRUCTURE & TRANSPORTATION IMPACTS	PRIORITY	NOTES
Damage to and disruption of infrastructure services (water, sewer)		
Damage to disruption of power infrastructure (electrical, natural gas)		
Damage to disruption of transportation infrastructure (roads, transit)		
Damage to and disruption of telecommunication services (phone, internet)		
Cascading impacts to other parts of Vancouver and region (i.e., knock-on impacts)		
Emergency access disruptions (due to road closures, damage)		
Other:		
Other:		



# LOCAL & REGIONAL ECONOMY

The area is home to about 280 industrial, warehouse and commercial buildings, concentrated within the floodplain area south of Marine Drive. This area is home to approximately 700 businesses. There are also a number of businesses located there who rely on access to the Fraser River for their operations.

## COST

Vancouver is taking action now to prevent and minimize potentially devastating impacts to local communities, our economy, and our natural environment, and to avoid even higher costs down the road. Regionally and around the world, sea level rise and flood-related events are already causing extremely costly and sometimes cause permanent damage.



Local crews work to remove sand on streets that were impacted by the storm surge of Hurricane Sandy in Rockaway, N.Y., November 2012. Photo: Jocelyn Augustino/FEMA

## WHAT DO YOU THINK?

Please review the coastal flooding impacts below. **Take a strip of sticky dots** and use them in any combination to prioritize the impacts that are most important to you. Please use a sticky note if you have any comments or want to tell us why you voted the way you did. If an impact was missed, please use a sticky note and place it in one of the blank spaces provided.

LOCAL & REGIONAL ECONOMY IMPACTS	PRIORITY	NOTES
Business interruptions and damage to assets (buildings, inventory, etc.) from flooding		
Loss of employment lands		
Disruption to regional services, supply chains and goods movement		
Other:		
Other:		



# CULTURE & HERITAGE

From sites of spiritual, historic and archeological significance of the Musqueam People, such as middens and ceremonial sites, to the unique agricultural character of the Southlands, culture and heritage are rooted deeply along the Fraser foreshore. Additionally, Musqueam uses some foreshore areas near their reserve for traditional use activities (e.g., fishing, gathering).

**A CITY BY THE SALISH SEA**

Vancouver has always been a coastal community defined by its proximity to the ocean, river and mountains. Thousands of years before European settlement, xʷməθkʷəyəʾ m (Musqueam), Skwxwú7mesh (Squamish) and səl̓í lwətaʔ4 (Tsleil-Waututh) villages and settlements dotted the shorelines, with trade and travelers using the waterways as highways to travel great distances. Each Nation had, and continues to have, its own relationship to the area, including place names and uses for the lands and resources. Today, our city remains a bustling west coast seaport and Indigenous peoples retain their strong connections to the water.



The Salish Sea has been home to Indigenous communities for time immemorial.

**WHAT DO YOU THINK?**

Please review the coastal flooding impacts below. **Take a strip of sticky dots** and use them in any combination to prioritize the impacts that are most important to you. Please use a sticky note if you have any comments or want to tell us why you voted the way you did. If an impact was missed, please use a sticky note and place it in one of the blank spaces provided.

CULTURE & HERITAGE IMPACTS	PRIORITY	NOTES
Damage to archeological sites		
Damage to and loss of traditional use areas		
Damage to and loss of cultural sites, including ceremony sites		
Damage to heritage homes in Southlands		
Damage to heritage landscapes in Southlands		
Other:		
Other:		



# HEALTH & SAFETY

Public safety and wellbeing are critical community concerns that only become heightened during an emergency (i.e., flooding). While flood events pose significant life safety concerns, recovery from flood events can also pose significant health and safety challenges.

## BUILDING UP FOR THE FUTURE: FLOOD CONSTRUCTION LEVELS

The buildings we construct today will last at least 75 to 100 years. Over that same time period sea levels will rise 50 cm to 100 cm or more, putting the very same buildings, communities, and businesses that exist in flood hazard areas at risk from flooding. To reduce this risk to homes and the local economy and help protect health and safety today, the City adopted a one metre increase to Flood Construction Levels (FCL) in its Building By-law to protect against sea level rise. Adopted in 2014, this standard means that new buildings constructed in flood hazard areas will be raised by an additional metre at minimum or more, depending on local soil conditions.



### WHAT DO YOU THINK?

Please review the coastal flooding impacts below. **Take a strip of sticky dots** and use them in any combination to prioritize the impacts that are most important to you. Please use a sticky note if you have any comments or want to tell us why you voted the way you did. If an impact was missed, please use a sticky note and place it in one of the blank spaces provided.

HEALTH & SAFETY IMPACTS	PRIORITY	NOTES
Loss of life		
Injuries		
Contaminants released into environment from flooding		
Emergency access disruptions (due to road closures and damage)		
Disruptions to lifeline infrastructure and services (power, water, roads, communications)		
At 'risk' people adversely impacted (e.g., seniors)		
Other:		
Other:		



# CHOICES & PRIORITIES

Coastal flooding will impact the Fraser River Foreshore and the City of Vancouver in many ways. What are the general areas of concern that are most important to you?

**WHAT DO YOU THINK?**  
**Take a strip of sticky dots** and use them in any combination to prioritize the areas of concern that are most important to you. Please use a sticky note if you have any comments or want to tell us why you voted the way you did. If you feel an area of concern was missed, please use a sticky note and place it in one of the blank spaces provided.

COASTAL FLOODING IMPACT AREA	PRIORITY	NOTES
Communities and People		
Environment		
Recreation		
Infrastructure and Transportation		
Local and Regional Economy		
Culture and Heritage		
Health and Safety		
Other:		
Other:		



# PLANNING FOR CHANGE

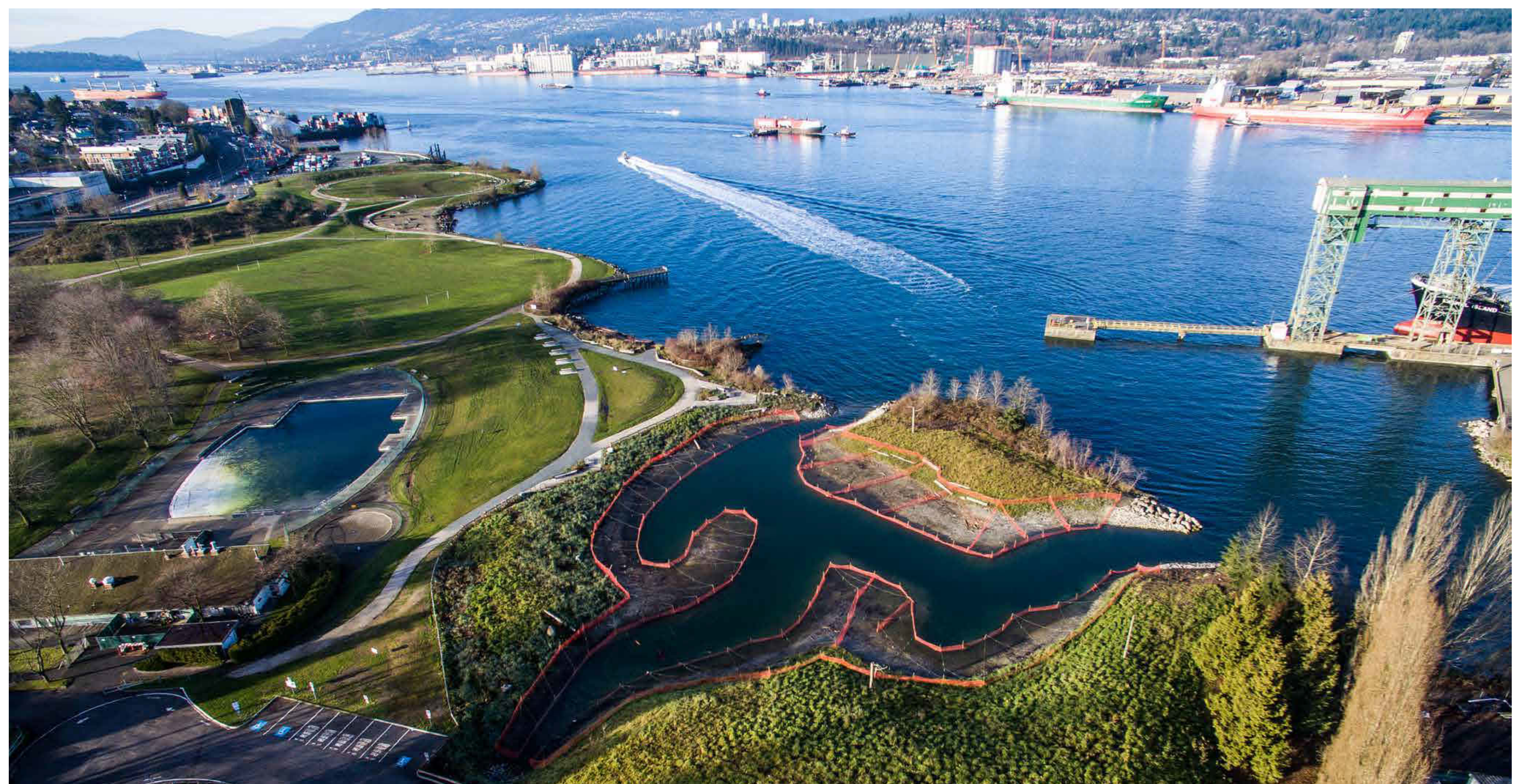


Vancouver is taking action now to prevent and minimize the impacts of flooding on local communities, our economy, and our natural environment.

Vancouver has long recognized the need to plan for future sea level rise and to help neighbourhoods, communities and businesses vulnerable to flooding along our shoreline become more resilient to the coastal flooding challenges ahead. In 2012, City Council approved a Climate Change Adaptation Strategy, which recommended several priority actions for the City. As one of the priority actions, the Coastal Flood Risk Assessment program was launched shortly afterwards to prepare for sea level rise and its impacts on the City of Vancouver.

The sea level rise program, a first of its kind in Canada, is a multi-phase undertaking. The first phases of work identified flood hazard zones in Vancouver and the second one investigated a variety of potential solutions, adaptation options, at a high level for each of the flood hazard zones. The final phase of the program created a work plan that outlined when work should occur in each of the flood hazard zones.

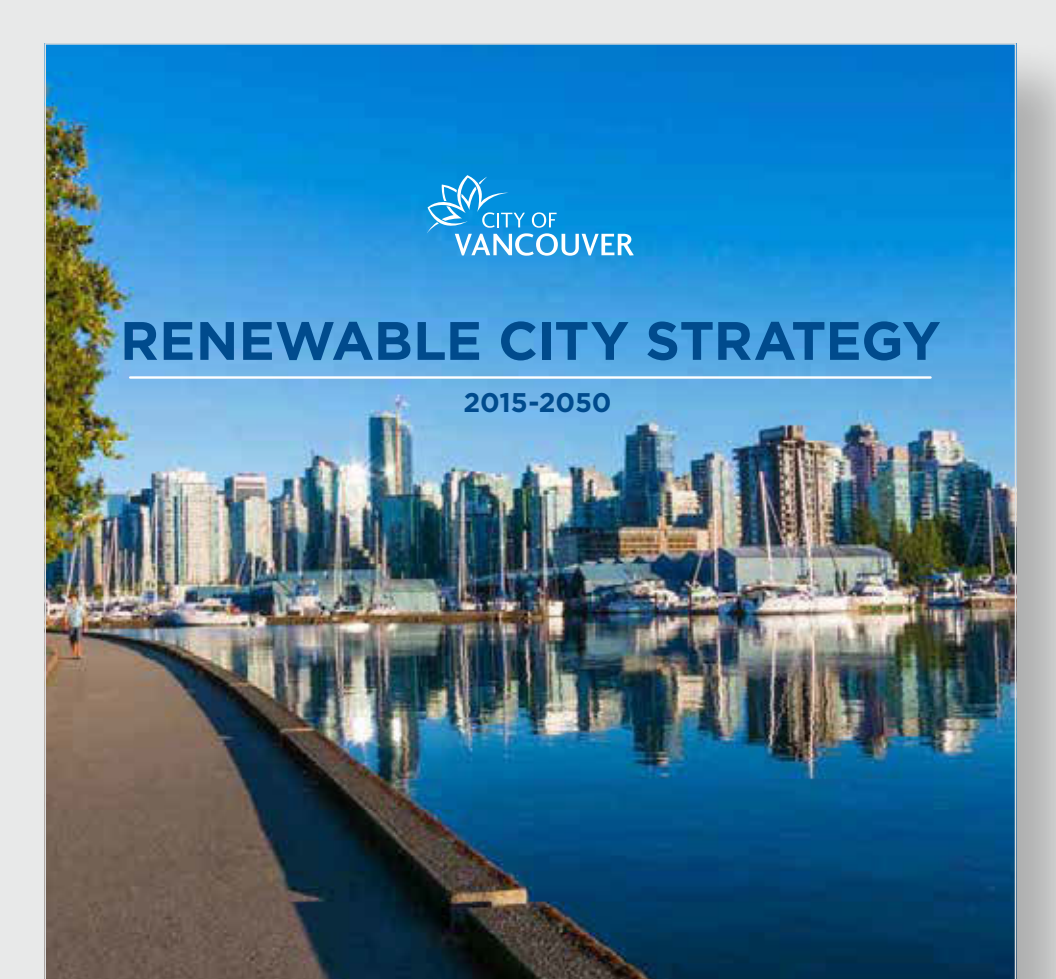
Future sea level rise planning efforts will refine emerging options with public and local communities, experts and staff. This work will be undertaken systematically, beginning with the most vulnerable areas along Vancouver's Fraser River shoreline. There will be multiple opportunities for the public to shape this work.



*The creation of a salt marsh in New Brighton Park is an example of habitat restoration and adaptation. The new marsh creates space for plants and sea life. It also provides space for high ocean waters and a buffer against waves during storm surge events.*

## CLIMATE CHANGE MITIGATION - PLAYING OUR PART

In addition to our ongoing climate adaptation work, Vancouver is also deeply committed to reducing greenhouse gas (GHG) emissions that are driving climate change. The Greenest City Action Plan and Renewable City Action Plan are two examples of initiatives working to reduce the city's contribution to global climate change. These initiatives will change how we build, heat, and power buildings, as well as change how we get around. These actions will reduce our GHGs. The Renewable City Action Plan targets a transition to 100% renewable energy and an 80% reduction in carbon pollution by 2050.





# RESILIENCE STRATEGY

Looking to the future, the impacts of climate change will continue, exacerbating shocks and stresses Vancouver residents may experience as the city grows and develops over the next century.

## RESILIENCE AND SEA LEVEL RISE

Rising sea levels and extreme weather mean that the infrastructure that has served us in the past will not serve us in the future, and that many of the green spaces and urban systems that contribute to our health and sense of well-being are under threat.

Planning for sea level rise today is critical to the long-term resilience of our city and needs to be done in the context of many other challenges that Vancouver is facing, including hazards like earthquakes, and stresses like social isolation and affordability. Understanding these trade offs and finding solutions that do not create more risk is important.



## COASTAL FLOOD PLAN AND RESILIENCE STRATEGY

The Coastal Adaptation Plan will continue to support the development of the Resilience Strategy by:

- Continuing to build residents' understanding and awareness around sea level rise and coastal flooding,
- Developing flood adaptation options that lower flood risks for our city and are robust to other hazards such as earthquakes,
- Involving community members in the development, evaluation and selection of flood adaptation options, and
- Improving neighbourhood emergency management so we are ready to respond to any future coastal flood or climate emergency that may arise.

**HOW IMPORTANT OF AN ISSUE IS COASTAL FLOODING?**  
Compared to other issues the City is facing, how important do you think it is for us to act in the next five years to prepare for coastal flooding? Take a sticky dot and place it in the appropriate row below. Use a sticky note to tell us why you voted the way you did.

ACTING IN THE NEXT FIVE YEARS TO PREPARE FOR COASTAL FLOODING IS...	PRIORITY	TELL US WHY
Very important		
Important		
Not important		
Not at all important		

**Q:**  
WHAT IS RESILIENCE?

**A:** Resilience relates to the capacity for our community and the ecological, social and physical systems that support us, to adapt and thrive in the face of uncertainty, change and disasters. In Vancouver and around the world, the social and economic costs of climate change are increasing.



# EXPLORING OUR OPTIONS

As part of the second phase of our sea level rise program, a number of preliminary adaptation options were identified for 11 different flood hazard zones across Vancouver, including the Fraser River Foreshore. The pros and cons, estimated costs, and likely trade-offs for each option were evaluated as part of the study. This information provides us with a starting point for conversations with residents, businesses and experts about flood management options in each of the areas, as well as how each option or combination of options supports local community values.

**The adaptation options that will be explored in more detail with the community going forward can be organized into three general approaches. As illustrated, each option has its pro and cons; there is no “silver bullet” flood management approach.**

## RESIST



*Build structures to keep floodwater out and protect areas and community assets. Common approaches here include shoreline and inland dikes or offshore features to help reduce wind and wave action (which can help push more water ashore during storm surges).*

### PROS

- Helps better protect communities and people
- Helps better protect infrastructure and transportation
- Opportunities for co-benefits (e.g., recreational trails)

### CONS

- Depending on alignment, some loss of land or building and homes will occur
- With sea level rise, the risks from a dike breach become more consequential (i.e., risks go up for people, communities and infrastructure behind dikes)
- Requires significant and expensive drainage infrastructure to move water from behind dikes into the river
- Could be technically unviable due to soils and seismic concerns
- Potential negative impacts on the environment and fish habitat, depending on location and type of dike
- Requires on-going maintenance and must be raised and upgraded over time as sea level rise continues

## ACCOMMODATE



*Rather than keeping floodwater out, these flood management options aim to keep community assets dry when flooding occurs. Examples include raising buildings and infrastructure (i.e., Flood Construction Levels) or designing them so that they can accommodate temporary flooding and stay dry when flooding occurs (e.g., “wet-proofing” “dry-proofing”).*

### PROS

- Promotes and supports recovery after a flood event (i.e., promotes resiliency)
- Helps better protect infrastructure and transportation
- Opportunities for co-benefits (e.g., recreational trails)

### CONS

- Implementation challenges (cost, phasing)
- Expensive to raise infrastructure and buildings to flood construction levels
- Relatively expensive, but the cost could be part of regular building replacement
- Requires on-going maintenance and may require retrofitting over time as sea level rise continues

## MOVE



*Plan for the eventual relocation of people and/or facilities and buildings in high exposure, high risk areas of the city. This approach often includes returning portions of land to pre-development conditions (i.e., “naturalizing”).*

### PROS

- Potential habitat gains
- Potential recreational gains
- Would reduce flood risk during an earthquake
- Long-term strategy would work regardless of rate of sea level rise

### CONS

- Implementation challenges (cost, phasing)
- Would likely take decades to be implemented



# EXPLORING OUR APPROACHES

As has been the case in other jurisdictions in the Pacific Northwest and around the world, it is likely that Vancouver's flood hazard areas will use a combination of approaches phased in over time as sea level continues to rise. The use of a combination of approaches in a flood hazard area (i.e., resist, accommodate, move) will help us achieve a range of community values, like habitat conservation, recreation, and livability.

## TAKE A STICKY NOTE AND TELL US WHAT YOU THINK:

- What do you like about each approach?
- What don't you like the approaches?
- What would have to be included to make each of the approaches work better for you?

### RESIST



### ACCOMMODATE



### MOVE





# CHOOSING OUR PATH FORWARD





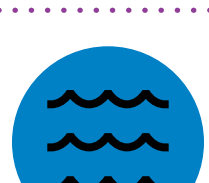
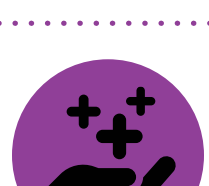
The community values that residents, businesses and other stakeholders have been sharing with us have helped us create a preliminary set of design principles, or guidelines, to provide direction for future phases of CAP work around flood management approaches. These design principles will provide direction for future phases of CAP work, including the development of flood management options, infrastructure design and policy.

**The following three posters illustrate six preliminary design principles and how they could be incorporated in different flood management approaches – resist, accommodate, move.**

## WHAT DO YOU THINK?

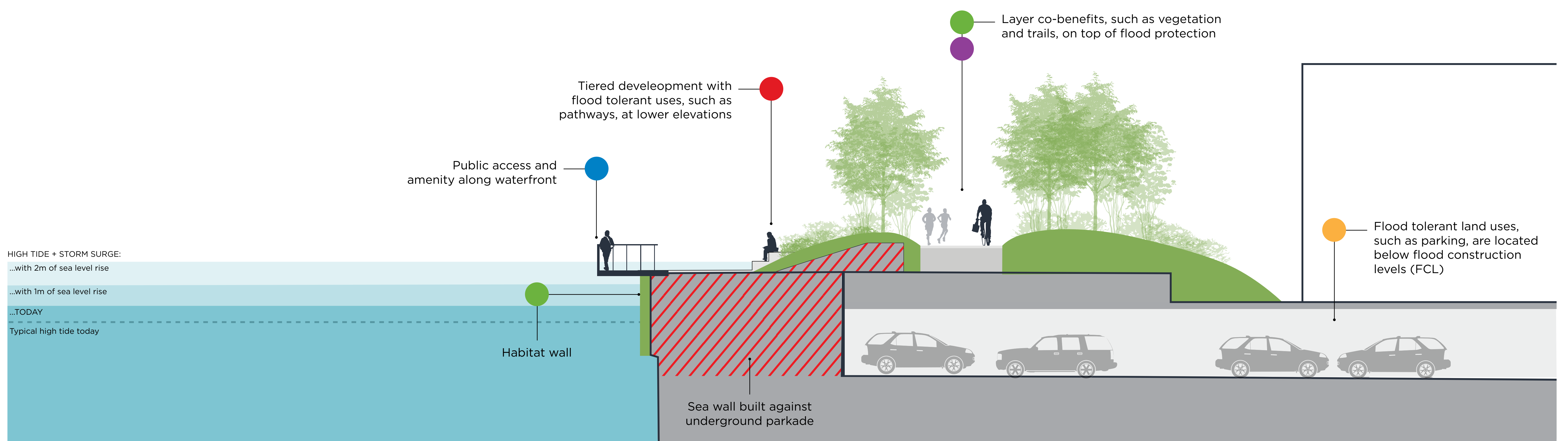
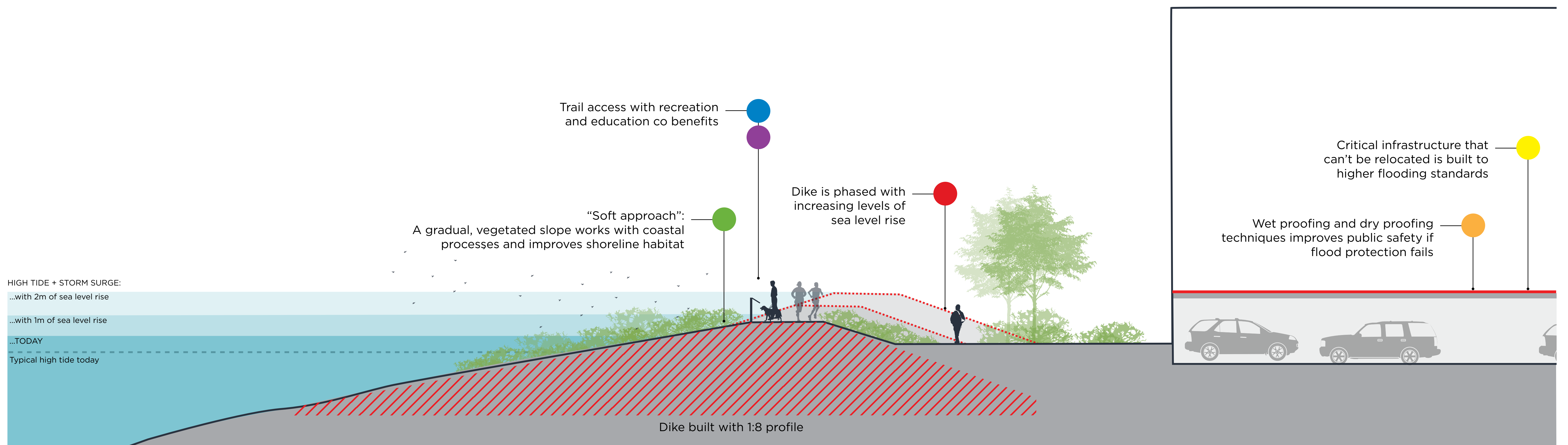
Please review the following three posters, then take a sticky note and tell us:

- ***What do you like about each principle?***
- What don't you like about a principle?

PRINCIPLES	NOTES
 <b>Design for adaptability:</b> Develop flexible options that can adjust to a wide range of future conditions, including the pace of sea level rise, the height of sea level rise, and future land uses.	
 <b>Design for safety and public health:</b> Ensure risks to life-line infrastructure and services are minimized, and that public health and wellbeing are protected.	
 <b>Design for safe-to-fail infrastructure systems:</b> Ensure risks to lifeline infrastructure and services are minimized, and that redundant systems are in place in case of failure.	
 <b>Design for nature:</b> Ensure that Fraser River impacts are minimized to protect salmon habitat and regionally critical and rare estuary habitats.	
 <b>Design for access:</b> Improve access to the river and include recreational and interpretive opportunities where feasible.	
 <b>Design for co-benefits:</b> Ensure that new approaches support multiple community values (e.g., recreation, health and wellbeing, communities and people).	



# RESIST



## PRINCIPLES



**DESIGN FOR ADAPTABILITY:**  
Develop flexible options that can adjust to a wide range of future conditions, including the pace of sea level rise, the height of sea level rise, and future land uses.



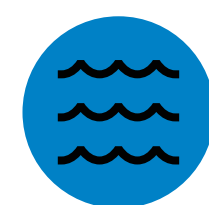
**DESIGN FOR SAFETY AND PUBLIC HEALTH:**  
Ensure risks to life-line infrastructure and services are minimized, and that public health and wellbeing are protected.



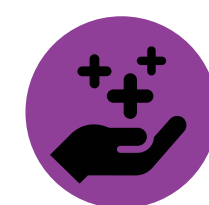
**DESIGN FOR SAFE-TO-FAIL INFRASTRUCTURE SYSTEMS:**  
Ensure risks to lifeline infrastructure and services are minimized, and that redundant systems are in place in case of failure.



**DESIGN FOR NATURE:**  
Ensure that Fraser River impacts are minimized to protect salmon habitat and regionally critical and rare estuary habitats.



**DESIGN FOR ACCESS:**  
Improve access to the river and include recreational and interpretive opportunities where feasible.

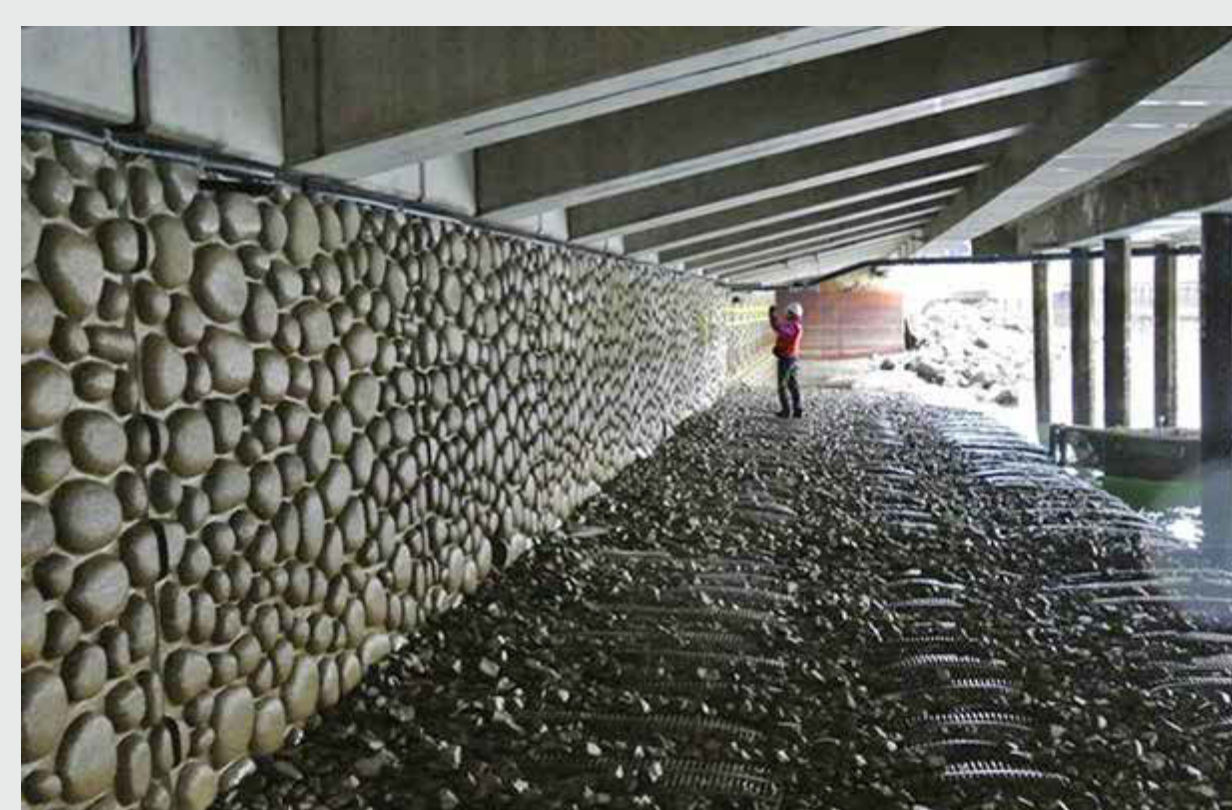


**DESIGN FOR CO-BENEFITS:**  
Ensure that new approaches support multiple community values (e.g., recreation, health and wellbeing, communities and people).

## PRECEDENTS



The Jericho Beach Restoration in Vancouver uses Green Shores strategies to protect against flooding. Photo: Connect Landscape Architecture



Marine aquatic habitat features are included in the design of the Elliott Bay Seawall replacement in Seattle, WA. Photo: Hart Crowder, <https://www.hartcrowder.com/project/elliott-bay-seawall-replacement/>



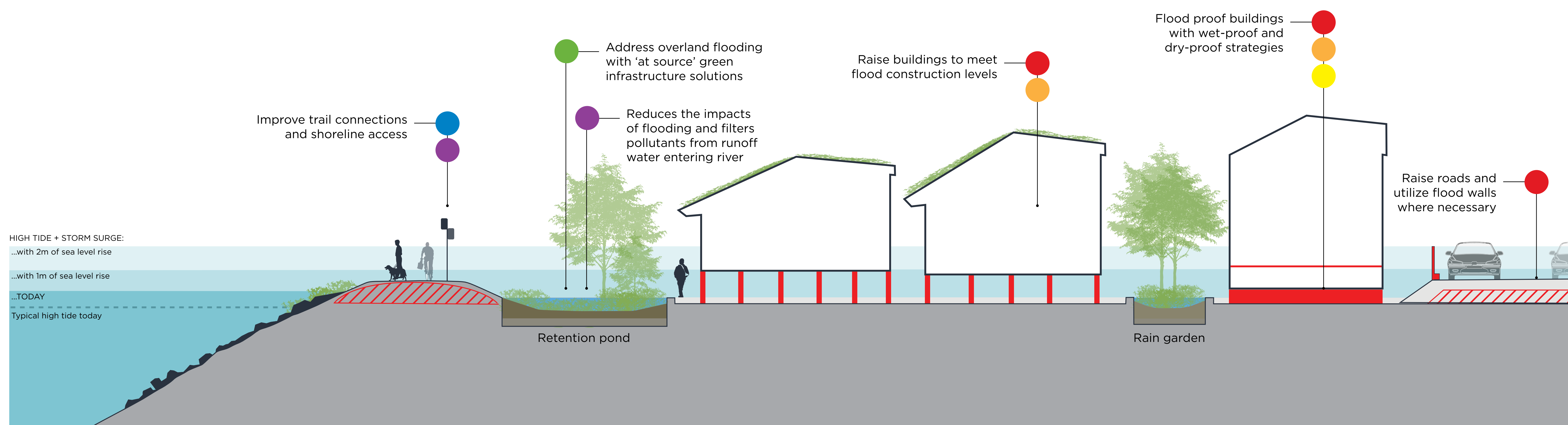
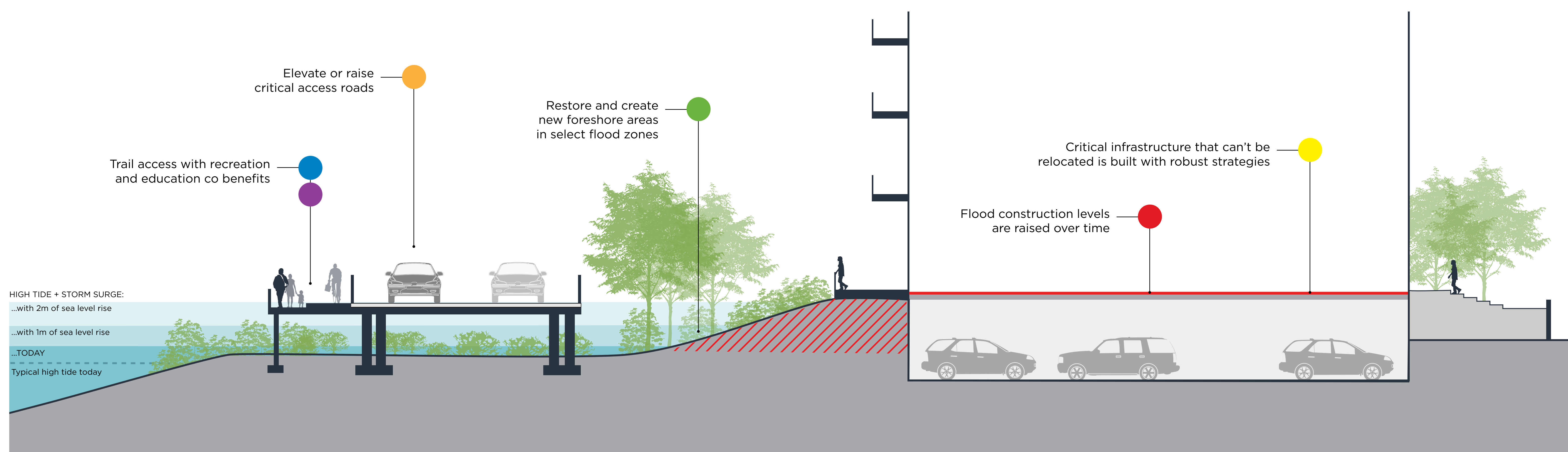
A view of the dike in Richmond along the Fraser River. This is one of many stretches of dikes in Richmond, BC that will need raising due to sea level rise. Photo: Les Bazso, Vancouver Sun



Tiered development along the Elbe River, in Hamburg Germany. The lowest levels, which are designed to flood, are designated for pedestrians and bikes while the highest level is for buildings and roadways. Photo: ELBE&FLUT. Courtesy HafenCity Hamburg GmbH



# ACCOMMODATE



## PRINCIPLES



**DESIGN FOR ADAPTABILITY:**  
Develop flexible options that can adjust to a wide range of future conditions, including the pace of sea level rise, the height of sea level rise, and future land uses.



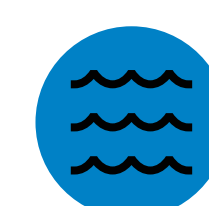
**DESIGN FOR SAFETY AND PUBLIC HEALTH:**  
Ensure risks to life-line infrastructure and services are minimized, and that public health and wellbeing are protected.



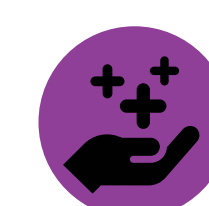
**DESIGN FOR SAFE-TO-FAIL INFRASTRUCTURE SYSTEMS:**  
Ensure risks to lifeline infrastructure and services are minimized, and that redundant systems are in place in case of failure.



**DESIGN FOR NATURE:**  
Ensure that Fraser River impacts are minimized to protect salmon habitat and regionally critical and rare estuary habitats.



**DESIGN FOR ACCESS:**  
Improve access to the river and include recreational and interpretive opportunities where feasible.



**DESIGN FOR CO-BENEFITS:**  
Ensure that new approaches support multiple community values (e.g., recreation, health and wellbeing, communities and people).

## PRECEDENTS



Copenhagen Strategic Flood Masterplan, Copenhagen, Denmark. The Copenhagen Strategic Flood Masterplan proposes the uses of green infrastructure surface solutions, as well as pipe-based solutions, to combat flooding as a result of increased rainfall. These solutions include detention roads and parks for temporary flood storage, the creation of canals and stormwater roads that divert flood water to lakes and the harbour. Photo: Atelier Dreiseitl <http://www.landezine.com/index.php/2015/05/copenhagen-strategic-flood-masterplan-by-atelier-dreiseitl/bay-seawall-replacement/>



Spaulding Rehabilitation Hospital, Charleston Massachusetts. The hospital, completed in 2013, integrates multiple strategies in order to be resilient to flooding. Measures include: raising the building much higher than the code requires (first floor is 30 inches above the 500-year flood elevation), operable windows that are keyed open in the event of system failure, and the location of critical services on the roof. Photo: Steinkamp Photography, courtesy Perkins + Will



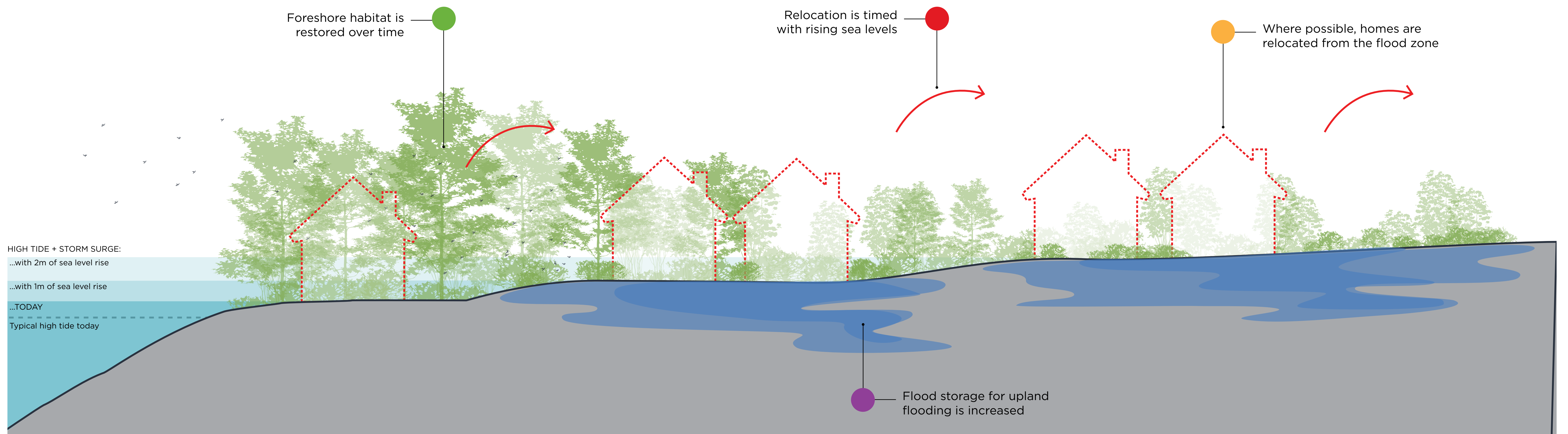
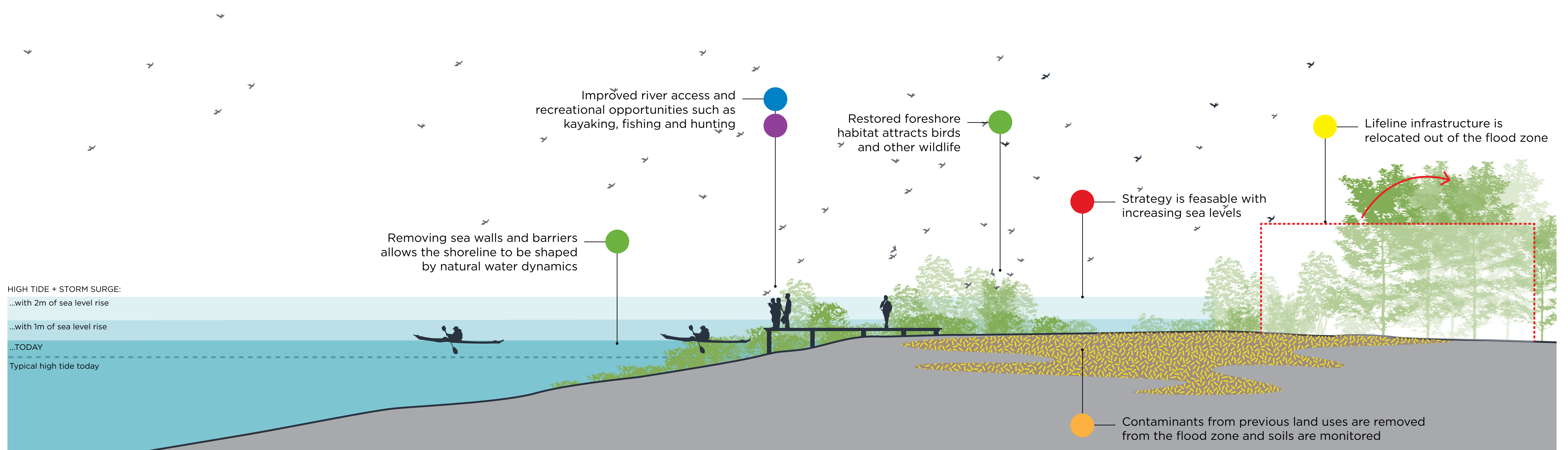
Queen Elizabeth Olympic Park, London, England. The park integrates flood storage into park design features. Along with a "wetland bowl" and "wet woodlands", an extension of the Waterworks River has been widened by 8m and planted with reeds and other riparian vegetation. The park has temporarily flooded 9 times, protecting approximately 5,000 homes around the park. Photo: EG Focus, 2012 <https://www.flickr.com/photos/egfocus/6944381592/in/photostream/>



Depoldering Noordwaard, The Netherlands. Depoldering Noordwaard is one of the largest projects in the Netherlands aiming to create more room for the river. Over 30 bridges and 8 pumping stations (many of which double as viewing platforms) were designed to allow for pedestrians, cyclists and vehicles to access and move through this flooded landscape. Photo: IPV Delft



# MOVE



## PRINCIPLES



**DESIGN FOR ADAPTABILITY:**  
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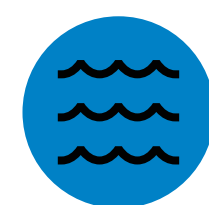
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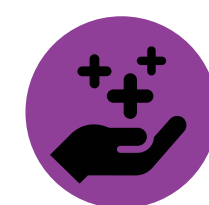
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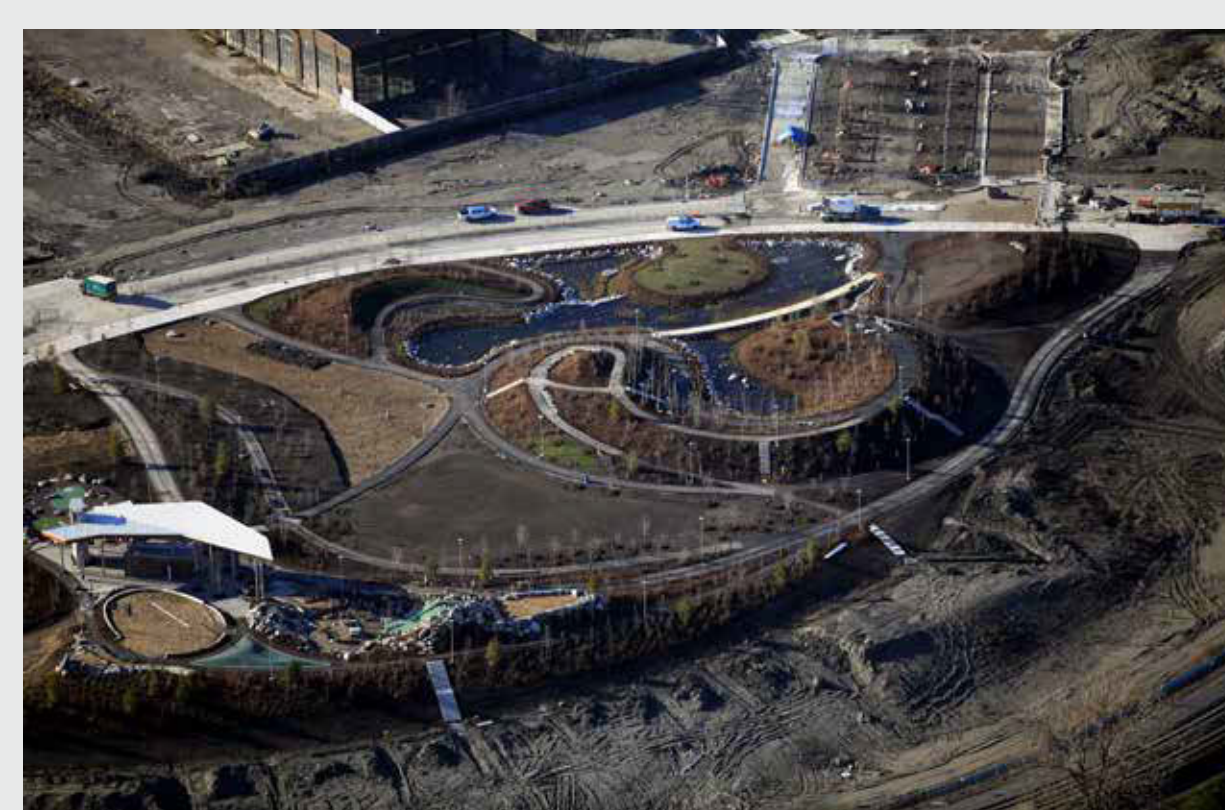
## PRECEDENTS



Room for the River, The Netherlands. "Room For the River" is a national strategy in the Netherlands to restore the natural floodplains and make more room for floodwater for three major rivers: the Rhine, Meuse, Scheldt. The program makes room for the river by strengthening dikes (resist), accommodating water and, in some cases, by moving certain land uses out of the floodplain. Photo: <http://nlintheusa.com/room-for-the-river/>



Fraser River tidal marsh habitat, Vancouver BC. In areas where homes and other land uses have been relocated from the floodplain, a process of shoreline restoration and naturalization can occur. Photo: Larry Pynn, Vancouver Sun



Lower Don River West Remedial Flood Protection Project, Toronto, ON. Through a process of soil remediation, a former brownfield site is transformed into a landform that provides flood protection for new development sites. On the river side of the landform, land uses that are not resilient to flooding are relocated over time. Photo: Toronto and Region Conservation Authority



Hesketh Out Marsh is the biggest so-called managed realignment project in the UK, and is one of the country's most important estuary habitats for birdlife. Seawater was let back in to flood the land, re-creating saltmarsh and providing space for nature. At the same time, the new saltmarsh acts as a buffer, soaking up some of the energy of the sea before it reaches the stronger, new dikes. Photo: Royal Society for the Protection of Birds



# NEXT STEPS

Adapting to sea level rise and associated coastal flooding will be an ongoing process. By starting our work together now, we will have time to listen, learn and make thoughtful decisions.

The first phases of our sea level rise work helped us understand where and how we are vulnerable and what options might be considered to manage coastal flooding in identified hazard areas. Over the next several years, we will continue to explore, implement and plan for short, medium, and long-term adaptation options based on the unique neighbourhoods in Vancouver.

The results from all of the 2018 Fraser River CAP community workshops will be recorded in a report that will be shared with Mayor and Council in early 2019. The next phase of work will explore adaptation approaches and options for sea level rise and increased flooding in areas like the Fraser River Foreshore area and False Creek in 2020. In the years ahead, we will no doubt need to make many tough decisions.



## COASTAL ADAPTATION PLAN (CAP)

### BUILDING SHARED UNDERSTANDING

- Coastal Flood Risk Assessment (CFRA) phases 1 & 2
- Community values elicitation and development of design principles

### SHAPING OPTIONS

- Public engagement and co-design of adaptation options
- High level technical assessment of options
- Community driven evaluation of options

### MAKING DECISIONS

- Refine adaptation options
- Participatory options selection process
- Detailed design and phasing

**2014-2018**

**We are here**

**2019-2021**

**2021+**

Over the coming months and years, we will be continuing to expand and enrich our efforts to engage people in this critical work. As a resident or business owner, your input will be vital. Your voice can help shape our collective response to climate change and sea level rise as it continues to impact our city by the Salish Sea.

### STAY CONNECTED

Keep up to date about all the ways you can help Vancouver minimize the effects of climate change and make Vancouver a greener place to live, work and play. Sign up for our newsletter or follow us on social media.

- **Phone 3-1-1**
- **[cap@vancouver.ca](mailto:cap@vancouver.ca)**
- **[vancouver.ca/fraserriver](http://vancouver.ca/fraserriver)**
- **[#vansealevelrise](https://twitter.com/vansealevelrise)**

In the next six months staff aim to improve neighbourhood resiliency by amending the City's Zoning and Development Bylaw to ensure that new developments provide adequate setbacks from the coastline to allow for future flood infrastructure. The City will also take the first steps to plan and seek funding to launch a sea level rise design challenge to advance solutions for the most flood-vulnerable areas. With roughly \$1 billion of flood management infrastructure needed in Vancouver by 2100, building public awareness and support will be critical. A high-profile design challenge, modelled on successful programs implemented in New York City and San Francisco, will be undertaken in 2020 to engage local, national and international experts, along with local residents and businesses, to co-develop implementable designs. This approach is expected to deliver outcomes that are more holistic, and with greater community buy-in, than a traditional public consultation process.

