# Bainbridge Island
# Climate Impact Assessment

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## Mitigation and Adaptation

There are essential roles for both climate mitigation and adaptation strategies in Bainbridge Island's actions relating to climate change, including in our Comprehensive Plan.

> "**Mitigation** responses aim to reduce the rate and extent of climatic change caused by greenhouse gas emissions, while **adaptation** responses address the effects of climate change by increasing resilience and/or decreasing vulnerability. Combined, these two approaches create a comprehensive, integrated strategy for addressing climate change." (Central Puget Sound Regional Open Space Strategy 2015)

**Mitigation** can be achieved through approaches such as higher-density development, reducing vehicle miles traveled, non-motorized transit, green building techniques, and renewable energy sourcing.

**Adaptation** addresses the effects of climate change (including sea level rise, altered precipitation pattern with related flood and drought, increasing temperature) through approaches such as low-impact development; climate certified zoning, permitting & procurement; and climate-savvy hazard mitigation.


## Acknowledgements:

EcoAdapt would like to thank the Bainbridge Community Foundation for their generous support and belief in the importance of this project. We are also grateful to Sustainable Bainbridge and the City of Bainbridge Island staff, City Council and Planning Commission for their partnership in conducting the community elicitation workshop in November 2015. Thanks to the 54 community members who participated in that workshop, sharing their time, wisdom and ideas to make the Bainbridge Island Climate Impact Assessment more informed. This Assessment would also not be what it is were it not for our reviewers Michael Cox and Cami Apfelbeck.

Finally, we dedicate this report to the past, current and future members of the Bainbridge Island community. Our aim is that the Bainbridge Island Climate Impact Assessment will sustain the legacy of our past, challenge the imagination of our present and foster the survival of our future.

## Preferred citation:

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## Executive Summary

### Why does Bainbridge Island need a Climate Impact Assessment?

By explicitly considering climate change in local planning and decision-making, Bainbridge Island will be on a path to a resilient future. These actions must start today as the decisions currently being made will set the stage for our ability to respond in the future. The broader vision and hope for this Climate Impact Assessment is that the guidance contained herein will enable the City of Bainbridge Island (COBI) to effectively adapt to the implications of a changing climate in the coming decades.

Communities need to know how to begin planning for climate change. One guiding premise of this Assessment is that:

***Communities can make good decisions when they have information and know what questions to ask.***

Let's break that down.

*Communities*: That means all community members, not just City Council members, not just City department staff, but every member of the community in whatever their capacity — teacher, retailer, physician, developer, emergency service provider, landscaper, student, you name it.

*Good decisions*: Good decisions are the ones that get you to good outcomes now and into the future. They don't trade short-term gains for long-term problems. They demonstrate prudent use of community time and money in order to achieve community benefit and meet our collective goals.

*Information*: This means not just reflecting on what you want or what you think, but doing research to learn what is the state of knowledge and analysis to determine how that knowledge applies to local conditions and goals.

*Questions*: Sometimes the best place for a community to use information is by asking the questions that will illuminate the path to a good decision.

The Bainbridge Island Climate Impact Assessment (BICIA) is a resource to guide the community to the relevant and applied information to help us ask the questions that will lead us to climate-informed decisions. Users of the BICIA should be able to find pertinent climate information, formulate questions to help them evaluate the implications of climate change for their own work or interests, and make climate-savvy decisions that will generate the best long-term outcomes for our community — its businesses, schools, services, recreation, ecosystems and individuals.

### What is within this Bainbridge Island Climate Impact Assessment (BICIA)?

Using the framework of local comprehensive planning, the Washington State Comprehensive Plan requirements, and the existing 2004 Bainbridge Island Comprehensive Plan, which is actively undergoing an update and review by the City, this Climate Impact Assessment was developed to enable the understanding and inclusion of anticipated climate change impacts into the local long-range planning by Bainbridge Island government officials and citizens.

This Assessment is presented in three main sections:

1. **Impacts of Climate Change for Bainbridge Island**. This report summarizes the climate change impacts expected to affect Bainbridge Island in terms of six impact areas: temperature, precipitation/storminess, sea level rise, vegetation change, ocean acidification and slope stability. Table 1, Climate Change Implications for Comprehensive Plan Elements, identifies the impacts of each of these six areas on the element areas within the City's Comprehensive Plan.

There will always be uncertainty in climate information, however this should not stop or delay action. Climate change will alter the circumstances upon which everyone makes decisions; to continue making durable and resilient choices one needs to overlay the expected impacts onto an issue area, determine what the implications of climate change will be, and then to act in a way that will allow for durable and resilient choices, development and investment.

2. **Climate Change Implications for Various Areas of Interest**. Climate adaptation planning requires one to understand how climate change will impact the baseline information used to make decisions within any area of expertise. Then, to understand how that baseline information will change over time. Lastly, in order to adapt to climate change local government officials and others need to accommodate that change in their planning, permitting, and fiscal decision-making.

   This section of the Assessment is organized by Comprehensive Plan element. It provides details about each climate impact and how it will have implications on an elements' concerns (see Tables 2–8, Implications from Climate Change). Questions are provided for each element that should be asked and discussed by the community at large and local decision-makers. Doing so will imbed climate change into our thinking and enable us to adapt to likely implications.

3. **What we need to do Now: Take Actions with Real Impact.** This Assessment leads up to what is perhaps the most important section – suggested actions for Bainbridge Island. Table 9, Adaptation Planning Implementation, lays out climate adaptation implementation measures that are called for. Three are called out as the primary actions that will begin to allow for future adaptation. They are:

   **Action One: Create a Climate Change Task Force**. This involves designation of the leaders, managers and staff that should incorporate climate change and community resilience into their duties. This will enable climate change considerations to be mainstreamed into the actions and decisions of Bainbridge Island into the future.

   **Action Two: Develop and require a Climate Assessment Certification (CAC)**. This requires evidence that any project proponent (including the City of Bainbridge Island) has assessed future site/operating conditions and determined climate readiness, including the avoidance of projected vulnerabilities. Such certification should be applied to and required prior to any fiscal or permitting decision.

   **Action Three: Apply your understanding** of how climate change will affect Bainbridge Island. Use the BICIA and Table 9 in particular to support these efforts.

   1. **Integrate climate information into all decision-making processes** and continuously update access and understanding of the latest climate-relevant information.
   2. **Map all known and future vulnerable areas**, showing overlays/intersections with critical facilities, ecosystems and infrastructure. This visual tool will enable us to apply our understanding of the climate changes that will have a locational effect on Bainbridge Island. Many implications of climate change cannot be mapped, however for those that can be pinpointed they should be made clear.
   3. **Track the application and efficacy of climate-savvy actions** in order to modify and update as needed to keep Bainbridge Island on a path to resilience.

### How can local government use the BICIA?

The BICIA offers focused, applicable products and process for developing climate-savvy local planning and management. Figure 1 below shows the process undertaken to develop the BICIA. Major components included a community elicitation process, whereby local knowledge and community values were gathered to infuse the BICIA with innovative community-driven solutions. The community workshop (held at Bainbridge Island City Hall on November 18, 2015) enabled citizen access to informational materials and one-on-one engagement that helped to build local capacity and climate literacy and began to help individuals apply that to what they each care about. An intended outcome of this workshop and this project is to provide information and guiding questions so the community can create a more resilient Bainbridge Island in the face of climate change. If used, it can lead the City to effectively manage the changing conditions in the decades to come.

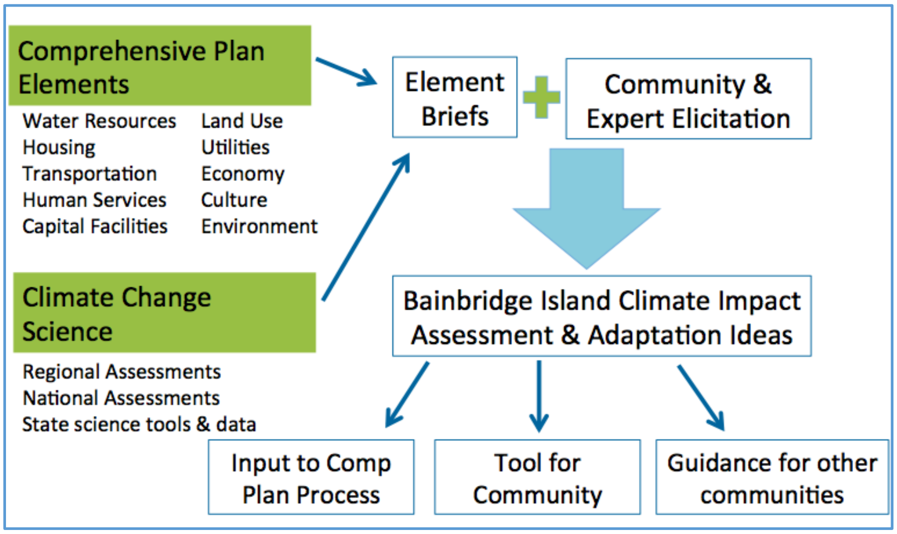


**Figure 1.** The BICIA process, shown here, uses existing information that is freely accessible by all community members and community engagement in order to provide a tool for use by all Bainbridge Islanders in their own work, as well as in the update of the Comprehensive Plan. This process will also provide guidance for other communities.

Rather than creating a stand-alone climate change plan for the City of Bainbridge Island (COBI), this process encourages the integration of climate change information directly into existing decision-making processes such that all decisions are climate informed and can benefit from the latest information, because climate change is a topic of emerging information and has implications for virtually every facet of our lives.

### What is the intent of this Climate Impact Assessment?

The BICIA provides the foundation for the City and its citizens to create a more resilient Bainbridge Island in the face of climate change, by giving a framework for **regular integration of climate impacts and implications into all local activities**, including the update of the Comprehensive Plan. As individuals, as a community and as a society, we need to plan for climate change, just as we plan for future growth, social needs and economic trends. Doing so within a community's Comprehensive Plan is logical and appropriate.

The BICIA is intended to guide both government and citizens to incorporate climate change considerations into all activities. COBI can use the BICIA to do the following:

- Inform the Comprehensive Plan update and implementation processes;
- Assist with planning and decision making, such as siting, improvements, finance and project design undertaken by local government agencies including City of Bainbridge Island, Bainbridge Island Police Department, Bainbridge Island School District, and Bainbridge Island Metropolitan Park and Recreation District; and,
- Assist with public/private partnerships, such as business improvement, transportation, and housing.

Local government decisions can help improve local community outcomes, but the decisions each citizen makes have implications for their own lives as well as our collective community resilience. The BICIA contains information and ideas that can help us all make more informed and effective decisions in light of climate change. See the following box, *What Can Community Members Do*, for ideas.

## WHAT CAN COMMUNITY MEMBERS DO?

1) **Inform yourself.** Resources to get you started include:

- An interview with Dr. Lara Hansen, EcoAdapt, by Bainbridge Community Broadcasting, providing information on climate change and Bainbridge Island (bestofbcb.org/cafe-031-ecoadapt-helps-cobi-comp-plan-to-adapt-to-climate-change/);
- Guides to evaluating the climate vulnerability of a Comprehensive Plan element. See Element Briefs available at EcoAdapt.org/workshops/BICIA-workshop;
- Puget Sound regional climate change impacts reports (Mauger et al. 2015), available at cses.washington.edu/picea/mauger/ps-sok/PS-SoK_2015.pdf;
- Washington Chapter of the American Planning Association's website, including their "Ten Big Ideas," the first of which is to address climate change: www.washington-apa.org/address-climate-change.

2) **Help the City incorporate climate change into all activities:**

- Encourage the **Planning Commission** to add all climate-savvy recommendations into the 2016 Comprehensive Plan update.
- Ensure that the **Comprehensive Plan recommendations** become part of local code and practice.
- **Be the voice** that asks about climate change when decisions are being made.

3) **Make your own climate-savvy decisions at home, school and work**

- Consider how you can make a contribution to mitigation and adaptation on Bainbridge Island. There are goals, policies and actions within the BICIA that translate to your business or home. Modify what you see here for your own needs. Make your personal ecosystem climate savvy and durable.
- Take every opportunity you have to plan for climate change in building, maintenance and transportation choices, including:
  - energy efficiency,
  - landscape and lawn care choices,
  - facilities siting and design,
  - encouraging non-motorized transport and car-pooling, and
  - conservation measures including reducing consumption and selecting smallest-footprint products.
- Encourage your child's **school** to:
  - Have a climate change curriculum that includes understanding of climate-relevant STEM topics, implications of climate change for society and opportunities to improve outcomes for their future.
- Encourage your **community groups** (e.g. religious or social organizations) to:
  - Make community projects climate savvy for long-term success, including activities across the spectrum from social service support to recreational planning.
- Ensure that your **business** is climate savvy:
  - Improve your energy and water efficiency to reduce current and future costs;
  - Work to improve or select for a more stable supply chain, including transportation links;
  - Plan for climate change in building, maintenance and transportation choices, including energy efficiency, landscape choices and other conservation measures and
  - Incorporate the premise that a stable, less climate-vulnerable local economy could benefit your business.

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## Impacts of Climate Change for Bainbridge Island

The effects of climate change relevant to Bainbridge Island can be categorized in terms of six impact areas: temperature, precipitation/storminess, sea level rise, vegetation change, ocean acidification and slope stability.

### Temperature

Regional climate has warmed over the past century, with increasing warming in the past thirty years (Mauger et al. 2015)[1]. This pattern is expected to continue in the 21st century with an increase of double to ten times as great. In degree terms, the historic average temperature for the Puget Sound lowland region was 50.3° F between 1950 and 1999, with 1.3° F of warming by 2014. This is trend is consistent throughout the region. Along with this warming, the frost-free season has grown longer by 30 days.

Between now and mid-century, average annual air temperatures have a +4-5.5° F projected increase, with even greater warming possible in the years after. This warming, unlike warming observed to date, which has not substantially affected spring temperatures, will affect all seasons, with the greatest increase in summers.

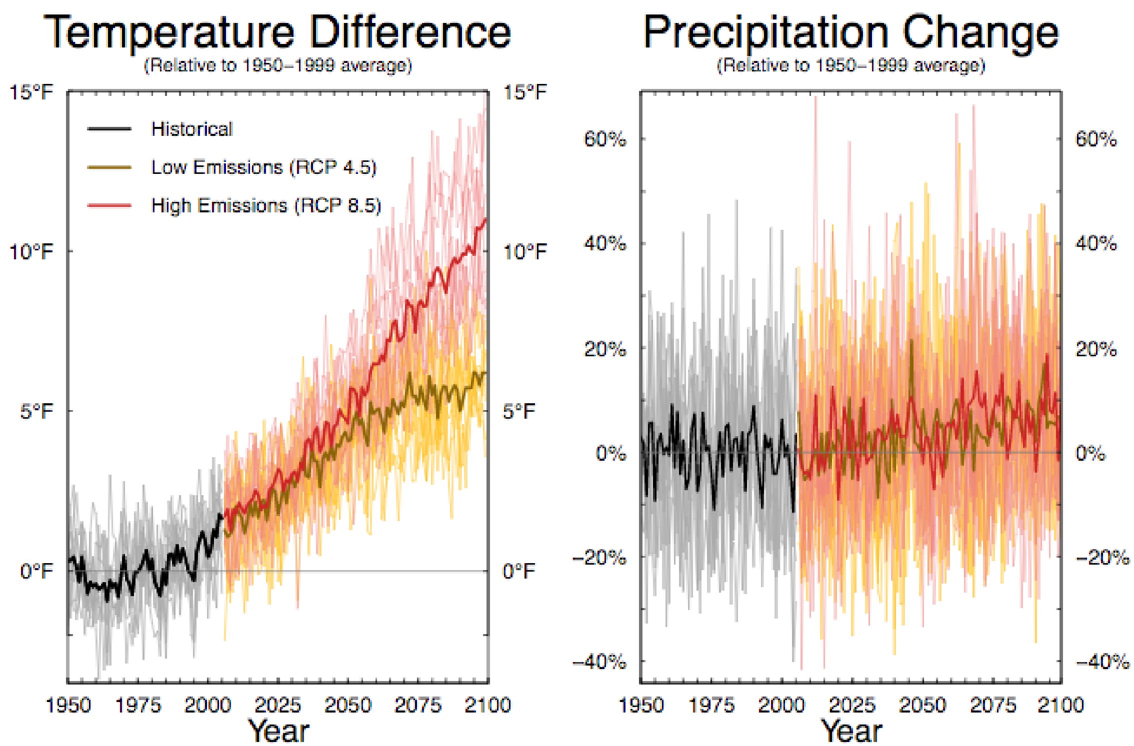


**Figure 2.** Regional projections for changes in temperature and precipitation. Note current emissions trajectory matches the RCP 8.5 curve on this graph. From Mauger et al. 2015.

Increasing temperature has implications for Bainbridge Island in many aspects of our community and personal lives. Increasing temperatures may affect our demand for water, and it will certainly increase the need for water by Island vegetation (natural systems, agriculture and landscaping). Increasing temperatures will also affect our terrestrial, freshwater and marine ecosystems. They will also increase

[1] State of Knowledge: Climate Change in the Puget Sound, Mauger et.al. 2015, is a report prepared by the University of Washington's Climate Impacts Group with a focus on the Puget Sound region and therefore with results applicable to the Bainbridge Island.

local incidence of heat-related illness, increase likelihood of diminished air quality, and add thermal stress to the list of things degrading local infrastructure such as road and bridges. (Table 1)

### Precipitation/Storminess

To date there has not been a long-term change in regional precipitation. However, there has been a "modest increase" in rainfall events that are considered heavy. Going forward, year-to-year variation is expected to be the dominant factor in precipitation for all seasons except summer, which is expected to see declining precipitation (Mauger et al. 2015) (Figure 3). Additionally, there is an expectation for more intense (+22%) and more frequent extreme winter precipitation events (seven events per year, up from two events per year historically).

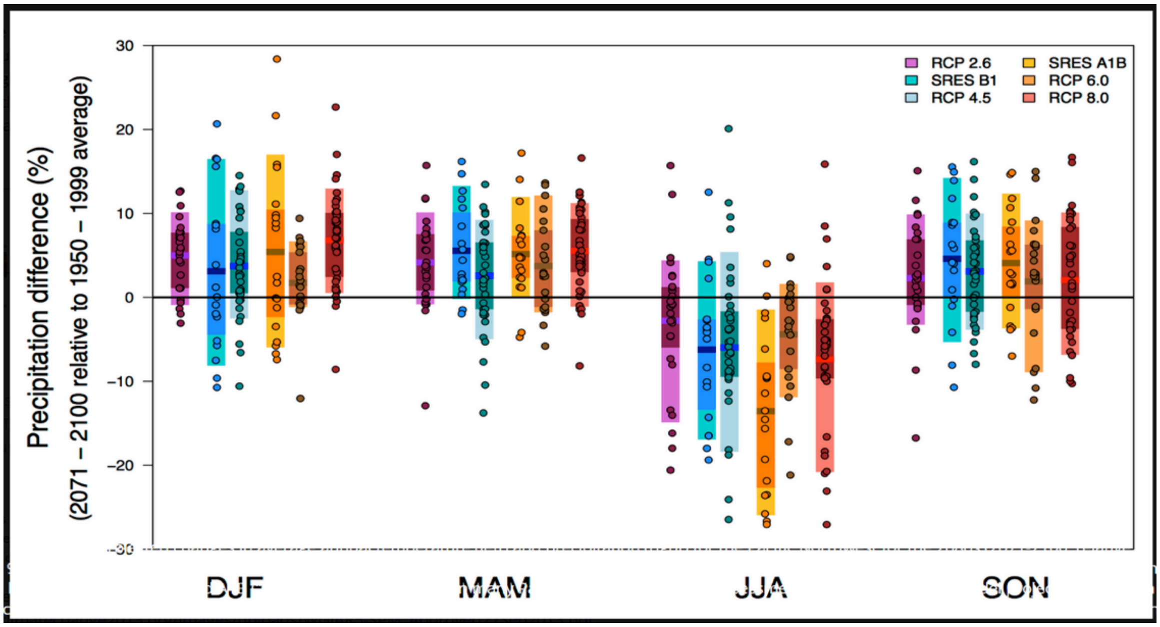


**Figure 3.** Projected percentage difference in precipitation by season for the Pacific Northwest based on six climate scenarios (RCP 2.6, 4.5, 6.0 and 8.0; SRES B1 and A1B). From the Climate Impacts Group, University of Washington.

Increasingly intense winter precipitation events have significant implications for all things affected by episodic flooding. This includes homes, businesses and critical infrastructure. For example, increasing "storminess" has the ability to overwhelm stormwater infrastructure that was designed to handle lower flows. Intensity of precipitation also negatively affects groundwater recharge rates (faster-moving water has less time to infiltrate) and surface water quality (heavier, faster rains pick up contaminants, nutrients and sediments, enabling them to travel).

Declining precipitation during the summer, already our dry season, may result in decreased groundwater recharge rates as well. These decreased rates may not be offset by more intense winter precipitation, because periods of high flow often result in a greater percentage of the water running off into the Sound, increased risk of vegetation or wild fires (which do already occur on Bainbridge Island; Figure 4), and a change in the types of vegetation that can thrive on our Island.

Another concern with respect to changing precipitation patterns are the approximately 6,900 onsite septic systems on Bainbridge Island, whose function will be affected by climate change because either too much water or too little water adversely affects their ability to function. The remaining 1,500 of the approximately 8,400 developed properties on-island are connected to sewer systems. The function and use of septic systems is important to understand because their use impacts groundwater recharge. Additionally, "increased precipitation or sea level rise may certainly affect septic system performance due to their impacts on shallow groundwater levels and soil saturation" (J. Kiess, Assistant Environmental Health Director, Kitsap Public Health District, Pers. Comm., June 17, 2016).

Additional aspects of the implications of changing precipitation and storminess patterns for Bainbridge Island are outlined in Table 1.

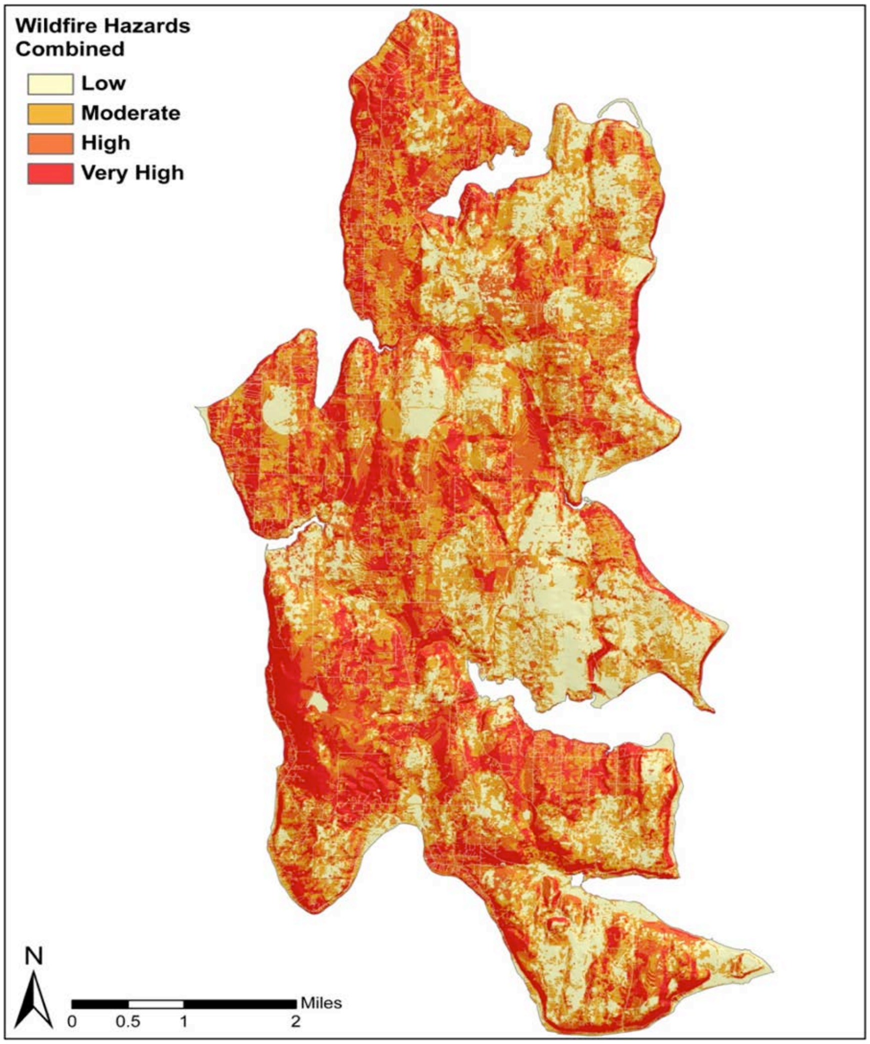


**Figure 4.** Wildfire hazards as identified in the Bainbridge Island Hazard Identification and Vulnerability Assessment. This map was created in 2010 based on an assessment and ranking of spatial hazards, proximity to a hydrant, and past occurrence of vegetation fires, which in part is related to annual precipitation and weather. The hazard shown here is based on past conditions; climate changes on top of this can result in increased occurrences or intensity of wildfires in some areas. From BIFD 2012.

### Sea Level Rise

Global sea level rise and local factors are influencing sea level rise around Bainbridge Island. Over the next century, conservative estimates show sea level rising 14 to 54 inches in our region (Mauger et al. 2015). Variability is largely due to our understanding of ice melt in Greenland and Antarctica, as global sea level rise is due to thermal expansion as the ocean waters warm and increased volume as terrestrial ice sources (especially Greenland and Antarctica) melt into the world's oceans. Increases at even the lower end of this range could seriously affect Bainbridge Island ecosystems and infrastructure, inundating coastal habitat, flooding roads and structures, and compromising the function of stormwater, septic and sewer systems. Areas of particular interest include the head of Eagle Harbor, Point Monroe and Lynwood Center, as well as Bill Point, home of the former Wyckoff Company and now an EPA Superfund site (Figure 5).


**Figure 5.** Point Monroe, Lynwood Center and Eagle Harbor with a projected 3m of sea level rise. From NOAA 2015.

It should be noted that shoreline planning will be directly affected by sea level rise. Shoreline Master Programs (SMP) are local land use policies and regulations designed to manage shoreline use in Washington State. They are prepared collaboratively by the Washington Department of Ecology (DOE) and each shoreline community, and must comply with the Shoreline Management Act (SMA) and Program Guidelines. SMPs are intended to "protect natural resources for future generations, provide for public access to public waters and shores, and plan for water-dependent uses" (WA Department of Ecology, n.d.a website).

Currently, the SMA *does not* require consideration of or planning for sea level rise, and the Bainbridge Island SMP does not either. At the time of this report, the DOE was considering updating the rules that implement the SMA. Part of the scope under consideration is to include a new section on planning for sea level rise, as evidenced by an April 1, 2016, DOE workshop on this topic (Talebi, Bobbak. 10 March 2016. "Re: Ecology Sea Level Rise Workshop Invitation." Message to Christy Carr, COBI. E-mail.). Guidelines could be amended to provide technical or procedural recommendations for jurisdictions that elect to voluntarily address future conditions resulting from sea level rise.

Another effect of sea level rise is the potential for seawater/saltwater intrusion into Bainbridge Island's aquifers. The combination of rising sea level, increased extraction of water (due to population growth and increased temperatures, each increasing demand) and decreasing recharge (due to declines in summer precipitation, intensity of storm events, and reduced permeable surfaces) can increase the risk of saltwater intrusion into our aquifers. Saltwater compromising an aquifer reduces or precludes that aquifers' utility as a source of drinking or agricultural water, possibly increasing local conflict and cost for water resources. On Bainbridge Island there has been one reported *potential* occurrence of saltwater intrusion detected in a nearshore community well causing it to be decommissioned and a new well drilled (Bannister et al. 2016). Funding and studies are now needed to confirm whether the cause was seawater intrusion, which would lead to mitigative or remedial actions to protect the drinking water supply in that area (C. Apfelbeck, COBI, Pers. Comm. June 27, 2016).

In order to better understand groundwater resources, as well as future potential for saltwater intrusion, COBI contracted with Aspect Consulting for a groundwater assessment and modeling project to: 1) review recent groundwater data; 2) review and recommend updates and changes needed to the 2011 Bainbridge Island groundwater model by the United States Geological Survey (USGS 2011), and; 3) evaluate scenarios supporting land-use planning including a Critical Aquifer Recharge Area assessment and an aquifer system carrying capacity assessment (Bannister et.al. 2016). This third phase included climate change projections by "considering three concurrent stressors on the aquifer system": 1) decreased groundwater recharge rates; 2) a 4-foot increase in mean sea level by the year 2100, and; 3) increased groundwater withdrawal rates to reflect population increases (Bannister et al. 2016). Predictive model results indicate that "groundwater from the Bainbridge Island aquifer system flows to Puget Sound and keeps the freshwater/seawater interface at a distance from the Bainbridge Island shoreline," and that the "100-year simulated model results indicate no seawater intrusion and groundwater level decreases were less than [Bainbridge] Early Warning Levels" (Bannister et al. 2016). However, there are policy and planning implications that should follow from these findings that are discussed below in the Water Resources section. Specifically, future conditions may prove to be different from model parameters (e.g., future stressors may be greater than modeled) and seawater intrusion could result locally.

It should also be noted that Bainbridge Island is home to a coastal Superfund site that involves soil and groundwater contamination. The Wyckoff site, located at the mouth of Eagle Harbor, was evaluated for vulnerability from climate change, especially sea level rise (EPA 2016a). Site managers are working with the knowledge that local sea level rose approximately "8.6 inches from 1900 to 2008" and is projected to rise up to 9.5 inches by 2030, up to 19.7 inches by 2050 and up to 60.7 inches by 2050. Over the past several decades, projections of sea level rise have steadily increased. Therefore, prudence suggests planning for the higher-end projections while preparing for even higher potential increases. This is especially relevant since the U.S. Army Corps of Engineers has made estimates of water-level impacts from the combination of sea level rise and 100 year extreme water levels, which have inundation at between 8 and 13 feet. To date there has not been any use of hydrological models to assess the implications of sea level rise and storm events on the aquifers in the vicinity of the Wyckoff site in the evaluation of treatment options. However, considerations around flooding and rainwater runoff have been evaluated and are anticipated to be addressed with possible changes in outfall pipe diameter (H. Bottcher, USEPA, Pers. Comm., June 1, 2016).

Additional aspects of the implications of sea level rise for Bainbridge Island are outlined in Table 1.

## Vegetation Changes

Changes in our local climate (e.g., increasing temperatures, decreasing summer precipitation) will affect local vegetation — forests, horticulture and agriculture. Forest distribution is projected to reduce Douglas fir in the Puget Sound region by mid-century, with possible expansions of western hemlock, whitebark pine and western red cedar across the Pacific Northwest (Mauger et al. 2015). Currently Bainbridge Island has a maritime evergreen needle leaf forest; climate change is projected to result in transition to temperate evergreen needle leaf forest or subtropical mixed forest. Summer water stress will decrease tree growth and increase fire risk. These changing conditions (e.g. climatological, heat and water stressed plants) are also likely to cause changes in pests. Therefore, while length of our growing season may increase, more extreme stressful conditions (heat, drought, flooding), coupled with pest pressure by new species and at different times may adversely affect agriculture and landscaping species.

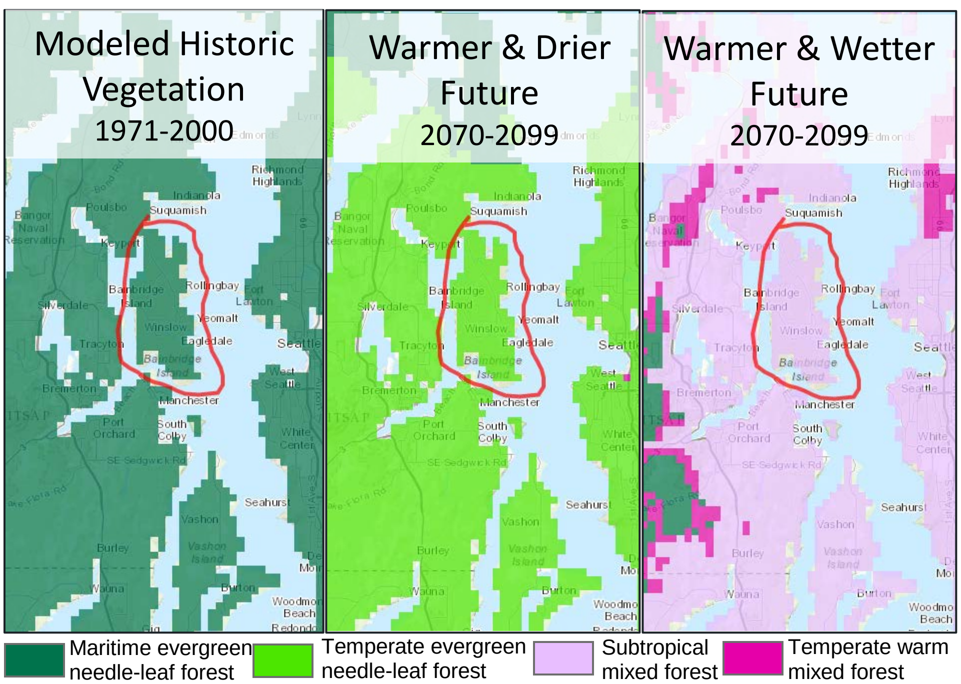


**Figure 6.** Projected vegetation changes for Bainbridge Island, based on MC1 models of A2 SRES emission scenarios. (From DataBasin)

Local marine habitat will also see changes in flora and fauna. One area of particular concern is increasing magnitude and frequency of Harmful Algal Blooms, which can adversely affect shellfish, marine foodwebs and air quality. This is expected due to increasing temperature and altered pH (Mauger et al. 2015).

Additional aspects of the implications of vegetation changes for Bainbridge Island are outlined in Table 1.

### Ocean Acidification

As carbon dioxide levels increase in the atmosphere, more of carbon dioxide is absorbed by the world's oceans, resulting in acidification of the Puget Sound. Measurable declines in pH have already occurred and are expected to continue (Mauger et al. 2015).

The impacts of ocean acidification on Puget Sound may be further compounded by changes in circulation and salinity due to changing runoff (heavy precipitation, declining snowpack) and water temperatures, and hypoxia (diminished dissolved oxygen). All of this has implications for water quality compliance and activities that affect or rely on water quality, including aquaculture and municipal sewage discharge compliance. Our understanding of the ramifications of ocean acidification is just beginning, with new revelations being made regularly. Our community will need to monitor this issue in order to plan and respond effectively. In addition to staying up to date on the emerging science and management practices in relation to ocean acidification, we can also find out what is happening locally by using the closest ocean acidification monitoring buoy to Bainbridge Island, located in Dabob Bay (Dabob NANOOS ORCA buoy http://www.pmel.noaa.gov/co2/story/Dabob ). This site provides a local picture of how ocean conditions are changing and may help advise local decisions, such as marine resource management, aquaculture planning and permitting, and run-off and discharge issues.

Additional aspects of the implications of ocean acidification for Bainbridge Island are outlined in Table 1.

### Slope Stability (confounded by climate change)

Climate change has the potential to affect slope stability by increasing saturation (due to altered precipitation intensity and timing), altering the vegetation that holds slopes together (due to altered precipitation and increasing temperatures), increasing erosion (due to sea level rise and altered precipitation) and undermining hillsides (due to sea level rise and flooding). As a result, it is necessary to consider how planning, conservation and development may need to be modified due to changing slope stability. According to the most recent building exposure risk analysis, Bainbridge Island has a significant number of buildings (177, valued at $55 million) located within the landslide zone. Clearly this is not an insignificant concern for local planners (FEMA 2015).

Since slope instability can threaten public and private infrastructure and natural resources, and endanger lives, stability should be understood prior to any local permitting. Currently there are tools provided by the Washington Department of Ecology intended to guide regional land use decisions, although in most cases these do not incorporate climate change concerns. However localities can apply their own knowledge of changing precipitation and sea level rise to shoreline slope stability mapping products (Figure 7)(Coastal Zone Atlas of Washington 1979).

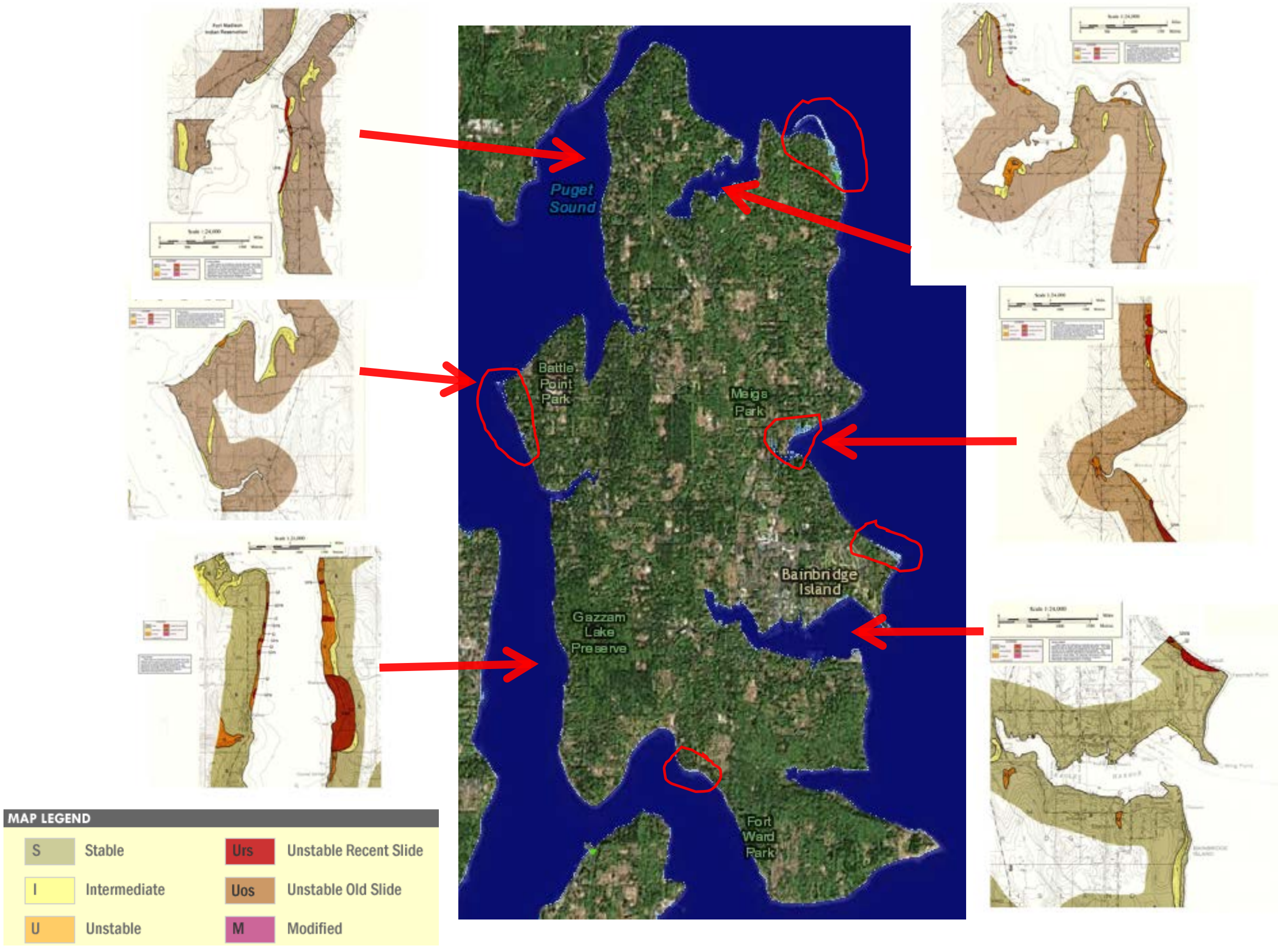


**Figure 7.** Figure 7. Shoreline Stability and Future Sea Level Rise. Some of the areas potentially impacted by simulated two feet sea level rise (light blue, circled in red; center). Sample areas showing slope stability concerns (outer). Sea level rise and associated coastal erosion are likely to exacerbate shoreline stability. From the Washington Department of Ecology (ecy.wa.gov/programs/sea/femaweb/kitsap.htm) and NOAA (coast.noaa.gov/slr).

Additional aspects of the implications of changing slope stability due to climate change for Bainbridge Island are outlined in Table 1.

The following **Climate Change Implications for Comprehensive Plan Elements** table (Table 1) identifies the climatic implications that Bainbridge Islanders can expect to affect the interests considered in each local comprehensive plan element. This table, however, is not just useful for community planning; anyone can use it to understand which climate impacts will affect their personal, organizational or business choices, development decisions, capital expansions, future markets, landscaping, conservation actions, etc.

Table 1. Climate Change Implications for Comprehensive Plan Elements

| Table 1 | IMPACTS | | | | | |
|---|---|---|---|---|---|---|
| ELEMENT | Temperature | Precipitation/ Storminess | Sea Level Rise | Vegetation Changes | Ocean Acidification | Slope stability |
| Water Resources | • Increased temperature results in increased water use/extraction rates<br>• Increased evaporation rates<br>• Diminished water quality | • Changes in groundwater recharge rates<br>• Alter storm water retention & infrastructure needs and effects on stormwater discharge compliance<br>• Flooding effects on water quality<br>• Effects on proper function of septic & sewage systems | • Risk of saltwater inundation of some aquifers and surface waters<br>• Risk of salt/seawater intrusion into aquifers<br>• Risk of inundating shoreline aquatic resources and habitat | • Changing vegetation may require more water, alter hydrograph or limit groundwater recharge<br>• Loss of riparian buffer function or composition | • May affect sewage and stormwater discharge compliance<br>• May negatively affect aquaculture<br>• Potential negative impacts to and loss of flora/fauna, particularly shellfish | • Loss of flora or new species may alter slope stability |
| Land Use and Housing | • Greater need for water due to higher temperatures<br>• Increased agricultural stress<br>• Increased temperature in buildings<br>• Regional population growth due to impacts in other regions | • Groundwater recharge may be diminished and further limited by impermeable surfaces<br>• Potential risk to housing stock (flooding, leaks)<br>• Stormwater retention and infrastructure needs may change<br>• Effects on proper function of septic & sewage systems | • Risk of saltwater inundation of septic systems and wells<br>• Loss of some land and property<br>• Affect Shoreline Master Plan efficacy | • Change in buffer and green space condition | | • Limit suitability of lands for some uses |
| Economy | • Increased costs associated with cooling, water and some resources<br>• Possible changing needs of heating & cooling<br>• Changes in tourism patterns<br>• Change in fisheries | • Increased costs associated with water and some resources (food) due to less water<br>• Risk of flooding events<br>• Tourism disruption<br>• Service disruptions<br>• Increases in insurance costs<br>• Increased costs for energy | • Issues for boating and ferries<br>• Cost of infrastructure repair/retrofit<br>• Insurance costs<br>• May affect cost of water if supply diminished | • Changing agriculture costs, output and composition<br>• Altered energy needs due to changes in plant cover | • Change in fisheries<br>• May affect cost of sewage and stormwater treatment | • Loss/damage to facilities and infrastructure |

| Table 1 | IMPACTS | | | | | |
|---|---|---|---|---|---|---|
| ELEMENT | Temperature | Precipitation/ Storminess | Sea Level Rise | Vegetation Changes | Ocean Acidification | Slope stability |
| Environment | • Thermal stress on local habitat<br>• Diminished water quality (including nearshore marine, including hypoxia and harmful algal blooms)<br>• Change in fisheries | • Decreased seasonal stream flow, affects native fish<br>• Stormwater systems overwhelmed<br>• Recharge surface may become insufficient<br>• Floodplain protection may need to increase<br>• Altered fire risk | • Altered hydrograph of estuaries and streams<br>• Diminished water quality due to septic and sewage inundation | • Possible loss of some protected or iconic flora (forest, agriculture) | • Change in fisheries<br>• Potential negative impacts to and loss of flora/fauna, particularly shellfish | • Erosion<br>• Critical habitat loss |
| Transport | • Roads and bridges adversely affected by thermal stress<br>• Smog-related air quality hazards increase<br>• Heat may reduce non-motorized transport | • Increased risk of flooding<br>• More drought may increase non-motorized transport, while strong rain events may increase auto dependence | • Inundation of coastal roads<br>• Dock/harbor infrastructure affected | • Altered canopy cover may reduce protection for non-motorized transport<br>• Loss or change of vegetation near roads may affect road condition (water flow, erosion) | | • Loss or change of vegetation may affect slope stability near roads |
| Utilities and Capital Facilities | • Changing energy demand<br>• Changing energy availability<br>• Capital facilities not designed for higher temperatures | • Increased risk of flooding and fire<br>• More wind storms increases risk of power outage<br>• Septic and sewage systems affected by both heavy precipitation and low-flow drought events | • Inundation of coastal infrastructure | • Energy demand increases with different % canopy cover | • May affect sewage and stormwater discharge compliance | • Infrastructure placed in unstable locations |
| Cultural Resources and Human Services | • Increased incidence of heat-related illness (including respiratory due to adverse air quality)<br>• Introduction of new disease-bearing pests | • Potential risk to housing stock (flooding, leaks)<br>• Drought and changes in water supply leading to rising costs<br>• Heightened risk of waterborne pathogens and bacteria from flooding | • Loss of coastal art and artifacts | • Changing agriculture costs, output and composition | | • Loss of art and artifacts |

## Climate Change Implications for Various Areas of Interest

The preceding section provided an overview of the climatic changes forecast to impact our local environment. This section intends to help Bainbridge Islanders begin adaptation planning by enabling you to ask and answer the initial appropriate question:

***What are the climate issues of concern for my area of interest and how will those issues affect what I am planning to do?***

Climate change will alter the circumstances upon which everyone makes decisions. To continue making informed decisions one needs to overlay the expected impacts onto an issue area and determine what the implications of climate change will be. For example, if you are an infrastructure planner, you need to know about site conditions such as slope stability. If you are planning for a capital investment near the shoreline, you would want to know about future flooding and sea level rise impacts. If you are permitting or constructing housing you should need to know about changes in average seasonal temperatures and the impact on energy consumption. Transportation systems generate stormwater and their function depends on its management; therefore transportation engineers and planners need to know projected precipitation to properly design durable facilities. If you are a local first responder, you need to know the hazards to which your community is vulnerable. This list goes on.

Climate adaptation planning asks you to think about what baseline information you depend on to make decisions within your area of expertise. Next, you are asked to understand how that baseline information will change over time due to climate change. And lastly, you are asked to accommodate that change in your planning.

### A Framework for Adaptation: Considering impacts and implications

Arguably the most important goal of climate adaptation planning is to integrate climate-informed thinking and apply the implications of climate projections into everyday decision-making. Effective planning in the face of climate change seeks to reduce a community's contribution to climate change by reducing greenhouse gas emissions (mitigation) and increasing community resilience to the manifestations of climate change (adaptation) as central organizing principles of local policymaking.

According to the APA Washington Chapter, there are three valid methods for fitting climate change into the planning process: 1) integrating future climate considerations into all long-term projects, 2) integrating climate change adaptation and resilience into existing planning practices, and 3) developing a climate adaptation/resilience plan (American Planning Association-Washington Chapter. 2015). It is also reasonable to use a combination of these methods, thereby tackling adaptation from many angles at once. Because Bainbridge Island is updating its Comprehensive Plan, this is an excellent opportunity to use an active planning process to integrate climate change into the plan, achieving methods 1 and 2, and thereby eliminating the need for a separate climate action planning process (method 3).

As an umbrella for incorporating climate change into a Comprehensive Plan, it is important to have an overarching frame that provides perspective. To this end, a guiding principle for climate change in local planning could be:

> Reduce *greenhouse gas* emissions (mitigation) and increase the community's *climate resilience* (adaptation) in the face of shifting conditions (e.g. sea level rise, changing precipitation patterns, increasing temperatures and more extreme weather events) and the effects they cause (e.g., altered vegetation, changing water demands, economic shifts).

One should also remember that climate adaptation planning is not only about dealing with negative circumstances, though it is often framed in terms of avoiding loss and safeguarding people, places, and things. There is *opportunity* to increase resilience and to construct a more sustainable and climate-conscious community and economy. This section explores seven community planning areas and provides questions to steer one toward climate-savvy decision making. Areas include: land use, water resources, environment, infrastructure (including transportation, capital facilities and utilities), economic development, housing, and social services (including cultural resources and human services).

### Land Use

Most if not all of the implications of climate change come into play in work related to land use and land use planning. For example, sea level rise, changing precipitation patterns, increasing temperatures, vegetation changes and our responses to those changes will all affect the suitability and success of all land use decisions, and changes in these conditions alter the foundation upon which most decisions are made today.

Local development patterns provide opportunities to either benefit or compromise both climate **mitigation** and **adaptation** for the long term. The City should use its Comprehensive Plan and the Land Use goals to give a clear directive to enact mitigation and adaptation strategies:

- *Mitigation* measures include reducing vehicle miles traveled, encouraging non-motorized transportation, taking other actions that will reduce consumption of fossil fuels, establishing green building incentives or regulations, and preserving vegetated/forested areas.
- *Adaptation* measures include shifting development and infrastructure from flood-prone and other hazard areas, improving and integrating hazards planning, requiring drought-tolerant plantings in drought-prone areas and other efficient uses of climate-sensitive resources, Low-Impact Development, implementing economic development strategies that are sustainable in future climates, and encouraging energy-saving buildings, multimodal transportation, and redevelopment/retrofitting.

Land use decisions and local planning are in large part about protecting public health, safety and welfare; therefore overarching most local government functions. Similarly, dealing with the impacts of climate change spans all disciplines and elements of any comprehensive plan. Several things should be acknowledged about climate change any time our community makes a land use decision, including:

- Municipal officials will be called upon to address both the causes and consequences of climate change;
- These same officials can be responsible for development of climate-aware goals and actions within each element of the local Comprehensive Plan and its implementation;

- The groundwork for a climate-savvy local plan needs to be laid down within the goals and policies of the Land Use – or overriding – element;
- Regulations should acknowledge that climate change will impact future conditions and should be factored into all decision-making today;
- Proactive climate-aware strategies and responses should be developed by all local actors, not just the local government; and that,
- Bainbridge Island is, in fact, an island. We are bound by distinct borders and have a finite carrying capacity.

In order to make land use decisions and investments today that will prove lasting in the future, we must understand and acknowledge what our future may look like (e.g., what resources and conditions will be present). Studies to determine components of this future should be undertaken. When they are it will be critical that climate change and future climatic scenarios be incorporated into any analysis. For example, if a City (or homeowner developing a supply well) undertakes a water study, parameters should be given for scenarios of supply and demand that consider altered precipitation patterns over time based on best available climate predictions (e.g. through longer study time horizons). Efforts should be made to evaluate potential future conditions to the degree possible.

The Federal Emergency Management Agency (FEMA), through the Disaster Mitigation Act of 2000 and their subsequent implementing actions, encourages communities to integrate hazard mitigation planning into local comprehensive planning in order to establish "resilience as an overarching value of a community and provid[e] opportunity to continuously manage development in a way that does not lead to increased hazard vulnerability" (FEMA, n.d.b). Climate adaptation planning follows this same reasoning and asks the same of communities. Resilience can be built through land use policies and regulations that take into consideration "information of the location, frequency, and severity of hazards ... and setting forth recommendations that influence development in a way that does not increase risks to life and property" (FEMA, n.d.b. Web).

Basic questions about future climate must be asked when considering any development proposal, investment, maintenance, or new project. See Table 2, Land Use Implications from Climate Change, to determine what future climate related changes will affect land use.

Table 2. Land Use Implications from Climate Change

| CLIMATE IMPACT | LAND USE IMPLICATIONS |
|---|---|
| Precipitation → <br>*changing patterns and extremes, longer duration, and greater intensity* | • Changing patterns have the potential to affect the proper functioning of local infrastructure.<br>o stormwater inundation and localized flooding, chronic flooding, non-infiltrated run off, erosion and landslides<br>o increased maintenance needed<br>• Changing patterns and extremes will cause shifts in overall vegetation types and habitats on the Island.<br>• Groundwater recharge may be diminished and further limited by impermeable surfaces. |
| Temperature → <br>*more extremes and prolonged summer highs* | • Increases and seasonal changes will increase the frequency and duration of droughts:<br>o changes in growing seasons affects commercial agriculture and recreational gardening<br>o increased demand for water<br>o increased risk of wildfire (conflicts at the wildland-urban interface)<br>• Long-term temperature trend changes will cause shifts in vegetation and habitats on the Island. |
| Vegetation changes → <br>*shifts will occur in habitat suitability as a factor of changing temperature and precipitation* | • Changes can occur in buffer and green space conditions due to vegetation shifts.<br>• There is the potential for deadwood and detritus as die-off occurs, which will increase the fuel load and risk for wildfires.<br>• Changes can be seen in flora and fauna habitat suitability. |
| Sea Level Rise → <br>*Projected Mean*<br>*2030: +2.6 in. (+/- 2.2 in)*<br>*2050: +6.5 in. (+/- 4.1 in)*<br>*2100: +24.3 in. (+/- 11.5 in)* | • Coastal zone resources and shoreline stability are likely to be compromised by rising seas.<br>o Roadways could be undermined by shoreline instability and land loss. Mapping should be done to identify vulnerable local infrastructure and critical community facilities. Consider linkages with Hazard Mitigation Planning.<br>o outright loss by inundation of land<br>• There is a risk of saltwater intrusion and its effect on the groundwater and drinking water supply of the Island.<br>• There is a risk of saltwater inundation of septic and sewer systems.<br>• The efficacy of the Shoreline Management Plan will be affected if it too doesn't adapt to sea level rise. |
| Slope Stability → <br>*Sea level and precipitation pattern changes will compromise once stable slopes* | • There is the potential for limited suitability of lands for some uses (both coastal and inland) due to changing slope stability and associated conditions (temperature, precipitation, sea level rise). |
| RELEVANT NON-CLIMATE DATA THAT MAY AFFECT THE GOALS OF THE ELEMENT | |
| Population changes → <br>*account for anticipated increase or decrease due to climate refugees* | • Will climate lead to larger or smaller population on-Island? Population projections are an important piece of data in long-range planning. It is thought that regional population growth will occur due to impacts in other regions. |
| Transportation plans → <br>*Vehicle miles traveled is one of the greatest contributors to greenhouse gas emissions* | • Sprawling versus compact development is fueled by transportation infrastructure, which will have a direct role in the Island's ability to address local greenhouse gas emissions and the long-term costs of infrastructure maintenance. |

### Questions to Consider for Land Use Adaptation

The implications identified above in Table 2 should make it obvious that responsible planning and development requires decisions be considered through a climate change lens. Prior to any land use decision, we should ask:

1. Are our community and all stakeholders aware of effects on Island land uses from today's precipitation, temperatures, and sea levels?
   - If these climate factors were to be altered, how would that affect our land use?
   - How would alterations affect land use investments?

2. Will future conditions prevent or hinder a proposed system/infrastructure/use/parcel from working as expected? Will they remain durable in the face of future climate?

3. Are our land use regulations sufficiently requiring compact, low-impact development patterns?
   - Does our community employ a host of land use tools that result in sustainable development?

4. Are there particular land uses that are likely to be impacted more directly or to a greater extent by climate changes? What special planning considerations can and should be made for these?
   - If we seek to preserve working waterfronts, will climate change alter conditions so that they can't function?
   - If wetland was set aside, will it be wetland in the future?
   - Are we allowing space for migrating species and habitats?

5. Does hazard mitigation factor into land use decisions?
   - Does the permitting process explicitly require considering present and future vulnerable site conditions?
   - What hazard planning is required to be undertaken and how are vulnerability or risk assessments used in decision-making?
     - Are we as a community asking, "If development is allowed in a coastal zone that is subject to future sea level rise, and therefore becomes vulnerable to shoreline instability and localized flooding, is the City liable for any resulting harm?" (After all, they allowed the development in a known/projected hazard area.) Questions like this are beginning to be asked nationally (even by insurers), and it is important for planners and City leaders to get out in front.
   - If we do allow development in high-hazard areas, should we require bonding of the property by the developer to avoid future cost to the community that may be incurred by the risky development?

### Water Resources

Water is an essential part of our Island life — for both natural and built environments — and its health is linked to the sustainability of both people and ecosystems on the Island. Bainbridge Island had chosen to add a Water Resources element to their 2004 Comprehensive Plan in order to elevate its importance and provide space to focus on it appropriately. This element includes consideration of surface water (including marine and freshwater aquatic resources), stormwater, and groundwater. Typically in Washington community water supply resources are discussed in Comprehensive Plan Land Use elements where state statute requires that they "shall provide for protection of the quality and quantity of groundwater used for public water supplies" (RCW 36.70A.070(1)). The 2004 Water Resources element (COBI 2004) states,

> *Adequate protection of the important [water] resource requires an understanding of what can affect the quality and quantity. Also of great importance is the management of the resource by guarding against potential impacts and monitoring the resource to ensure that water quality and quantity is in fact maintained at high standards.*

In March 2013, the Environmental Protection Agency designated the Bainbridge Island Aquifer System a sole source aquifer. According to that designation (EPA 2016b),

> *[a] sole source aquifer is an underground water supply designated ... as the sole or principal source of drinking water for an area. The system EPA designated encompasses the entire Bainbridge Island area and is made up of six principal aquifers. One hundred percent of the current population on Bainbridge Island obtains their drinking water from the designated aquifer. There are no other sources of drinking water nearby that would be economically feasible to supply all residents in the area.*

It doesn't take much thought to realize that there is a direct link between climate and the health and abundance of our water resources. According to the 2015 Central Puget Sound Regional Open Space Strategy, "natural and built systems are at risk from the effects of a changing climate, including increased average temperatures, altered precipitation patterns, altered hydrology (e.g., decreased snowpack, flow patterns), altered oceanic and atmospheric circulation, sea level rise, and changes in water chemistry and quality," and these changes will stress water supplies and quality (ROSS 2015).

The local Comprehensive Plan has a 20-year time horizon for planning. However, like many decisions a comprehensive plan informs, water resource decisions made in the past, present, and near future will affect the resource well beyond 20 years from now. How is this reconciled so that the community can ensure sustainable water resources? One part of the answer needs to be the factoring of future climate conditions (changing precipitation, temperatures, and sea level rise) into today's decision-making.

The Washington Department of Ecology Shoreline Master Program (SMP) deals with water resources in the nearshore and is a local document that drives policy and regulations affecting coastal development. Unfortunately, climate change impacts, including sea level rise, are not addressed or planned for by the SMP. The City has an opportunity within its Comprehensive Plan to address this omission by requiring holistic shoreline management under present and future conditions.

Recent groundwater modeling studies done by Aspect Consulting for COBI provide new information the City can use to better protect its groundwater resources (Bannister et al. 2015, Bannister et al. 2016, Scrafford et al. 2015). This recent work clearly indicates that there are policy and planning changes needed to protect groundwater resources, and they will be especially important in light of climate change. In particular, while study results do not project the freshwater-saltwater interface being pulled closer to shore (Bannister et al. 2016), achieving future groundwater conditions that align with the study parameters that stave off seawater intrusion, will require both water conservation and on-site recharge being maximized. To avoid degradation of our groundwater, a paradigm shift in planning around water must occur with a regulatory system that maximizes recharge, conservation, and reuse. This includes stormwater, sewer discharge, and all other wastewater stream runoff that historically have been managed to be removed from the water cycle on-island (C. Apfelbeck, COBI, Pers. Comm., May 31, 2016).

See Table 3, Water Resource Implications from Climate Change, to determine how climate change has the potential to affect both the health and supply of Bainbridge Island's surface and groundwater resources.

Table 3. Water Resource Implications from Climate Change

| CLIMATE IMPACT | WATER RESOURCE IMPLICIATIONS |
|---|---|
| Precipitation → <br><br>*changing patterns and extremes, longer duration, and greater intensity* | • More intense and frequent storms or heavier rainfall events can cause stormwater inundation and localized flooding, chronic flooding, non-infiltrated runoff (degrading water quality), erosion, landslides, sediment loading and siltation downstream and in the Island's embayments and other nearshore habitat/areas.<br>• Stormwater systems may be undersized and development may have to accommodate greater flows and retrofit.<br>• Undersized stormwater systems and flood events lead to runoff that may degrade water quality.<br>• Changes in precipitation patterns will lead to changes in groundwater recharge rates (i.e., more intense events of shorter duration will decrease recharge; because water will simply run off before it has a chance to infiltrate).<br>• Discharge compliance of sanitary and stormwater discharge may be affected.<br>• Flow flashiness can cause erosion that degrades instream habitat and negatively impacts macroinvertebrate diversity and health. |
| Temperature → <br><br>*more extremes and prolonged summer highs* | • Increases in temperature results in:<br>o increased water use/extraction rates<br>o rising surface water temperature that may affect aquatic species (e.g. salmon, macroinvertebrates, plankton)<br>o increased evaporation rates that will affect surface habitat and groundwater recharge rates<br>o diminished water quality |
| Vegetation Changes → <br><br>*shifts will occur in habitat suitability as a factor of changing temperature and precipitation* | • Species composition in natural areas will change as precipitation and temperature changes.<br>• Changes in water retention/recharge will affect wetland ecosystem functions, and result in the loss of riparian buffer function or composition.<br>• Changing vegetation may require more water, alter the hydrograph or limit groundwater recharge. |
| Sea Level Rise → <br>*Projected Mean*<br>*2030: +2.6 in. (+/- 2.2 in)*<br>*2050: +6.5 in. (+/- 4.1 in)*<br>*2100: +24.3 in. (+/- 11.5 in)* | • Changes to coastal zone resources and shoreline stability<br>o Shoreline instability and potential land loss can affect water pumping stations, sewer/septic and stormwater infrastructure as well as water supply wells.<br>• Inundation risk to aquifers (intrusion), surface waters (overwash and increased tidal ranges), shoreline ecosystems and habitat. |
| Slope Stability → <br>*Sea level and precipitation pattern changes will compromise once stable slopes* | • As vegetation changes and shifts there could be a loss of flora or addition of new species that alter slope stability. Slope failure may impact water infrastructure and negatively affect wetland ecosystem function.<br>• Die-back and loss of root systems supporting slopes could lead to instability in highly vulnerable areas. |
| Ocean Acidification → <br>*decreasing pH of the waters of Puget Sound* | • This has the potential to affect stormwater discharge compliance as toxicity is affected by pH.<br>• Aquatic species may be affected by acidification due to climate change. |
| RELEVANT NON-CLIMATE DATA THAT MAY AFFECT THE GOALS OF THIS ELEMENT | |
| Population changes → <br>*account for any anticipated increase or decrease due to climate refugees* | • Climate change may increase population on-Island (climate migrants).<br>o An increase in population will increase water use/extraction rates and require more sanitary disposal, as well as causing additional pressure on local aquatic habitat integrity. |

### Questions to Consider for Water Resources Adaptation

The implications identified above in Table 3 should make it obvious that responsible use and preservation of Island surface and groundwater resources should be considered through a lens of climatic changes. We should ask:

1. Are current precipitation patterns fully understood as to how they impact water resources, wastewater systems, and stormwater management on-island?
   - If precipitation were to increase, decrease or change in intensity and duration, would it affect local water resources?
   - What in-stream flow impacts will result during both during wet and dry season base flow levels?

2. How will the many facets of climate change and our responses to it affect the islands aquifer systems and water budget?

3. Will our groundwater recharge pathways be affected by altered precipitation patterns? Will existing or proposed development and impermeable surfaces further confound this?

4. If sea level were to rise, would it affect our water resources? Do current tidal ranges have an impact on coastal lands, shoreline stability, and infrastructure in the coastal zone?
   - Do we know where vulnerable systems are located?
   - How would sea level rise affect our groundwater/drinking water supply? Is saltwater intrusion a risk under future conditions and what needs to be done to avoid the risk?

5. If average seasonal temperatures were to shift would it affect our water resources and the aquifers on which we depend? Are there currently any seasonal/temperature related impacts? Do isolated high-heat or cold days have an effect? Does use change with increasing temperatures? Does the efficiency of our water system change?

6. What is the appropriate planning horizon that should be applied to decisions in order to protect and sustain groundwater resources? If that timeframe is longer than a decision's effective time horizon, should we conduct appropriate analysis and modeling so that we understand, as best we can, what state the resource is likely to be in 50 years? 100 years?

7. Are water resource conservation measures being fully implemented?

8. Can the Island use the Comprehensive Planning process and the Water Resources element to address precipitation change, sea level rise and other climate-related impacts, including altered patterns of use, which the Shoreline Master Program does not?

9. Has the City's Critical Areas Ordinance, which has a role to play in water resources protection, been reviewed under the climate lens? Are there protections that can be strengthened or employed in this ordinance that will help reduce the impacts of anticipated climate change?

10. Under current climate conditions, are there any locations on the Island that are currently nearing or exceeding allowed discharge per sanitary or stormwater permits? What are the current concerns and will they be exacerbated by expected future climate?

### Environment

Changing climatic conditions are anticipated to alter the long-term function of our natural systems —plants, pests, animals, surface water, fires, forests, agriculture, and everything else in the natural world around us (WA Department of Ecology, n.d.b website). Planning how we will adapt to and accommodate these changes is what Bainbridge Islanders should be starting today, and the Environmental Element of the Comprehensive Plan is an obvious place to start. Various landscapes and ecosystems of the island should be considered holistically as "environmental resources" of Bainbridge Island, including water resources, critical areas, wellhead and aquifer recharge areas, agricultural lands, open spaces (forests, fields), as well as the built environment and areas within it that form ecosystem corridor connections.

One part of our local environment (and a noted priority for Islanders) is our open space/natural lands. There is opportunity to value and prioritize these natural areas beyond their aesthetic or community character value if we think about them as the climate adaptation tools that they are. The Central Puget Sound Regional Open Space Strategy (ROSS 2015) argues for the thoughtful preservation of open space as one strategy to both mitigate and adapt to climate changes. ROSS (ROSS 2015) defines open space as:

> *A diverse spectrum of lands across a rural and urban continuum on large and small scales. Traditionally open space may be imagined as wilderness lands or public parks, but it also encompasses resource lands for agricultural and timber production, wetlands and water bodies, local and regional recreational trail systems, as well as urban green spaces like parkways, rain gardens, and green roofs.*

Careful planning and acknowledgement of the importance of these open space resources on Bainbridge Island should be a main goal of our local community planning. Natural resource design standards will make natural systems and ecosystems more resilient to changing local conditions.

In 2006, Bainbridge Island Mayor Darlene Kordonowy appointed the 2025 Growth Advisory Committee and asked them to develop recommendations on how to accommodate the City's projected growth in a way that satisfied the mandates of the Growth Management Act, the spirit of the City's Comprehensive Plan, and the community's values and vision. The Committee produced the 2008 Bainbridge Island Open Space Study that presents an assessment of high-priority open space areas for conservation and gives a multi-pronged approach for preservation that includes both regulatory strategies and landowner incentives (Bainbridge Island Open Space Study 2008). The Open Space Study should be revisited and updated so that it can serve as a guidance document to the Comprehensive Plan and be made climate savvy itself.

See Table 4, Environmental Implications from Climate Change, to determine what future climate related changes will have local effects on our environment.

Table 4. Environmental Implications from Climate Change

| CLIMATE IMPACT | ENVIRONMENTAL IMPLICATIONS |
|---|---|
| **Precipitation →**<br><br>*changing patterns and extremes, longer duration, and greater intensity* | • Changing patterns have the potential to cause stormwater inundation and localized flooding, chronic flooding, non-infiltrated runoff, erosion and landslides, which have the potential to affect the proper functioning of local infrastructure and to degrade water quality and local environments.<br>• Changing patterns and extremes will cause shifts in overall vegetation types and habitats on the Island.<br>• Groundwater recharge may be diminished by flow rates and increased speed of runoff, and further limited by insufficient recharge surface area.<br>• Drought and flood will cause alterations to the wildfire hazard risk.<br>• Floodplain protection may need to increase and current floodplain delineations may become inaccurate.<br>• Changes in seasonal streamflow will affect native fish. |
| **Temperature →**<br><br>*more extremes and prolonged summer highs* | • Increases and seasonal changes will increase the frequency and duration of droughts.<br>• Changes in growing seasons will affect commercial agriculture and recreational gardening.<br>• Increased demand for water will result from drought, lower flows, etc.<br>• As temperatures increases, longer drought periods result in increasing wildfire risk (conflicts at the wildland-urban interface).<br>• Thermal stress will affect local habitats, and also local fisheries.<br>• Inland and nearshore water quality will diminish as temperatures change, causing hypoxia and harmful algal blooms. |
| **Vegetation changes →**<br>*shifts will occur in habitat suitability as a factor of changing temperature and precipitation* | • Long-term temperature and precipitation trend changes will cause shifts in vegetation and habitats on the Island.<br>• Changes can occur in buffer and green space conditions due to vegetation shifts.<br>• There is the potential for deadwood and detritus as die-off occurs, which will increase the fuel load and risk for wildfires.<br>• Changes can be seen in flora and fauna habitat suitability, leading to possible loss of some protected or iconic flora.<br>• Agricultural operations and recreational gardeners will need to adapt to changes in crop suitability and species tolerance. |
| **Sea Level Rise →**<br>*Projected Mean*<br>*2030: +2.6 in. (+/- 2.2 in)*<br>*2050: +6.5 in. (+/- 4.1 in)*<br>*2100: +24.3 in. (+/- 11.5 in)* | • Coastal zone resources and shoreline stability are likely to be compromised by rising seas. Outright loss of floodplain and other critical habitat area will result from inundation of today's shoreline.<br>• Saltwater intrusion can affect groundwater and drinking water supply of the Island.<br>• Water quality can be affected by saltwater inundation/flooding of sanitary sewer and septic systems.<br>• The efficacy of the Shoreline Management Plan will be affected if it too doesn't adapt to sea level rise.<br>• Alterations to the Island's hydrograph will affect estuaries and streams. |
| **Slope Stability →**<br>*sea level & precipitation pattern changes will compromise once stable slopes* | • Erosion of slopes can cause loss and damage to critical habitat. |
| **Ocean Acidification →** *decreasing pH of the waters of Puget Sound* | • Changes will occur in local fisheries. |
| RELEVANT NON-CLIMATE DATA THAT MAY AFFECT THE GOALS OF THIS ELEMENT | |
| **Population changes →**<br>*account for anticipated increase or decrease due to climate refugees* | • Increases in Island population will place increased demands and stress upon all environmental resources. |
| **Transportation plans →** *Vehicle miles traveled is one of the greatest contributors to greenhouse gas emissions* | • Transportation projects and associated development patterns will have a direct role in the Island's ability to address local greenhouse gas emissions. Vehicle miles traveled will directly impact Island air quality and ground level ozone (see Environmental Goal 13). |

### Questions to Consider for Environmental Adaptation

In order to comprehend the climate vulnerability of the environment and apply climate change realities to decision-making, we should ask:

1. How do current **precipitation** patterns affect our environment? How will alterations in precipitation patterns affect our local environment? (E.g., if water recharge set-asides or permeability standards are devised, they would need to be sufficient under changing precipitation patterns.)

2. Are there currently any seasonal/temperature-related impacts (e.g., do isolated high-heat or cold days have an effect on our environment)? If average seasonal **temperatures** and patterns were altered, would it affect our local environment?
   - What effects will occur locally as the growing season changes? Will there be impacts for crop suitability, including species tolerance, water needs and pest management?

3. How do **sea level** and associated conditions (high tides, inundation and frequency) affect the Island today?
   - How does sea level affect our coastal zone and nearshore environmental resources?
   - Does this have an impact on sanitary sewers, septic systems, and stormwater drainage? And how do the proper functioning of all these systems affect the Island's environment?

4. Do changing patterns have the potential to affect critical area and habitat location and function? Will natural resource lands and open space areas be affected?
   - Should we prioritize areas likely to serve as climate refuges for local and migrating flora and fauna (areas likely to maintain more stable conditions over time)?
   - Do we need to look to yet-unprotected or unidentified lands in order to avoid future flooding? To accommodate vegetation and habitat (e.g. wetlands) migration?
   - Are local regulations sufficient to prevent or promote development that is desirable and resource protective?

5. What effects would the Island experience if there are shifts in **vegetation** composition (die-off, migration, new species) in natural areas?
   - How can we ensure future ecosystem function under changed conditions?
   - What effects will be seen on the type and quality of open space and the function of our natural resource lands? Will it matter if these areas change?
   - If a wetland, or other area, is protected or restored will it serve that function in the future? Will areas we protect today hold the same resource values under changed conditions?

6. As temperature and precipitation patterns change (more frequent and prolonged drought) the risk of wildfire may increase. (Note: Bainbridge experiences vegetation fires every year – according to the Bainbridge Island Fire Department Hazard Vulnerability Assessment, from 1989-2009 there were 454 reported vegetation fires.)
   - What actions should be taken now to prepare for this risk?
   - Is it important to identify vulnerable forests and their interface with developed areas?
   - What are the consequences of fires and firefighting efforts (e.g., physical breaks, chemical use, water needed) for our local environment and community?

7. How is local air quality today? Will Bainbridge Island exceed air quality standards in the future, either due to warmer summers resulting in more ground level ozone, or colder winters resulting in greater local fuel use?

### Infrastructure - Transportation, Capital Facilities and Utilities

Infrastructure is a category that includes myriad capital facilities and services that a government typically provides to its citizens, including utilities, roads, transportation systems, public buildings, schools, parks, water, sewer and stormwater systems, and first responder services. Climate change may significantly alter the proper functioning, longevity, and fiscal responsibility of local infrastructure. Climate-savvy planning for infrastructure would ensure that climate vulnerabilities/variabilities inform infrastructure improvements, siting and design.

#### Transportation

Land use and transportation are clearly linked: good outcomes in one can allow good outcomes in the other. If land use development patterns result in compact development, then multi-modal transportation systems that generate lower numbers of vehicle miles traveled can flourish. Low-impact modes such as walking and biking become more practical. Transportation infrastructure and use patterns are directly linked to production of greenhouse gas emissions and local air quality. Therefore, when they are managed to reduce motorized transit they foster climate change mitigation.

On Bainbridge Island there are homes and businesses that are indeed spread out across the island, and for many, transportation seems dependent on car trips. Improvements and expansions in the non-motorized pathways and trail systems (if done well, such that they provide routes to where people need to go) could reduce car dependence while increasing safety, decreasing traffic, improving environmental quality and improving public health. Every opportunity should be taken by the City to invest in non-motorized transportation infrastructure (e.g., pedestrian and bicycle trail expansions, improvements, and linkages). Additionally, great effort should be taken to improve public transportation, which reduces traffic, improves environmental quality (think hybrid and electric buses), and reduces greenhouse gas emissions. Additionally, public transit and non-motorized transit corridors can be designed to be more resilient to climate change, being built out of harm's way from expected risks and vulnerabilities.

#### Capital Facilities

Hazard mitigation and climate adaptation strategies overlap perhaps nowhere else as obviously as they do when thinking about capital facilities. Providing public facilities or services and making capital expenditures in areas that are vulnerable to hazards is simply not good public policy. FEMA recognizes that "a community's facilities and infrastructure policies are directly linked to land use patterns and community development" (FEMA n.d.a). Resilience will be improved when policies limit or exclude facilities, services and capital expenditures in present or future hazard areas. It is critical to ensure long-term durability and continued function by not investing in climate vulnerable locations. Additionally, it is important to ensure that any ongoing hazard identification and risk assessment on which planning is based fully incorporates climate change impacts and implications. Plans relevant to Bainbridge Island include the 2012 Bainbridge Island Hazard Identification and Vulnerability Assessment by Bainbridge Island Fire Department & Western Washington University, the 2015 Risk Report prepared by FEMA for Kitsap County, and the 2012 Kitsap County Multi-Hazard Mitigation Plan by the Kitsap County Department of Emergency Management. Updates of these should all be informed by climate change implications.

Communities make major investment in stormwater infrastructure, which is quite vulnerable to climate change due to its ability to function during low and high flow periods. Both of these are likely to be more common on Bainbridge Island due to climate change. The Washington Department of Ecology will soon begin to require Low Impact Development (LID) Municipal Stormwater Permitting (also known as Green Stormwater Infrastructure). Bainbridge Island will be required to incorporate LID best management practices into local codes, ordinances, and standards. LID is "a stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices ... that are integrated into a project design" (WA Department of Ecology, n.d.c website). LID best management practices include infiltration, filtration, storage, evaporation and transpiration through the use of bio retention, rain gardens, permeable pavements, minimal excavation foundations, vegetated roofs, and rainwater harvesting. Bainbridge Island should utilize this opportunity and require the use of LID to the greatest extent possible and design LID standards such that they are responsive to the changes we will see in the coming decades.

### Utilities

Conversion and conservation are key words when it comes to developing climate resilient and durable utilities. The reliance on and continued use of fossil fuels in the production of energy is the largest contributor to greenhouse gas emissions. A community can work to reduce its overall reliance on fossil fuels by increasing requirements on utility providers for conservation of fossil fuels and conversion to renewable sources of energy. Communities with an opportunity to switch to a utility provider that relies on renewable energy should take every available opportunity to do so, as it is the most efficient and rapid path to reduced carbonization. Additionally, an overall reduction in energy use and water use is a climate adaptation strategy; if we need less, we can thrive when there is less. Other opportunities in the utility sector for resilience include improved energy efficiency, grid redundancy and "smart" control design coupled with renewable energy.

Forward-thinking communities are undertaking measures to change their energy footprint. For example, the Metropolitan Council of Minnesota, the regional planning agency for the Twin Cities area, is encouraging inclusion of climate change in local plans, and has developed a regional plan, Thrive MSP 2040, that encourages resilience. The Resilience Plan provides suggested implementation measures, such as suggesting "natural resource design standards to make natural systems and ecosystems more resilient to development" (Metropolitan Council 2016). Community forests, for example, will help to mitigate urban heat island effects. Local Twin Cities' governments are required by state law to include an element in their Comprehensive Plan for protection and development of access to direct sunlight for solar energy systems (a mitigation measure). Other communities have also prioritized maximizing their local generation and renewable potential. Lancaster, Calif., for example, has created a locally run, not-for-profit power program to promote local generation and use of sustainable energy, and aims to be the first net-zero city in the United States (City of Lancaster n.d.). The city has also set in place high energy efficiency requirements and incentives for all local development (residential and commercial), as well as incentives for local generation (Center for Sustainable Energy n.d.).

Future climatic conditions and impacts on infrastructure must be considered in order to effectively plan any long-term investment, maintenance, or new infrastructure project. See Table 5, Infrastructure Implications from Climate Change, to determine what climate related changes will have an impact on Bainbridge Island infrastructure.

| Table 5. Infrastructure Implications from Climate Change | |
|---|---|
| CLIMATE IMPACT | INFRASTRUCTURE: TRANSPORTATION, CAPITAL FACILITIES AND UTILITIES IMPLICATIONS |
| **Precipitation →**<br><br>*changing patterns and extremes, longer duration, and greater intensity* | • Changing patterns have the potential to cause inundation and localized flooding, chronic flooding, non-infiltrated runoff, erosion and landslides, which will affect the proper functioning of local infrastructure and the provision of utilities (including stormwater inundation and localized flooding, more frequent power outages as transmission lines are compromised, and structural damage to critical facilities from erosion and landslides).<br>• Predicted "storminess" includes the potential for more wind storms, which increases the risk of power outages and disruption to the provision of other utilities.<br>• Drought and flood will cause alterations to the wildfire hazard risk, necessitating increases in fire department services and infrastructure and potential costs associated with land management to prevent wildfire.<br>• Sanitary sewers and community/private septic systems will be impacted by both heavy precipitation and low-flow drought events.<br>• New infrastructure (capital projects) may be needed to remedy system failure or capacity.<br>• More rain or extreme storms may lead fewer people to use non-motorized transportation; the desirability of the bike/walker culture may be affected. This shift would increase greenhouse gas emissions, degrade local air quality and increase Island ground-level ozone. It may also impact demand patterns for other modes. |
| **Temperature →**<br><br>*more extremes and prolonged summer highs* | • Increases and seasonal changes will increase the frequency and duration of droughts, leading to increased demand for water. New infrastructure may be needed to remedy system failure or increase capacity (capital projects).<br>• As temperatures increase and there are longer drought periods, there is an increased risk of wildfire, necessitating increases in fire department services and infrastructure and potential costs associated with land management to prevent wildfire.<br>• Longer seasons, hotter hots and colder colds will change energy demand from what it is today and may change the availability of certain types of energy. Additional and differentiated energy sources may be needed and will result in capital projects and costs, as well as new or expanded infrastructure.<br>• Excessive or prolonged heat degrades infrastructure more quickly, necessitating increased maintenance budgets for repairs and replacements (thermal stress).<br>• Smog-related air quality hazards may increase.<br>• The desirability of the bike/walker culture may be affected and more extreme temperatures (colder colds, hotter hots) may lead fewer to use non-motorized transportation (thus increasing greenhouse gas emissions, degrading local air quality and increasing Island ground level ozone). This may also impact demand patterns for other modes. |
| **Sea Level Rise →**<br><br>*Projected Mean:*<br>*2030: +2.6 in. (+/- 2.2 in)*<br>*2050: +6.5 in. (+/- 4.1 in)*<br>*2100: +24.3 in. (+/- 11.5 in)* | • Coastal zone resources and shoreline stability are likely to be compromised by rising seas.<br>  o Outright loss of floodplain and other critical habitat area will result from inundation of today's shoreline and low-lying areas.<br>  o Roadways can be undermined by shoreline instability, land loss, and inundation.<br>  o Dock and harbor infrastructure will be compromised by rising seas, necessitating increased maintenance, retrofitting or replacement.<br>• Saltwater intrusion can affect groundwater and drinking water supply of the Island.<br>• Water quality can be affected by saltwater inundation of sanitary sewer and septic systems or untreated stormwater runoff.<br>• The efficacy of the Shoreline Management Plan will be affected if it too doesn't adapt to sea level rise. |
| **Vegetation changes →**<br>*shifts will occur in habitat suitability as a factor of changing temperature and precipitation* | • Long-term temperature and precipitation trend changes will cause shifts in vegetation and habitats on the Island. (If these changes occur in transportation corridor buffers, they could impact roadways (brush fires, deadfall, water flow, etc.)<br>• There is the potential for deadwood and detritus as die-off occurs, which will increase the fuel load and risk for wildfires.<br>• Energy demand for heating and cooling will increase if the percentage of tree-cover/canopy changes over time. |

| Table 5. Infrastructure Implications from Climate Change | |
|---|---|
| CLIMATE IMPACT | INFRASTRUCTURE: TRANSPORTATION, CAPITAL FACILITIES AND UTILITIES IMPLICATIONS |
| **Slope Stability →** *Sea level and precipitation pattern changes will compromise once stable slopes* | • Loss or change of vegetation, precipitation patterns, and rising sea level may affect slope stability near and under roadways or other infrastructure, causing structural failure and necessitating repairs. |
| **Ocean Acidification →** *decreasing pH of the waters of Puget Sound* | • Ocean acidification may compromise stormwater and sewage discharge compliance, making capital projects necessary. |
| **RELEVANT NON-CLIMATE DATA THAT MAY AFFECT THE GOALS OF THIS ELEMENT** | |
| **Population changes →** *account for anticipated increase or decrease due to climate refugees* | • It is uncertain whether climate changes will lead to increased or decreased population on-Island:<br>◦ Increases in population will place increased demands and stress upon all capital facilities and utilities across the island, including requiring additional transportation infrastructure; and<br>◦ Reductions in population may affect abilities to provide cost-effective public modes. |
| **Transportation projections, TIP projects, other proposals →** *vehicle miles traveled contributes to greenhouse gas emission* | • All future transportation projects will have impacts related to Island air quality and local greenhouse gas emissions. Know what new contributing sources may arise, and what to do about them. Projects including those that take cars off the road, decrease idling, improve and increase non-motorized use and access, or use and develop alternative/green fuels use will help mitigate future climate change by decreasing emissions. |

### Questions to Consider for Infrastructure Adaptation

The implications identified in Table 5 should make it obvious that responsible infrastructure development or commitment of resources should be considered through a lens of these changes. In order to responsibly provide durable infrastructure, climate vulnerability should be fully understood. We should ask:

1. Will future climatic conditions prevent existing or proposed infrastructure from working as expected?

2. How do current **precipitation** patterns affect infrastructure on the Island? As precipitation patterns are altered, how will they impact local infrastructure?
   - What effect would an increase in intensity of rainfall/storminess have on Island infrastructure?
   - What effect would periods of drought have on island infrastructure?
   - Are we prepared to respond and recover from infrastructure failures that may result from "storminess"? (E.g., too wet and too dry are both conditions under which septic systems fail.)
   - Does precipitation cause any transportation impacts, including delays or changes in levels of service, street flooding, changes in commuting/mobility patterns? (e.g., if it's rainier do fewer commuters bike and more drive instead?)
   - Are Low Impact Development stormwater management techniques sufficiently addressing concerns? Are they being used? Are they sufficient as designed? Do they need to be updated?

3. Are there currently any seasonal/temperature related impacts to Island infrastructure? If average seasonal **temperatures** were to shift, how might it impact our infrastructure?
   - Do isolated high-heat or cold days affect our infrastructure?
   - Are our capital facilities designed to function efficiently under altered temperature scenarios?
   - Can the community absorb increased costs of heating and cooling?
   - Can we provide adequate energy to meet those needs?
   - Do temperatures affect transportation patterns, e.g. fewer bikers and walkers?

4. How do sea level and associated conditions (high tides, inundation and frequency) impact the Island today? Would **sea level** changes impact infrastructure?
   - What community facilities and infrastructure are in places that may experience inundation or storm surge?
   - Which community facilities and infrastructure may experience functional impairment due to sea level rise or storm surge?
   - Are there transportation systems, locations, levels of service, or patterns that are affected by coastal conditions? Do current tides have an impact?

5. How does existing vegetation affect infrastructure and utilities today? Will shifts in **vegetation** composition (die-off, migration, new species) impact infrastructure and utilities?
   - As temperature and precipitation patterns change (more frequent and prolonged drought), the risk of wildfire may increase. What actions should be taken now to

prepare for this future risk? Does this involve capital projects and/or increases in public safety infrastructure?
    - Is it important to identify infrastructure and utilities that are located in or near wildfire risk areas?
    - What are our fire abatement techniques and what are the possible implication of these actions given climate change (e.g., use of chemicals, need for water, vegetative management)?

6. Does the community know where its vulnerable infrastructure is located? Is it likely that today's problems will be exacerbated by climate changes? Will stable infrastructure become vulnerable?
    - Do we know where our high hazard/vulnerable areas are and what critical facilities and infrastructure lie within that area? What infrastructure may be located in a future hazard area?
    - Can we create a "watch list" for infrastructure that already exhibits climate vulnerability? Which facilities or systems are likely to become more vulnerable under future conditions (some may even become less problematic)?
    - Does the City participate fully in ongoing hazard mitigation planning processes and utilize those findings in their land use, capital facilities, and economic development planning?
    - Are we ensuring that any active hazard identification and vulnerability assessment work includes climate change and its implications as hazards?
    - If we do allow infrastructure development in high-hazard areas, should we require bonding of the property by the developer (even if the "developer" is the City) to avoid future cost to the community that may be incurred by the risky development?

7. Are there local mechanisms that Bainbridge Island should employ now to diversify the provision of energy in the future?
    - Can the City do anything to act in advance of the fact that climate change may dictate significant cost structure changes and supply issues that are yet unknown and necessitate the need to abandon fossil fuel use and turn to renewables?

8. What mechanisms can the City use to address any climate vulnerability identified in our infrastructure? How can we require infrastructure investments that are designed to function in future climate scenarios?
    - Can any changes be made to the local building code and design requirements?
    - Can we create a "climate-secure certification process" whereby infrastructure must demonstrate consideration of present and future conditions and increased climate vulnerability in any capacity calculations, studies, siting, and permit approvals? Such a process could require inclusion of future projected conditions/climate scenarios to understand future resource conditions, including groundwater recharge rates, stormwater runoff calculations, supply conditions, location within a vulnerable area, and sustainable power supply.

9. Does our community prioritize alternatives to fossil fuel based systems, thereby acknowledging and demonstrating through action that our transportation and utility infrastructure can play a role in climate change mitigation?

- Is COBI doing all it can and should to support and plan for non-greenhouse gas emitting transit?
- Is COBI developing infrastructures for low carbon, alternative green energy based fuel systems?
- Are we supporting and enabling Low Impact Development techniques and green transportation infrastructure sufficiently and without unnecessary barriers?

10. Does our community prioritize actions within the Non-Motorized Transportation Plan to help address climate change?
    - Are there potential climate impacts to non-motorized infrastructure that will diminish its durability?

## Economic Development

Clearly, not all consequences of climate change are environmental, and impacts to the environment are not without ramification to our cities and economy. "Potential costs to Washington families, businesses and communities are projected to reach nearly $10 billion per year by 2020 if Washington state and other states and nations fail to drive reductions in climate-changing greenhouse gas pollution" (WA Department of Ecology, n.d.d website). Potential costs to Washington economies include lost natural water storage from snowpack decline, increased public health costs, reduced salmon populations, increased energy costs, increased wildfire costs, lost recreation opportunities, coastal and storm damage, reduced food production and increased infestation of pests in forests. Additionally, one close to home example of economic impact is to Washington's shellfish industry, which leads the nation in the production of farmed oysters, clams and mussels. Even by 2011, shellfish producers in Washington had already experienced declines in oyster production, due at least in part to the increasing acidity of our marine waters due to increased carbon dioxide in our atmosphere from the combustion of fossil fuels (WA Department of Ecology, n.d.d website). Conditions are not getting any better.

The Comprehensive Plan gives Bainbridge Island an opportunity to address future economic challenges from climate change and to plan for economic strength and diversity. Climate adaptation strategies and policies can bring about economic benefit, and other communities are beginning to recognize this and act. This is not a new idea, and is being done around the country by forward-thinking, climate-savvy communities. The Metropolitan Council of Minnesota (mentioned above as an energy leader) is encouraging planning for climate change in local plans, and states within their Local Planning Handbook that "[a] diverse local economy that strategically uses local resources is less vulnerable to economic volatility and regional or global recession. Minimizing exposure of city budgets to the risk of property value fluctuations or development cycles will help cities be better prepared for circumstances beyond normal operations…" (Metropolitan Council 2016). Consider actions taken by the City of Lancaster, Calif., to create economic incentives by decreasing local power costs with renewable power generation (City of Lancaster website). Bainbridge Island can position itself for a sustainable economic future by working toward energy efficiency and renewable energy programs.

There is a clear link to be understood between climate and economy. See Table 6, Economic Implications from Climate Change, to determine what future climate related changes will affect our local economy.

Table 6. Economic Implications from Climate Change

| CLIMATE IMPACT | ECONOMIC IMPLICATIONS |
|---|---|
| **Precipitation →**<br>*changing patterns and extremes, longer duration, and greater intensity* | • Changing patterns have the potential to cause stormwater inundation and localized flooding, chronic flooding, non-infiltrated runoff, erosion and landslides. This will affect the proper functioning of local infrastructure and lead to degraded water quality and local environments. All island residents, businesses and governments depend on the proper functioning of these systems.<br>• Water supply may be reduced, which will likely increase the cost of water for all users.<br>• Floodplain protection may need to increase and current floodplain delineations may become inaccurate, leading to additional insurance costs for businesses, residents, and local government.<br>• Changes in seasonal streamflow will affect native fish and fisheries.<br>• If tourism is largely weather-dependent, changes in precipitation patterns may result in changes in tourism numbers and patterns. |
| **Temperature →**<br>*more extremes and prolonged summer highs* | • Increases and seasonal changes will increase the frequency and duration of droughts.<br>• Increases and seasonal changes will affect the costs associated with indoor climate control, leading to higher costs for heating or cooling.<br>• Changes in growing seasons will affect commercial agriculture and recreational gardening, as well as associated businesses.<br>• Increased demand and rising costs for water will result from drought, lower flows, etc.<br>• Thermal stress will affect local habitats, and also local fisheries.<br>• If tourism is weather-dependent, changes in temperature patterns may result in changes in tourism numbers and patterns. |
| **Vegetation changes →**<br>*shifts will occur in habitat suitability as a factor of changing temperature and precipitation* | • Long-term temperature and precipitation trend changes will cause shifts in vegetation and habitats on the Island.<br>• Agricultural operations and recreational gardeners will need to adapt to changes in crop suitability and species tolerance.<br>o Changes in production costs, output and composition may result in higher food prices.<br>o Changes in recreational gardening needs may boost related business, but may also increase resources required.<br>• If canopy and/or ground cover change, it could lead to altered energy needs for indoor climate control. |
| **Sea Level Rise →**<br><br>*Projected Mean*<br>*2030: +2.6 in. (+/- 2.2 in)*<br>*2050: +6.5 in. (+/- 4.1 in)*<br>*2100: +24.3 in. (+/- 11.5 in)* | • Coastal zone resources and shoreline stability are likely to be compromised by rising seas. Outright loss of floodplain and other critical habitat area will result from inundation of today's shoreline. Water dependent uses will be adversely affected.<br>• Saltwater intrusion can affect the groundwater and drinking water supply of the Island – affecting costs and availability for all water consumers.<br>• Water quality can be affected by saltwater inundation/flooding of sanitary sewer and septic systems.<br>• Shoreline infrastructure (docks, piers, drainage systems, roads) will be negatively affected, resulting in costs for repair, maintenance, retrofitting, and loss of use.<br>• Changes in the coastal zone translates to changes in costs for coastal property owners (insurance, maintenance, loss of use). |
| **Slope Stability →**<br>*sea level & precipitation pattern changes may compromise once stable slopes* | • Erosion of slopes can cause loss and damage to facilities and infrastructure. |
| **Ocean Acidification →**<br>*Decreasing pH of the waters of Puget Sound* | • Changes will occur in local fisheries (recreational and commercially viable).<br>• Ocean acidification may affect the cost of sewage and stormwater treatment due to changes required to maintain compliance with discharge permits). |
| RELEVANT NON-CLIMATE DATA THAT MAY AFFECT THE GOALS OF THIS ELEMENT | |
| **Population changes →**<br>*account for anticipated increase or decrease due to climate refugees* | • Increases in Island population could place increased demands and stress upon all economic and environmental resources. |

### Questions to Consider for Economic Adaptation

The implications identified in Table 6 should make it obvious that economic sustainability depends on creating a flexible and durable economy in the face of climate change. In order to comprehend the climate vulnerability of the economy and to plan future resilience, we should ask:

1. Do current precipitation patterns affect our economy, and what will happen if precipitation patterns change? Consider the economic impact of:
   - increasing costs associated with water, food, transportation and energy;
   - precipitation on tourism;
   - increased risk of flooding, storm damage, wildfire (other impacts); and
   - changes in precipitation (more flood-prone areas, more frequent flooding events) and that effect on business costs (maintenance, insurance, continuity of service).

2. Do current average seasonal temperatures affect our local economy and what will happen if temperature patterns change? Consider the economic impact of high-heat or cold days and longer seasons:
   - will they have an effect on our economy and the resources that drive it;
   - will they affect personal and business operations and expenses (changes in energy needs, increased cost of water); and
   - does the weather affect tourism? Should we care?

3. Do sea level and associated conditions (high tides, inundation, etc.) affect the Island today?
   - If sea level rise affects our coastal zone and nearshore environmental resources, will this affect our local economy (consider shellfish production, boating infrastructure, homes, businesses, transportation, etc.)
   - Does sea level affect proper functioning of drinking water wells, sanitary sewers, septic systems, and stormwater drainage? And how would failures compromise the Island's economy (unanticipated expenses to business, government and taxpayers)?

4. Are there sectors of our local economy that are based on today's climatic conditions? Consider:
   - economic implications of losing/lessening value of working waterfronts/shorelines;
   - effects that will occur locally as the growing season changes;
   - agriculture/aquaculture (crop suitability, including species tolerance, water, pests);
   - water dependence (use of in processing, proximity to); and
   - tourism (an important local economic factor).

5. Do we understand our climate-economy link (at the global, regional, and then local scale)?
   - Is the Bainbridge Island economy vulnerable to changes elsewhere (e.g., supply locations for food and other products, transportation corridors)? Can we take action locally to reduce these vulnerabilities?
   - Will changes on Bainbridge Island affect people elsewhere? For example, will we receive and accommodate tourists at desired levels?
   - Is there local support for the long-term sustainability, including extreme weather event recovery, of local businesses?

6. Does local economic policy support an economy that is based on business that will help reduce community vulnerability to climate change (e.g., those that prioritize increased efficiency of resource use such as water and energy, promotion of sustainability elements, adaptable businesses as conditions change)?

7. Does the Island discourage a local economy that is vulnerable to climate change by avoiding businesses that will exacerbate community vulnerability (e.g., excessive water dependence, harmful land use change, transportation dependence, high greenhouse gas emissions, and high energy use)?

8. Are we encouraging use of durable assets (natural elements, renewable resources) in development of economy and community?

### Housing

Housing is a basic human need that must be affordable and accessible to everyone. Changing climatic conditions have the potential to greatly affect Bainbridge Island housing stock, particularly in terms of location within vulnerable areas and energy efficiency of its basic design. The Comprehensive Plan Housing Element gives us an opportunity to address both adaptation and mitigation in our housing decisions. Climate mitigation (reducing greenhouse gas emissions) will be affected by increases in sustainable and green building design that improve efficiency and lower consumption (less water and energy use, less need for heating and cooling through improved insulation, energy efficient appliances, alternative energy access, drought-tolerant plantings), as well as transportation patterns associated with location of housing (locations closer to non-motorized and public transit corridors could decrease emissions). In the future, sustainable design and access to non-motorized and public transit will help homeowners adapt to rising costs of resources because they will need to consume less.

Planning for an adaptive housing stock would also require development of affordable housing that remains affordable over time. If homes are not energy efficient under future climate scenarios, affordability may not be lasting, or it may pass costs onto future inhabitants. Similarly, adaptive housing should be located in areas associated with non-motorized and public transportation, providing residents with climate-savvy choices.

Location of housing within a known or projected hazard area is a true indicator of vulnerability. Just as we should consider the location of a home within a known or potential future floodplain or tidal inundation zone, we should understand its susceptibility to other climate related hazards as well. For example, wildfire is a hazard that already exists on the Island, has the potential to affect housing stock, and may increase over time as temperature and precipitation patterns change. Bainbridge Island experiences vegetation fires every year; from 1989-2009 there were 454 reported vegetation fires (BIFD 2012). Identifying the vulnerability of the existing housing stock to wildfire involves mapping wildfire risk areas and locating the wildland-urban interface (WUI). WUI is something that Bainbridge Island homeowners should be aware of, and homeowners should know their risk (Luke Carpenter, BIFD, Pers. Comm., April 29, 2016).

See Table 7, Housing Implications from Climate Change, to determine what future climate related changes will affect housing.

Table 7. Housing Implications from Climate Change

| CLIMATE IMPACT | HOUSING IMPLICATIONS |
|---|---|
| **Precipitation →**<br><br>*changing patterns and extremes, longer duration, and greater intensity* | • Changing patterns have the potential to cause stormwater inundation and localized flooding, chronic flooding, non-infiltrated runoff, erosion and landslides, which have the potential to affect the proper functioning of local infrastructure and to lead to degrading water quality and local environments. Development and design standards should accommodate future conditions to avoid failure, as well as increased maintenance, repair and other associated costs to homeowners and the community.<br>• Drought and flood will cause alterations to the wildfire hazard risk and affect housing stock at the wildland-urban interface.<br>• Floodplain protection may need to increase, and current floodplain delineations may become inaccurate. Be sure not to locate new housing in future hazard zones.<br>• Localized flooding and heavy rains can affect low quality, older, or poorly located housing stock. |
| **Temperature →**<br><br>*more extremes and prolonged summer highs* | • Increases and seasonal changes will increase the frequency and duration of droughts.<br>• As temperatures increase and there are longer drought periods, there is an increased risk of wildfire (conflicts at the wildland-urban interface).<br>• Local temperature fluctuations and new seasonal averages will affect energy use and a home's ability to maintain a stable, habitable climate in an affordable way.<br>• Local and regional greenhouse gas emissions may increase due to rates and types of home heating/cooling energy consumption. |
| **Sea Level Rise →**<br>*Projected Mean*<br>*2030: +2.6 in. (+/- 2.2 in)*<br>*2050: +6.5 in. (+/- 4.1 in)*<br>*2100: +24.3 in. (+/- 11.5 in)* | • Coastal zone resources and shoreline stability are likely to be compromised by rising seas. Outright loss of land can occur. Housing stock may be vulnerable. |
| **Slope Stability →**<br>*Sea level and precipitation pattern changes will compromise once stable slopes* | • Housing stock located on coastal and inland slopes may be in danger if instability develops or increase. |
| RELEVANT NON-CLIMATE DATA THAT MAY AFFECT THE GOALS OF THIS ELEMENT | |
| **Population changes →**<br>*account for anticipated increase or decrease due to climate refugees* | • Increases in Island population will place increased demands and stress upon all types of housing stock. |

### Questions to Consider for Housing Adaptation

The implications identified in Table 7 above make it clear that the provision of durable and/or affordable housing can be adversely affected by changing climatic conditions. As community housing decision are being made, the following questions should be asked:

1. If precipitation were to increase or decrease, how would it affect our housing stock? How do current precipitation patterns affect housing?
   - How does precipitation and "storminess" affect infrastructure related to housing? Will changes in precipitation have an impact on sanitary sewers, septic systems, and stormwater drainage? How do the proper functioning of all these systems affect the Island's housing stock and affordability?

2. If average seasonal temperatures are altered, would it affect our housing? Are there currently any seasonal/temperature related impacts on housing?
   - Do isolated high-heat or cold days have an effect on housing? What will happen if patterns change?
   - Does the community support and employ energy efficiency measures? (Future conditions may necessitate them even more – retrofits and upgrades are expensive.)
   - Is affordability affected by temperature extremes?

3. If sea level were to rise, would it affect our housing stock? How do sea level and associated conditions (high tides, inundation, etc.) affect Island homes today?
   - Should we continue the permitting of housing in high-hazard areas without requiring a climate assessment and analysis of the resilience of the house and its systems into the future?
   - If we do allow building in high-hazard areas, should we require bonding of the property by the developer to avoid future cost to the community that may be incurred by the risky development?

4. Do we understand the connections between climate impacts and housing affordability?
   - Are there some climate-vulnerable locations on-island that should be recognized as unsuitable for affordable housing?
   - Should the community acknowledge that climate vulnerability could cancel out the intended affordability (i.e., avoid locations susceptible to systems failure due to changing climate or show a preference for locations where alternative energy is more easily accessed)?
   - Should affordable housing be co-located with access to non-motorized and public transit corridors (thereby also making transit affordable, and reducing further greenhouse gas emissions)?

5. Are lands vulnerable to wildfire known and what is the area of interface with developed areas/housing stock?

6. Are we supporting and enabling low-impact development techniques and residential green infrastructure sufficiently and without unnecessary barriers? Are we incentivizing it?

7. Are there state or local "green" residential building requirements that can be employed on Bainbridge Island to reduce energy demand and water consumption?

8. Does COBI utilize any regulations and incentives to ensure the long-term durability and efficiency of its housing stock?

9. Should priority and incentives be given to housing development near non-motorized and public transit corridors?

### Social Services (inclusive of human services and cultural resources)

The health, safety, welfare and quality of life of Islanders should be the priorities for our local government. By electing to include the optional elements of human services and cultural resources in the Bainbridge Island Comprehensive Plan, the City has an opportunity to raise awareness about the connection between land use planning and long-term community resilience. They also have the opportunity now to address the connection between climate change and long-term community resilience.

Fostering a healthy community (both physically and mentally) will serve to increase local adaptive capacity as systems change and become strained. For example:

- planning for a sustainable local food system can insulate us locally from fluctuations in global food or fuel prices or long periods of drought in other areas;
- increasing conservation measures in housing stock and increasing walkability can strengthen our population and reduce local dependence on fossil fuel;
- education about climate change and its impacts on health, safety and welfare should be undertaken now so that our future citizenry is prepared for the climate-changed future; and,
- climate migrations to our area can occur such that social service providers could be stretched beyond capacity.

As regional and international systems are stressed by climate change, our local systems will be better positioned to provide basic human needs if the community makes climate-savvy choices now.

According to the 2004 COBI Cultural Resources element, the general purpose of the element is to link community cultural planning to large community issues — all shape the quality of life on Bainbridge. Also, according to the element, arts and humanities are tools for accomplishing larger community goals such as economic vitality, quality education, and community planning and design. Climate change is certainly a large community issue; therefore the cultural resources element can be applied to matters of education and awareness of its impacts and implications. Additionally, existing cultural resources can be vulnerable to changes on the ground. For example, sea level rise and slope stability may threaten art and artifacts in the coastal zone. It may be necessary for the Island to assess and locate art/artifacts and determine their climate vulnerability.

See Table 8, Cultural and Human Services Implications from Climate Change, to determine what future climate related changes may affect these planning areas.

Table 8. Cultural and Human Services Implications from Climate Change

| CLIMATE IMPACT | CULTURAL AND HUMAN SERVICES IMPLICATIONS |
|---|---|
| **Precipitation →**<br><br>*changing patterns and extremes, longer duration, and greater intensity* | • Changing patterns have the potential to cause inundation and localized flooding, chronic flooding, non-infiltrated runoff, erosion and landslides, which have the potential to affect the proper functioning of local infrastructure and lead to environmental degradation. Localized flooding and heavy rains can disproportionately affect low quality, older, or poorly located housing stock and increase costs for maintenance and repair.<br>• Predicted "storminess" includes the potential for more wind storms, which increases the risk of power outages and disruption to the provision of other utilities. This can impact the provision of fair and equitable distribution of basic human services.<br>• Sanitary sewers and community septic systems will be impacted by both heavy precipitation and low-flow drought events. New infrastructure may be needed to remedy system failure or capacity (capital projects). Rising costs may impact the equitable distribution of basic human services. |
| **Temperature →**<br><br>*more extremes and prolonged summer highs* | • Higher temperatures and seasonal changes will increase the frequency and duration of droughts leading to increased demand for water. Water shortages and/or increased costs for supply may result. Water as "an essential life need," should be a concern of the human services element.<br>• As temperatures increase and there are longer drought periods, there is an increased risk of wildfire. Cultural resources and human service providers may be affected.<br>• Stress and changes to agriculture and food production systems may result from changes in the growing season caused by increasing temperatures. |
| **Sea Level Rise →**<br><br>*Projected Mean*<br>*2030: +2.6 in. (+/- 2.2 in)*<br>*2050: +6.5 in. (+/- 4.1 in)*<br>*2100: +24.3 in. (+/- 11.5 in)* | • Coastal zone resources and shoreline stability are likely to be compromised by rising seas. Outright loss of shoreline lands may result from inundation. Coastal art and artifacts may be vulnerable. Human service facilities may be vulnerable.<br>• Saltwater intrusion can affect groundwater and drinking water supply and result in water shortages. Water quality can be affected by saltwater inundation/flooding of sanitary sewer and septic systems. Water as "an essential life need," should be a concern of the human services element. |
| **Vegetation changes →**<br><br>*shifts will occur in habitat suitability as a factor of changing temperature and precipitation* | • Long-term temperature and precipitation trend changes will cause shifts in vegetation and habitats on the Island, which will impact agricultural operations and recreational gardeners alike, both of which will need to adapt to changes in crop suitability and species tolerance.<br>• Changes in agriculture production costs, output and composition may result in higher food prices. |
| RELEVANT NON-CLIMATE DATA THAT MAY AFFECT THE GOALS OF THIS ELEMENT | |
| **Population changes →**<br>*account for anticipated increase or decrease due to climate refugees* | • Increases in Island population will place increased demands and stress upon all human services. |

### Questions to Consider for Social Services Adaptation

The implications identified in Table 8 should raise awareness of the fact that the provision of human services and our links to cultural resources that help define us are at risk. In order to comprehend the climate vulnerability of cultural resources and human services on Bainbridge Island we should ask:

1. If precipitation patterns were to increase or decrease, how might they impact cultural resources or human services? How does current precipitation (patterns and amounts) affect them?
   - What would be the effect of an increase in intensity of rainfall/storminess?
   - What would be the effect of increased periods of drought on these community resources?

2. If average seasonal temperatures were to shift, how might they impact our cultural resources or human services?
   - Are there currently any seasonal/temperature related impacts?
   - Do isolated high-heat or cold days impact cultural resources or human services?
   - Can the community absorb increased costs of heating and cooling? Is this a human services issue to consider?

3. How do sea level and associated conditions (high tides, inundation, etc.) impact the Island today? If sea level were to rise how might it impact our cultural resources or human services?
   - Are there stationary cultural resources located within the high-hazard coastal zone?
   - Are there human services or cultural facilities located in places that may be subjected to inundation or storm surge?

4. Population growth places more demands on human services, as does a more stressed, displaced, underprivileged, or under-employed population. Climate refugees or migrations may affect Bainbridge Island, thus increasing the demand for human services. Is there any pre-planning or capacity building that should be undertaken?

5. If food systems become stressed by climate factors, prices will increase, placing stress on lower-income families who are less financially resilient, triggering a need for more services. Is there any pre-planning or capacity building that should be undertaken?

6. As temperature and precipitation patterns change (more frequent and prolonged drought) the risk of wildfire will increase. Are cultural or human service resources and facilities located in or near wildfire risk areas?

7. Can we create a "watch list" of cultural resources and human services that exhibit climate vulnerability? What facilities and systems will be affected as conditions change over time?

8. Is our educational system preparing students for citizenship and employment in a climate-changed future?

## Actions with Real Impact: What We Can Do Now

There are three action steps that should be paramount and undertaken by the City of Bainbridge Island immediately. They are not small or easy steps, but they will begin the adaptation planning process and enable a foundation on which Bainbridge Island has the chance to build a climate-savvy and resilient community. They are:

**Action One:** **Create a Climate Change Task Force.** This involves designation of the leaders, managers and staff that should incorporate climate change and community resilience into their duties. This will enable climate change considerations to be mainstreamed into the actions and decisions of Bainbridge Island into the future.

**Action Two: Develop and require a Climate Assessment Certification (CAC).** This requires evidence that any project proponent has assessed future site/operating conditions and determined climate readiness, including the avoidance of projected vulnerabilities. Such certification should be applied to and required in any City fiscal or permitting decision.

**Action Three:** **Apply your understanding** of how climate change will affect Bainbridge Island. Use the BICIA and Table 9 in particular to support these efforts.

1. **Integrate climate information into our decision-making processes** and continuously update access and understanding of the latest information.
2. **Map all known and future vulnerable areas,** showing overlays/intersections with critical facilities, ecosystems and infrastructure. This visual tool will enable us to apply our understanding of the climate changes that will have a locational effect on Bainbridge Island. Many implications of climate change cannot be mapped, however for those that can be pinpointed they should be made clear.
3. **Track the application and efficacy of climate-savvy actions** in order to modify and update as needed to keep Bainbridge Island on a path to resilience.

By explicitly considering climate change in our local planning and decision-making, Bainbridge Island will be on a path to a resilient future. However, these actions must start today as the decisions we are currently making will set the stage for our ability to respond in the future. An initial suite of implementation recommendations for our community can be found in the following table, Table 9: Adaptation Planning Implementation. We invite the community to waste no time in bringing these actions to life and making Bainbridge Island climate savvy.

Table 9. Adaptation Planning Implementation

| Planning Sector | Main actions in this sector that will effect Mitigation | Main actions in this sector that will support Adaptation | Implementation / Tool Kit Actions *(implementing authorities in addition to COBI are listed in italics)* |
|---|---|---|---|
| Government Operations | | | • Create a **Climate Change Task Force** to oversee and organize climate change preparation and response strategies across the Island. *(BIFD, BIPD, BIMPRD, BISD)*<br>• Develop and require a **Climate Assessment Certification (CAC)**. Such CAC should be required before any fiscal or permitting decision could be final. A CAC would be evidence that any government action, project proponent, fiscal decision, etc. has assessed future climate conditions and determined durability of a choice, including the avoidance of projected vulnerabilities. Criteria for determination are suggested in the planning sector rows that follow here. |
| Land Use | Conserve natural resource lands and ecosystem functions by preventing land conversion to sprawling or incremental development.<br><br>Focus all new growth as infill or compact development.<br><br>Reduce consumption of fossil fuels. | Locate all new growth outside of future hazard prone area.<br><br>Assess any proposed project for its ability to function in the long term under climate change.<br><br>Minimize or avoid potential for future threats to the people, property, environment and economy of Bainbridge Island.<br><br>Utilize all Island-based hazard mitigation planning, shoreline and floodplain management processes, and capital facilities planning to identify and address local climate change concerns. | • Develop and require a **Climate Assessment Certification**. Include criteria for Land Use:<br>o Require use of the *Bainbridge Island Hazard Identification and Vulnerability Assessment* (BIHIVA) and create other local hazard identification processes as tools to determine suitability of a site for development or investment.<br>*(BIFD, BISD, BIMPRD)*<br>• Analyze Floodplain Management Plans and Hazard Mitigation Plans to be sure climatic scenarios are adequate and considered in analysis.<br>• Promote compact development through tax incentives and other tools.<br>• Promote walkability and prioritize multimodal, non-fossil fuel dependent transportation.<br>• Require the use of well-designed ecosystem based Cluster, Open Space Residential Design, or Conservation Subdivision regulations for any residential subdivision on-island.<br>• Create specific climate-informed Low Impact Development regulations and require use in all new or re-development.<br>• Participate fully in the *Kitsap County Multi-Hazard Mitigation Plan* (MHMP) planning and update processes (due to be updated in 2017) and integrate the findings into local decision-making. *(BIFD, Kitsap County Department of Emergency Management, FEMA)*<br>o Work to have Climate Change included as a hazard category in the future MHMP updates (currently climate change is not included as a hazard category in the county's plan).<br>• Participate in the process and fully incorporate climate change hazards into the *BI Hazard Identification and Vulnerability Assessment* (BIHIVA) (to be updated by BIFD in 2016). *(BIFD, FEMA)*<br>• Utilize available land use tools to increase the preservation of land for future |

| Planning Sector | Main actions in this sector that will effect Mitigation | Main actions in this sector that will support Adaptation | Implementation / Tool Kit Actions *(implementing authorities in addition to COBI are listed in italics)* |
|---|---|---|---|
| | | | agriculture, resource migration, open space, and population changes (including an Agricultural Resource zoning classification).<br>• Update and implement the recommendations of the 2008 Bainbridge Island Open Space Study. *(BIMPRD, Bainbridge Island Land Trust)* |
| Transportation | Reduce consumption of fossil fuels.<br><br>Link to land use and reduce sprawling development.<br><br>Prioritize walkability, non-motorized transit and mass transit, and discourage single occupancy vehicle use. | Promote compact development.<br><br>Place transportation infrastructure in locations that will not be affected by climate impacts | • Develop and require a **Climate Assessment Certification**. Include criteria for Transportation:<br>o Require any new transportation infrastructure to be located outside of vulnerable areas (ensure long-term function).<br>o Projects must include non-motorized transportation components such as trailway linkages and walkability, or include impact fees.<br>• Create a structure of impact fees for all development permits.<br>• Fund and implement the Non-motorized Transportation Plan.<br>• Adopt a Transportation Improvement Plan that prioritizes mass transit or, pedestrian, bicycle and other non-motorized modes over single occupancy vehicle use.<br>• Utilize land use regulations and incentives that promote compact, non-single occupancy vehicle-dependent development.<br>• Inventory and create a "Watch List" of vulnerable transportation infrastructure (combine with the list for other community infrastructure).<br>o Create a prioritized plan to relocate or retrofit vulnerable infrastructure. |
| Housing | Increase sustainable and green building design (which reduce energy consumption).<br><br>Prioritize siting in locations that are not motorized-vehicle dependent for access to jobs, education and commerce. | Development of affordable housing should require affordability over time (if not energy-efficient under future climate scenarios, will affordability remain?) | • Develop and require a **Climate Assessment Certification**. Include criteria for Housing:<br>o Location of structures out of vulnerable areas<br>o Use of sustainable building practices<br>o Use of renewable energy and conservation measures/features<br>o Creation of non-motorized transportation corridor connections<br>• Adopt Green Building Codes such as energy- and water-efficient fixtures and appliances, increased insulation requirements, including windows, etc.<br>• Enable use of green roofs, greywater and Low Impact Development methods on site.<br>• Utilize bonds in residential permitting within known hazard areas to cover potential future remediation. |
| Water Resources and Environment | Retain vegetation and tree canopy that serves to enhance the local air and | Plan improvements, source development, and stormwater infrastructure- | • Develop and require a **Climate Assessment Certification** Include criteria for Water Resources and Environment:<br>o Mandate demonstrated consideration of present and future conditions |

| Planning Sector | Main actions in this sector that will effect Mitigation | Main actions in this sector that will support Adaptation | Implementation / Tool Kit Actions *(implementing authorities in addition to COBI are listed in italics)* |
|---|---|---|---|
| | water quality.<br><br>Maintain ecosystem function and ability of systems and habitats to migrate and function over time. | based on future precipitation scenarios.<br><br>Implement supply and demand-side water conservation.<br><br>Protect ecosystems and their buffers.<br><br>Retain vegetation and tree canopy that serves to reduce stormwater runoff, promote ground water recharge and stabilize local climate.<br><br>Pay attention to shifting species in revegetation, restoration and other projects.<br><br>Utilize all compact and Low Impact Development techniques (which reduce impervious and engineered area). | in any water resource calculations, studies, and permit approvals. (Require inclusion of future projected conditions/climate scenarios to understand future resource conditions, including groundwater recharge rates, stormwater runoff calculations, etc.)<br>• Require any water resource data gathering and analysis to include metrics that are sensitive to and identifiable as markers of climate changes.<br>• Continue the Groundwater Monitoring Program and periodically review its program parameters.<br>• Update and reassess the predictive findings of the Groundwater Models prepared for COBI by Aspect Consulting in 2015-2016. Adopt the recommendations of Aspect Consulting for future carrying capacity assessments.<br>• Set no-net groundwater extraction rates to ensure maximized aquifer recharge and to stay below COBI early warning levels (balance the aquifer stressors of increased population and rising demand, decreased recharge from climate change, and rising sea levels).<br>• Require a Hydrologic Assessment Report that includes future climate scenarios for any proposed development projects.<br>• Ensure full protections under the Critical Areas Ordinance, review and revise as necessary.<br>• Adopt Critical Aquifer Recharge Area and Wellhead Protection Regulations.<br>• Adopt Low Impact Development standards and remove regulatory barriers to encourage green infrastructure, which can lessen stress on our natural systems (e.g., to promote on-site water retention/infiltration and slow stormwater runoff rates).<br>• Adopt Lot Coverage Maximums (adjusted to lesser values in aquifer recharge and other sensitive areas).<br>• Develop tree canopy and vegetation retention requirements (balanced with FireWise vegetation-free envelopes). *(BIFD)*<br>• Place importance on ground cover and understory for their water retention capacity.<br>• Enable systems and techniques that reduce energy and conserve resources (e.g., greywater systems, green roofs, use of green energy technology).<br>• Conduct a wildfire vulnerability survey of public lands/interfaces on the island and create a plan for wildfire management. *(BIFD)*<br>• Require drought-tolerant plantings.<br>• City tree planting efforts should require use of species that will persist for expected lifetime. |

| Planning Sector | Main actions in this sector that will effect Mitigation | Main actions in this sector that will support Adaptation | Implementation / Tool Kit Actions<br>*(implementing authorities in addition to COBI are listed in italics)* |
|---|---|---|---|
| Infrastructure[2] | Require utilities to use renewable energy sources.<br><br>Reduce energy use and water use. | Ensure that climate vulnerabilities/variabilities inform infrastructure improvements, or siting and design.<br><br>Ensure long-term return on investments and continued function by not investing in climate vulnerable locations.<br><br>Increase requirements on utility providers for conservation of conventional and conversion to renewable sources of energy. | • Develop and require a **Climate Assessment Certification**. Include criteria for infrastructure:<br>o Demonstrated consideration of present and future climate-vulnerable site conditions in any infrastructure capacity calculations, siting and permit approvals.<br>o Require inclusion of future projected conditions/climate scenarios to understand future resource conditions, including groundwater recharge rates, stormwater runoff calculations, supply conditions, and location within a vulnerable area.<br>• Enable conversion to a utility dependent on renewable energy sources.<br>• Prioritize and develop expedited permitting and funding for infrastructure that will decrease fossil fuel emissions and support adaptation.<br>o Priority given to infrastructure that increases walkability, is located in Winslow or neighborhood service centers, and allows access by multi-modes.<br>o Provide incentives through permitting for use of renewable energy providers and systems.<br>• Identify and map infrastructure that is located within hazard areas and create a "Watch List" of vulnerable infrastructure (combine with the list for transportation infrastructure).<br>o Create a prioritized plan to relocate or retrofit vulnerable infrastructure.<br>• Adopt Low Impact Development techniques and remove regulatory barriers to encourage green infrastructure, which can lessen stress on natural systems. |
| Economy | Support renewable energy development and those that utilize it in their business practices.<br><br>Do not permit location of industry/business on-island | Understand the vulnerability of local systems[3] to climate change and take measures to reduce the potential for exposure, damage and loss. | • Study and identify economic and financial vulnerabilities of the community and how they are likely to be worsened by climate change impacts.<br>• Enable incentives for actions that decrease vulnerability of the local economy.<br>• Employ creative funding mechanisms that support and coordinate citywide action to address climate and hazard mitigation. Develop a steady-state funding mechanism. |

[2] Infrastructure is a category that includes myriad capital facilities and services that a government typically provides to its citizens, including utilities, roads, public buildings, schools, parks, water, sewer & stormwater systems, and first responder services.

[3] Local systems include businesses, tourism, infrastructure, housing stock, transportation – disruption and losses in any of these sectors will negatively affect the local and regional economy.

| Planning Sector | Main actions in this sector that will effect Mitigation | Main actions in this sector that will support Adaptation | Implementation / Tool Kit Actions<br>*(implementing authorities in addition to COBI are listed in italics)* |
|---|---|---|---|
| | that are dependent on or high-volume users of fossil fuel.<br><br>Investment in a food system based on local production and one that is not industrialized and extractive. | Encourage a local economy that is not based on vulnerable resources or sectors that will be compromised by climate change.<br><br>Encourage diversity and independence of the local economy.<br><br>Investment in a food system based on local production that is adaptive to Washington's anticipated climate changes.<br><br>Education about the importance of early awareness and action in order to create resilience. | • Invest in the development of a local food system:<br>o Create an Agricultural Zoning classification.<br>o Use land use tools such as PDR, TDR and tax incentives to preserve farmland.<br>o Incentivize farm practices that employ resource (fuel, water) conservation methods and are not extractive or chemically dependent.<br>o Support markets for local farmers to sell goods locally.<br>• Form partnerships with local organizations and action groups to develop a coordinated public outreach campaign intended to increase community awareness of the issue of climate change in their own lives and on our community's long-term resilience.<br>o Create materials (including online and signage) promoting sustainable features of our community that make us more resilient to climate change, and encourage businesses, patrons and visitors to take their own actions to reduce the effects of climate change.<br>o Engage the local media to ask questions about climate implications in coverage of local planning issues.<br>*(Chamber of Commerce, Downtown Business Association, Sustainable Bainbridge)* |
| Cultural and Human Services[4] | Ensure that services are located and provided such that transportation and energy use are minimized. | Anticipate and be ready to accommodate the rise in demand for the provision of human services if things "get bad" due to climatic changes.<br><br>Education about climate change and the impacts and implications on the health, safety, welfare and future of all to create a ready and adaptive citizenry. | • Develop and require a **Climate Assessment Certification.** Include criteria for cultural and human services:<br>o Create criteria for public cultural and human service projects that ensure they are not vulnerable to climate change.<br>• Create incentives for on-island agriculture and disincentives for the conversion of agricultural landscapes to other uses. Recognize the importance of a robust local food production system as a human service.<br>• Incorporate climate change into school curricula to help prepare our students for their careers and citizenship in a climate-changed world. *(BISD)* |

[4] Human services are those that assist people in meeting the essential life needs of food, clothing, shelter and access to health care.

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## Appendix 1: The How and Why to the Bainbridge Island Climate Impact Assessment

### Project Activities

1. Research and general knowledge: This Climate Impact Assessment was informed by published climate data, general research, and expert and community knowledge of the project team.

2. Community Elicitation Workshop: EcoAdapt held a community elicitation workshop on November 18, 2015, in collaboration with the City of Bainbridge Island and Sustainable Bainbridge during which we solicited community input and fostered education about climate impacts and implications that will affect Bainbridge Island. Fifty-five participants attended, representing the general public, state government, local government, local and regional nonprofit organizations, and local businesses.

   Workshop participants were split into teams where they considered each Comprehensive Plan element in the context of climate change data and then determined relevant impacts and the implications those impacts would have on each element's issues. Participants were given planning questions to guide their evaluation of the climate vulnerability of each element, and in turn added their local knowledge and concerns by recording their thoughts and table discussion as follows: individual issue of concern; how they understand climate change to affect their issue of concern; ideas as to how the impact of climate change can be reduced; and how they anticipated that change could happen (such as with partners, funds, regulations, etc.)

   Materials were prepared for use during the process that included:
   - Analysis, depiction, and presentation of the climate science and findings that are specifically relevant to Bainbridge Island and show what climatic changes are expected to affect local ecosystems, and by extension the implications of those impacts on land use planning and related comprehensive planning issues.
   - Briefing documents for each Comprehensive Plan Element were created to inform the participants of Washington State planning requirements, 2004 local goals, specific climate impacts and implications that affect an element, and to prepare them for thought and discussion by providing planning questions to guide evaluation of the climate vulnerability of every element.

   (For a full list of participants and materials see http://ecoadapt.org/workshops/BICIA-workshop).

3. Comprehensive Plan element review: The EcoAdapt project team provided the Planning Commission and city staff continuing input on each element throughout their review and update process (August 2015 through June 2016). This included a thorough reading of each element of the 10 elements through the lens of climate change, and suggested revisions within existing text where it would be appropriate to recognize climate change, future conditions, and the climate impacts on what each element is intended to plan for, protect, and preserve. In other words, advice was given on how to mainstream climate mitigation and adaptation goals, policies, and implementation as appropriate throughout the City's long-term planning

framework. Project team members also provided public comment on this subject at numerous Planning Commission meeting during this timeframe.

### Why did EcoAdapt conduct the BICIA?

Beginning in April 2015, and continuing through December 2016, the City of Bainbridge Island is undergoing an update of its 2004 Comprehensive Plan. This process has provided a golden opportunity to make changes that would improve the community's long-term outcomes. EcoAdapt understands that by planning for its future while recognizing how climatic conditions will be changing, this Island community has chosen to minimize the effects of climate change on its social systems and environmental surroundings.

With ambitions such as sustainability almost ubiquitous in community management, considering the effects of climate change (such as sea level rise, increasing temperatures, changing precipitation patterns) and the responses to them (such as increasing use of water, reduced aquifer recharge, changing vegetation and species ranges, movement of more people into our region) is essential for durability. Considering the implications of such changes in the update of its Comprehensive Plan, Multi-hazard Mitigation Plan and any other planning, and then making it part of policy and management actions is the only way to ensure a sustainable future in the face of climate change.

The need for including climate change in community Comprehensive Plans was called for in the Puget Sound Regional Open Space Strategy (openspacepugetsound.org) Climate Change Challenge paper (openspacepugetsound.org/sites/default/files/151026_ClimateChange.pdf ). Responses to climate change require activities in two areas: adaptation and mitigation. Mitigation is the action we take to reduce the root cause of climate change (greenhouse gas emissions predominantly from burning fossil fuels for electricity generation, heating, and transportation). Adaptation is the action we take to reduce the effects climate change has on the world around us. Effective long-term outcomes require that we do both.

The City of Bainbridge Island has an opportunity to create a Comprehensive Plan that maps out goals and policies that allow for a durable future for the Island. Community members were invited to be part of the Comprehensive Plan process, including making suggestions about how to incorporate climate change. EcoAdapt has created products (Element Briefs) to support individuals and organizations as they think about each component of the Island Comprehensive Plan. Comprehensive Plan elements include: Land Use, Utilities, Transportation, Capital Facilities, Environment, Economy, Culture, Human Resources, Housing and Water Resources – each has considerations for climate change and needs to be considered through a mitigation and adaptation lens during this 2015-16 update process in order to help make Bainbridge Island more resilient.

The City of Bainbridge Island is also proposing, for the first time, to add a Guiding Principle to the Comprehensive Plan specifically highlighting the challenges of and opportunities to address climate change. Creating a Guiding Principle that can truly guide us into the future will be vital to the success of our interpretation and use of the Comprehensive Plan in creating policy and code to guide management and daily decisions by the City. The new Guiding Principle, if adopted, would provide a framework under which the City could make climate-savvy decisions that enable our small island to adapt to whatever climate changes may occur.