



Climate Impacts & Resiliency Study

CITY OF SHORELINE

JUNE 2020

Prepared by Cascadia Consulting Group
and Herrera Environmental Consultants





INTRODUCTION

On July 22, 2019, the Shoreline City Council authorized the City Manager to execute Contract 9360 with Cascadia Consulting Group, Inc. to conduct a Climate Impacts and Resiliency Study (“Study”). Cascadia partnered with Herrera Environmental Consultants, Inc., who provided expertise around stormwater infrastructure and management, hydrological sciences, and spatial analysis. The study was initiated in August 2019 and concluded in June 2020. The study identified climate change impacts and areas of

vulnerability for the Shoreline community, with a core focus on the City’s stormwater system. Educational materials and a mapping tool were developed to communicate climate change-related vulnerabilities for our community and support City staff in increasing resiliency in City projects and operations across all departments. The information gleaned from this study will be used to inform, and help build resiliency features into, future capital projects and planning efforts, including the next Climate Action Plan update.

BACKGROUND

In December of 2018, the Shoreline City Council adopted the 2018 Surface Water Master Plan, which identified the current and future needs of the surface water system within City limits. The master plan identified a need for a Climate Impacts and Resiliency Study to help sustain a successful surface water system under changing conditions. The master plan states that “some areas throughout the City are already prone to flooding, so when planning improvement projects, the City must consider the increase of rainfall that the Puget Sound region is expected to have in the future. Special approaches should be considered to downscale regional climate models and model scenarios depicting extreme events, and to propose resiliency measures.” In sum, this study was a direct response to a need identified in the 2018 Surface Water Master Plan.

CLIMATE CHANGE PROJECTIONS

The consultant developed climate change projections using the latest available climate science information (as of October 2019) from academic literature, research organizations, and other institutions. City-specific projections were not available for all areas of focus, so projections at a regional scale were often utilized.

Climate change projections help us understand how human-caused greenhouse gas (GHG) emissions—the gases from burning fossil fuels like coal and oil for cars, trucks, planes, heating buildings and other activities—affect our global climate. Scientists use complex models to





generate projections, which consider many factors—such as technological advancements, population growth, economic development, and changes in energy sources and land use—that influence global GHG emissions. The models show what might happen in the future based on different scenarios under which GHG emissions increase to different degrees.

Climate change projections were analyzed to understand impacts on temperature (annual, seasonal, and extremes), precipitation (annual, seasonal, and extremes), Puget Sound hydrology (snowpack and streamflows), and sea level rise.

The observed trends and projected changes in climate were summarized in a memo available on the City’s website at: www.shorelinewa.gov/home/showdocument?id=46886. Figure 1 provides the key findings from analysis of climate change projections. The findings suggest that climate change has been occurring for decades and is expected to both increase existing challenges and create many kinds of new challenges in the future. The findings also suggest that key areas of risk for the Shoreline community include increased precipitation and more intense rainstorms, with

associated flooding, increased temperatures, and extreme heat events. Decreasing snowpack and lower summer streamflows in the broader region may also negatively affect the Shoreline community’s potable water supply, which comes from the mountain-fed Tolt and Cedar River watersheds. Risk from sea level rise is relatively low due to steep coastal bluff topography, the scarcity of development directly along the Puget Sound coast, and the BNSF railway acting as a buffer.

Figure 1. Findings from analysis of climate change projections

<p>Temperature</p> 	<p>⬆️ The average year in Puget Sound is currently 1.3°F warmer than historic averages.</p>	<p>By the 2050s (vs 1970-1999 average)</p> <ul style="list-style-type: none"> ⬆️ Average annual temperature in Puget Sound will be 4.2°F to 5.5°F warmer. ☀️ The hottest summer days will be 4.0°F to 10.2°F warmer.
<p>Precipitation</p> 	<p>⬆️ Extreme rain events in Western Washington have increased moderately.</p>	<p>By the 2080s (vs 1980s)</p> <ul style="list-style-type: none"> ⬆️ Annual precipitation in Puget Sound will increase at least 6.4 percent. ⬆️ Rainstorms in Shoreline will be more intense. ☁️ Winters will be wetter and summers drier.
<p>Puget Sound Hydrology</p> 	<p>⬇️ Puget Sound rivers have lower streamflows during the summer, and streamflow peaks earlier in the year, leaving streams drier in late summer and fall.</p>	<p>By the 2080s (vs 1970-1999 average)</p> <ul style="list-style-type: none"> ⬇️ Summer streamflows will be even lower. ⬆️ Flooding risk will increase during the fall, winter, and spring. 💧 The Tolt and Cedar River watersheds (which supply Shoreline’s drinking water) will have less snowpack to source water from.
<p>Sea Level Rise</p> 	<p>⬆️ Sea level has risen 0.8 inches per decade in Puget Sound between 1900-2009.</p>	<p>By 2100 (vs 1991-2001 average)</p> <ul style="list-style-type: none"> ⬆️ Relative sea level in Shoreline will rise 2.0 feet or more, resulting in greater risk of coastal erosion and flooding.

VULNERABILITY ASSESSMENT

The consultant completed an assessment of climate change-related vulnerabilities for the Shoreline community using the four areas of risk identified in the climate change projections memo (temperature, precipitation, Puget Sound hydrology, and sea level rise). The assessment identified, categorized, and prioritized climate change vulnerabilities based on exposure, sensitivity, and adaptive capacity. Figure 2 defines these key components and indicates how they affect vulnerability. Vulnerability was assessed in four sectors across the community, which are listed in Figure 3.

During the vulnerability assessment process, staff from Public Works; Planning and Community Development; Parks, Recreation and Cultural Services; ASD (IT); Community Services; and the City Manager’s Office attended two workshops with the consultant team to refine the scope of the study, review and provide input on initial findings of the climate vulnerability assessment and exposure analysis, and collaboratively prioritize vulnerabilities relevant to the surface water system. This input helped guide development of resilience strategies most relevant for the city.

Figure 2. Defining key components of vulnerability

What is vulnerability?

It is a function of the exposure of a system to impacts from climate change, its sensitivity to those impacts, and its capacity to adapt to prepare for those impacts.







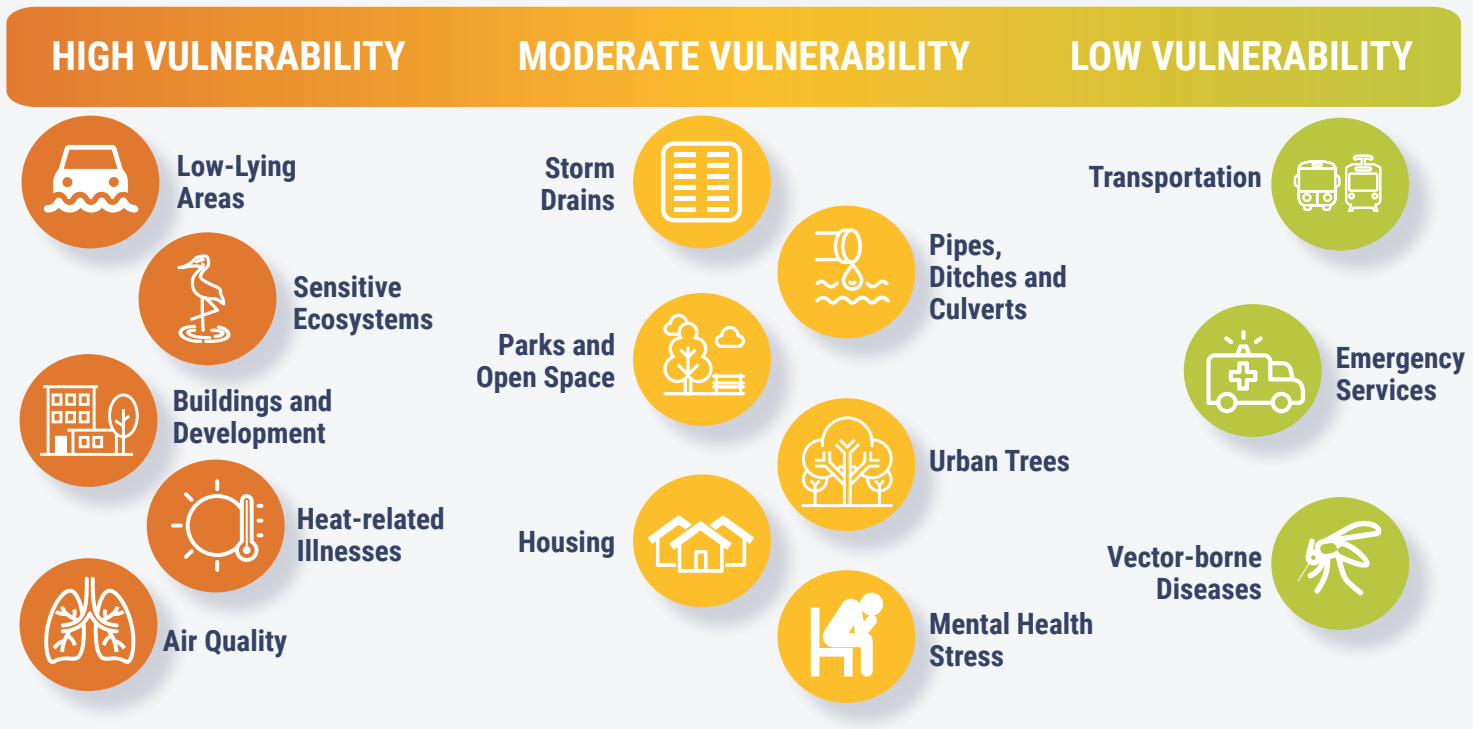
 <p>Exposure</p> <p>The portion of the community in harm’s way due to climate impacts.</p> <p> INCREASES VULNERABILITY</p>	 <p>Sensitivity</p> <p>The degree to which the community is affected by climate impacts.</p> <p> INCREASES VULNERABILITY</p>	 <p>Adaptive Capacity</p> <p>The City’s and community’s actions to prepare for climate impacts.</p> <p> DECREASES VULNERABILITY</p>
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Figure 3. Sectors and systems evaluated in the vulnerability assessment

 <p>Natural Systems</p>	 <p>Parks & Open Space</p>	 <p>Urban Trees</p>	 <p>Sensitive Ecosystems</p>		
 <p>Built Environment</p>	 <p>Housing</p>	 <p>Transportation</p>	 <p>Buildings & Development</p>		
 <p>Stormwater</p>	 <p>Low-lying Areas</p>	 <p>Storm Drains</p>	 <p>Stormwater Pipes, Ditches, & Culverts</p>		
 <p>Public Health, Safety & Emergency Services</p>	 <p>Heat-related Illnesses</p>	 <p>Air Quality</p>	 <p>Mental Health</p>	 <p>Emergency Services</p>	 <p>Vector-borne Diseases</p>

Figure 4 summarizes the high-level findings about areas and the relative magnitude of vulnerability to climate change impacts across the Shoreline community. Detailed results from the assessment are provided in a series of five factsheets available for reference by City staff and the community on the City’s website at: <http://www.shorelinewa.gov/our-city/environment/sustainable-shoreline/climate-water-energy/adaptation-resilience>.

Figure 4. Sector-specific vulnerabilities to climate change in Shoreline



How **climate impacts and related risks** affect **key areas of vulnerability**



More frequent heavy rainstorms



Increased flooding risk



More extreme heat and drier summers



Reduced air quality from heat & wildfire smoke risk



Low-Lying Areas

High vulnerability because low-lying areas are more likely than other parts of the City to be flooded during larger rainstorms, and ways to address these problems are expensive.



Sensitive Ecosystems

High vulnerability due to existing stress from human activities and the complex challenge of restoring natural systems. Wetter winters and hotter, drier summers may further stress wetlands, water bodies, and other ecosystems and the threatened and endangered fish and wildlife that inhabit these areas.



Buildings and Development

High vulnerability due to the need to prevent impacts of higher temperatures and increased flooding risk in the context of redevelopment and a growing population.



Heat-related Illnesses

High vulnerability due to the need for resources to protect residents from exposure to extreme heat. More extreme temperatures may increase risk of heat-related illnesses, especially in areas with more paved surfaces that absorb heat.



Air Quality

High vulnerability due to the need for preventative measures and more treatment for people affected by allergies and wildfire smoke. Warmer temperatures and higher risk of wildfire smoke may cause more pollution and reduce air quality.

CLIMATE IMPACTS TOOL

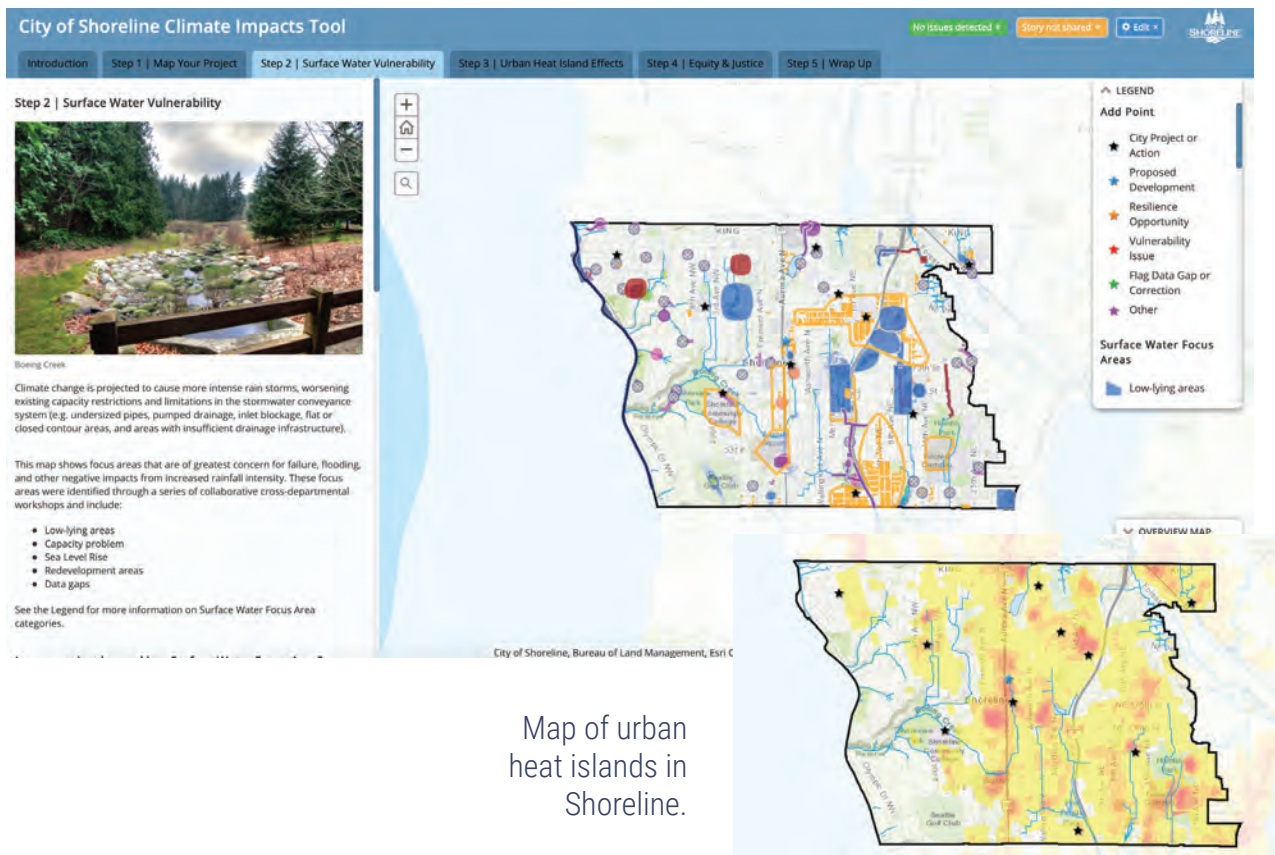
The consultant team drew information from the vulnerability assessment to create a new map-based geographic information system (GIS) tool to help City capital project managers and other staff easily identify current or future areas that are vulnerable to climate change impacts and consider implementing measures to increase resilience to these impacts (see Appendix A).

This tool includes interactive maps with instructions to navigate project managers through a series of steps to address three key topics: 1) Surface Water Vulnerabilities, 2) Urban Heat Island Effects, and 3) Equity and Justice. The tool provides suggestions for adaptive solutions to combat increased rain events and increased

extreme heat events in the City. The tool also provides information about socio-economic data in project areas to help inform project design and community engagement.

The tool was shared with six staff from Public Works for testing. In addition to submitting feedback forms, the testers were invited to a debriefing session to provide additional feedback. This information was used to update the tool to improve its usability and functionality. The tool is expected to evolve over time as Public Works and IT staff needs and resources change in the future. Figure 5 includes static images of the Climate Impacts Tool.

Figure 5. Static images of the Climate Impacts Tool



Map of urban heat islands in Shoreline.

RESILIENCY STRATEGIES

The consultant team used the vulnerability assessment as well as their expertise and best management practices to develop a list of near-term actions (within the next six years) that are focused on building resiliency into the City's stormwater system, as well as increasing resilience of general infrastructure, natural systems, and the overall community. The consultant team also developed an accompanying framework for prioritizing resiliency strategies for Shoreline's unique context based on agreed upon criteria (see Appendix B): effectiveness and impact, ease of implementation, co-benefits, urgency, and equity.

City staff reviewed the suite of strategies and prioritization values and collaborated with the consultant team to revise and finalize the set of prioritized strategies. The high priority resiliency strategies are listed below.

- Require capital facilities planning to consider opportunities to increase resiliency using the Climate Impacts Tool.
- Modify standards for stormwater facility sizing to increase capacity and ensure adequacy of flow control and water quality treatment facilities.
- Modify design standards for drain inlets to increase capacity.
- Build retrofit-focused regional stormwater facilities.
- Revise tree list and green stormwater infrastructure planting requirements to be more resilient.
- Modify urban design standards to ensure development increases city-wide climate resilience.

Master Plan Alignment

Resiliency strategies were evaluated in terms of applicability to City master planning efforts including: Comprehensive Plan; Climate Action Plan; Transportation Master Plan; Surface Water Master Plan; Parks, Recreation, and Open Space Plan; Ronald Wastewater District Comprehensive Plan; and Economic Development Strategy. This analysis will be shared with lead staff for each plan for consideration in future master planning updates (see Appendix C).

Common opportunities for advancing resiliency strategies across master planning processes include:

Proactively collect data and map areas with flooding or other stormwater vulnerabilities and/or urban heat island vulnerabilities when conducting any inventory or data collection for the specific master planning process to improve the City's ability to evaluate stormwater system deficiencies, improve system resilience, and protect critical areas.

Require capital project managers to review near-term planned and proposed projects for their potential to improve surface water issues, reduce urban heat island effects, and/or increase equitable services by using the Climate Impacts Tool.

Construct more green stormwater infrastructure (GSI) through new construction, retrofit programs, and/or policies to include GSI on City projects.

Develop a framework for public and private partnerships that works toward a more resilient city through stormwater management strategies that increase green space, habitat connections, and mobility.

Increase tree plantings of species that will be more resilient to climate impacts in open spaces, parks, along roads and trails, and other areas. Co-benefits include more resilient urban habitat, expanded urban forest canopy, reduced urban heat island effect, and greenhouse gas emissions mitigation.

Consider modifying design standards citywide to ensure that future development increases resilience to climate change.

Climate Change and the City of Shoreline



Introduction

The City of Shoreline's 2013 Climate Action Plan outlined a series of actions to reduce greenhouse gas (GHG) emissions and reduce future climate impacts for the Shoreline community. While we must continue to reduce GHG emissions, we must also prepare our community for climate impacts that are here now and anticipated in the future.

Scroll down to read about how our local and regional climate has changed historically and how it is projected to change in the future in terms of temperature, precipitation, flooding, and sea level rise.

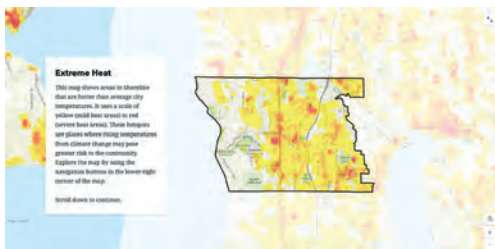
How will climate change impact the City of Shoreline?

Risk	Trends to Date	Projected Changes
Temperature	<ul style="list-style-type: none"> The average year in the Puget Sound region is currently 1.2°F warmer than historic averages. 	<ul style="list-style-type: none"> By the 2050s (vs 1970-1999 average) <ul style="list-style-type: none"> Average annual temperature in the Puget Sound region will be 4.2°F to 6.0°F warmer. The hottest summer days will be 4.0°F to 10.2°F warmer.
Precipitation	<ul style="list-style-type: none"> Extreme rain events in Western Washington have increased moderately. 	<ul style="list-style-type: none"> By the 2080s (vs 1980s) <ul style="list-style-type: none"> Annual precipitation in the Puget Sound region will increase at least 6.4 percent. Rainstorms in Shoreline will be more intense. Winters will be wetter and summers drier.
Puget Sound Hydrology	<ul style="list-style-type: none"> Puget Sound rivers have lower streamflows during the summer, and streamflow peaks earlier in the year, leaving streams drier in the late summer and fall. 	<ul style="list-style-type: none"> By the 2080s (vs 1970-1999 average) <ul style="list-style-type: none"> Summer streamflows will be even lower. Flooding risk will increase during the fall, winter, and spring. The Tolt and Cedar River watersheds (which supply Shoreline's drinking water) will have less snowpack to source water from.
Sea Level Rise	<ul style="list-style-type: none"> Sea level has risen 0.8 inches per decade in Puget Sound between 1900-2000. 	<ul style="list-style-type: none"> By 2100 (vs 1991-2001 average) <ul style="list-style-type: none"> Relative sea level in Shoreline will rise 2.0 feet or more, resulting in greater risk of coastal erosion and flooding.

Urban Heat Islands

Hotter temperatures in a changing climate are especially concerning for urban heat islands. Urban heat islands are areas where roofs, pavement, and other dark-colored hard surfaces absorb heat and cause some areas of a city to be warmer compared to shaded or vegetated areas, like forested parks or surrounding rural landscapes. Urban heat islands are already occurring in Shoreline and many other cities. As temperatures rise under climate change, people, plants, animals, and infrastructure in urban heat islands may be more vulnerable to extreme heat.

Scroll down to see a map of urban heat islands in Shoreline.



Scroll down to read about areas of vulnerability for our community.

CLIMATE IMPACTS & RESILIENCY STUDY

EDUCATIONAL MATERIALS

The consultant worked with City staff to develop public-facing educational materials to communicate areas of climate change-related vulnerabilities and opportunities for increasing resiliency. In addition to the climate change projections memo and sector factsheets, the consultant developed a public story map available at <https://arcg.is/081zPC0>. The story map was designed to communicate the vulnerability assessment results in a simple format and present a high-level overview of the type and magnitude of risk for the community. The story map also highlights a few of the steps the City has already taken to prepare for a changing climate, such as modeling the capacity of the stormwater system to identify weaknesses and areas most sensitive to more rainwater due to climate change and prioritize projects for improvements (e.g., larger pipes).

The story map, factsheets and memo were posted on a new Adaption & Resilience page on the City website and are all available for reference by the Shoreline community at www.shorelinewa.gov/our-city/environment/sustainable-shoreline/climate-water-energy/adaptation-resilience.

NEXT STEPS

The information gleaned from the Climate Impacts and Resilience Study will be used to inform, and help build resiliency features into, future capital projects and planning efforts. City staff will continue to identify how and when to best utilize the Climate Impacts Tool in capital project planning efforts. Educational materials developed during the study will be shared with local educators and with lead staff for City master planning efforts. The vulnerability assessment conducted for this study will also lay a foundation for the City's Climate Action Plan update, which is anticipated to occur in 2021-2022, by providing information on anticipated climate impacts and local vulnerabilities to inform the development of adaptation and resilience-building measures communitywide.

APPENDICES

- Appendix A: Climate Impacts Tool summary
- Appendix B: Recommended resilience strategies
- Appendix C: Resiliency strategies and master plans



Appendix A. Climate Impacts Tool summary



APPENDIX A: CLIMATE IMPACTS TOOL SUMMARY

The new Climate Impacts Tool was developed to help capital project managers easily identify current or future areas of vulnerability related to climate change. This mapping tool identifies areas that are vulnerable to climate change impacts and provides suggestions for adaptive solutions to address three key topics:

- Surface Water Vulnerabilities;
- Urban Heat Island Effects; and
- Equity and Justice.

The tool includes interactive maps with instructions to navigate projects through five steps. The tool also outlines potential resilience measures to combat increased rain events and increased extreme heat events in the City of Shoreline. Details of the five steps in the tool are below.

Step 1 | Map Your Project

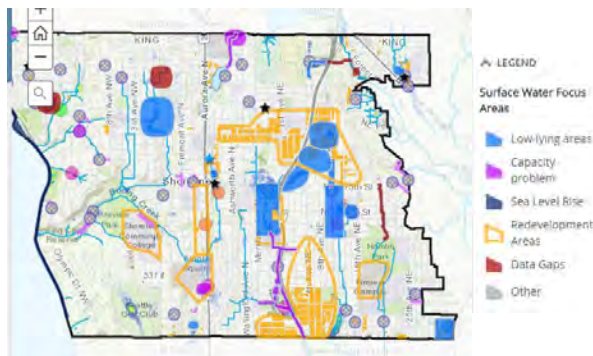
An interactive map allows project managers to add their capital project as a point on the map. This project point is then visible when assessing vulnerabilities and opportunities in subsequent steps.

Step 2 | Surface Water Vulnerabilities

A map shows areas that are of greatest concern for failure, flooding, and other negative impacts from increased rainfall intensity (Figure 1). These focus areas were identified through a series of collaborative cross-departmental workshops and include:

- Low-lying areas;
- Capacity problems;
- Sea level rise;
- Redevelopment areas (i.e. areas that may have more impervious surface in the future); and
- Data gaps.

Figure 1: Surface Water Vulnerabilities



The map also identifies resiliency measures for project managers to consider incorporating into projects to improve surface water management and reduce flooding risks.

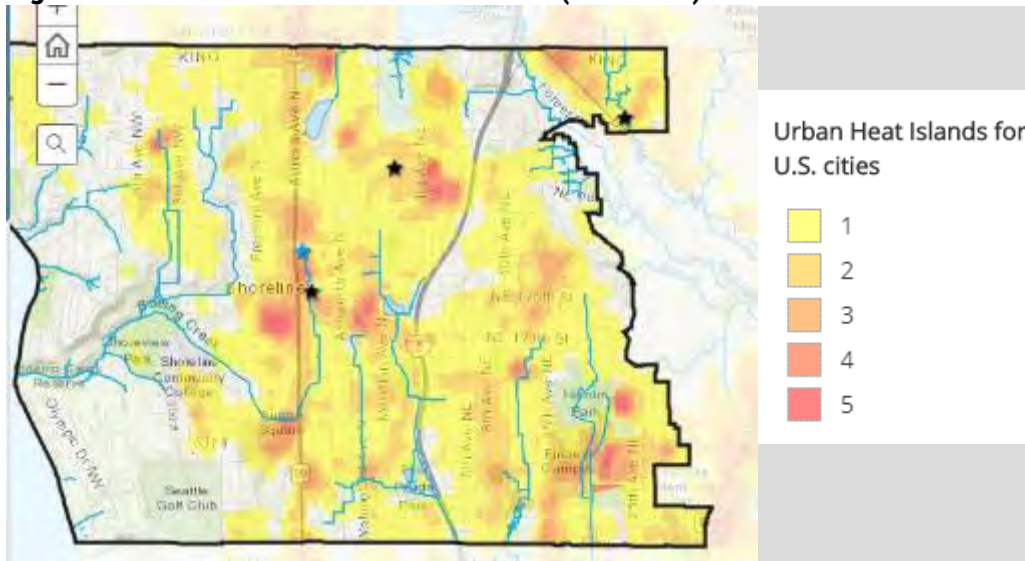
Figure 1: Surface water focus areas in Shoreline. Please note that the stars in all maps in this document represent project sites entered during testing for the tool.

Step 3 | Urban Heat Island Effects

Urban heat islands are areas where roofs, pavement, and other dark-colored hard surfaces absorb heat and cause some areas of a city to be warmer compared to shaded or vegetated areas, like forested parks or surrounding rural landscapes.

This map shows areas in Shoreline that are hotter than average city temperatures (Figure 2). It uses a scale of 1 as a mild heat area (yellow) to 5 as a severe heat area (red). As temperatures rise due to climate change, people, plants, animals, and infrastructure in urban heat islands may be more vulnerable to extreme heat. Some populations that may be more vulnerable to extreme heat include people who are very old or very young, have respiratory illness, work outdoors, or experience homelessness. The map also identifies resiliency measures for project managers to consider incorporating into projects to add shade, reduce surface types that enhance the urban heat island effect, and promote cooling.

Figure 2: Urban heat islands for U.S. Cities (Shoreline).



Step 4 | Equity and Justice Considerations

Climate change impacts will disproportionately affect vulnerable groups in our community. People with existing health conditions, who are very old or very young, or have few social connections may all experience greater physical and mental health impacts from climate change. Equitable climate resilience requires meaningful community engagement and relationship building that should be considered from the very start of a City project.

This map shows equity data from the U.S. Census Bureau’s American Community Survey (ACS) 5-year estimates (Figures 3-7). The map displays data for Shoreline’s census block groups for the following topics to highlight how a project might affect vulnerable and marginalized populations.

- **People of Color:** The population that does not identify as White/Non-Hispanic. This includes: Black, American Indian/Alaskan Native, Asian, Native Hawaiian-Other Pacific Islander, two or more races and the ethnicity grouping of Spanish/Hispanic/Latino. Definition drawn from the Washington Tracking Network.
- **Limited English-Speaking Households:** The percent of households with self-reported limited English-speaking ability, as defined by the ACS.
- **Households with People with Disabilities:** Any household with a self-reported member who has one of six disability types defined by the ACS: hearing difficulty, vision difficulty, cognitive difficulty, ambulatory difficulty, self-care difficulty, and independent living difficulty.
- **Households of One Person 65 Years or Older:** The percent of households with only one person living in it and that person is aged 65 years or older.
- **Median Household Income:** The median annual income on an individual level for all residents in a census block group.

Equity considerations are unique to each project, community, individual, and location, so there isn't a single set of recommendations that will make all projects more equitable. Instead, the map provides a series of questions to help project managers look for opportunities to address equity in their project design, implementation and outreach strategies.

Figure 3: People of color mapping in Shoreline.

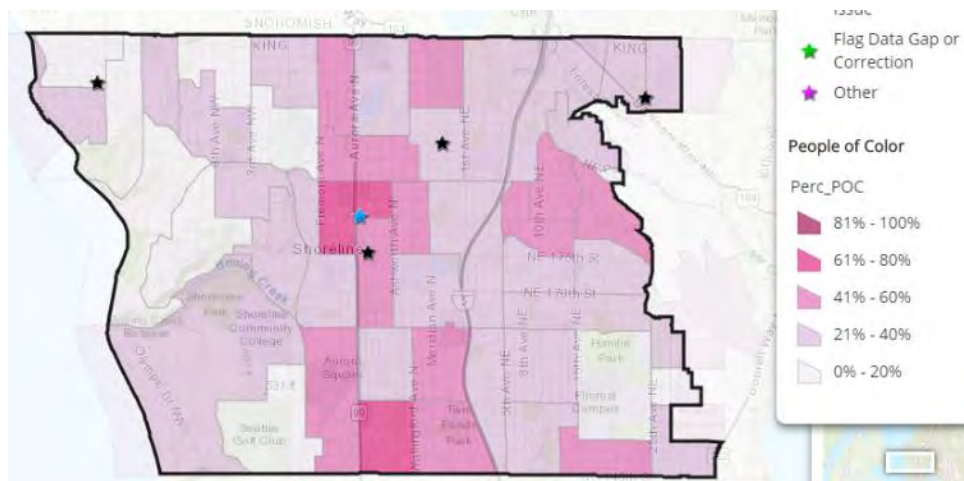


Figure 4: Limited English-speaking households in Shoreline.

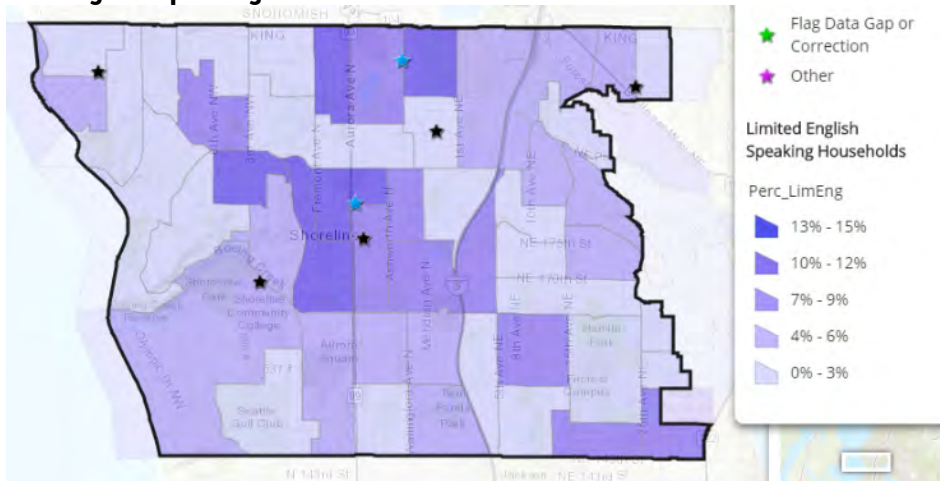


Figure 5: Shoreline households with members with disabilities.

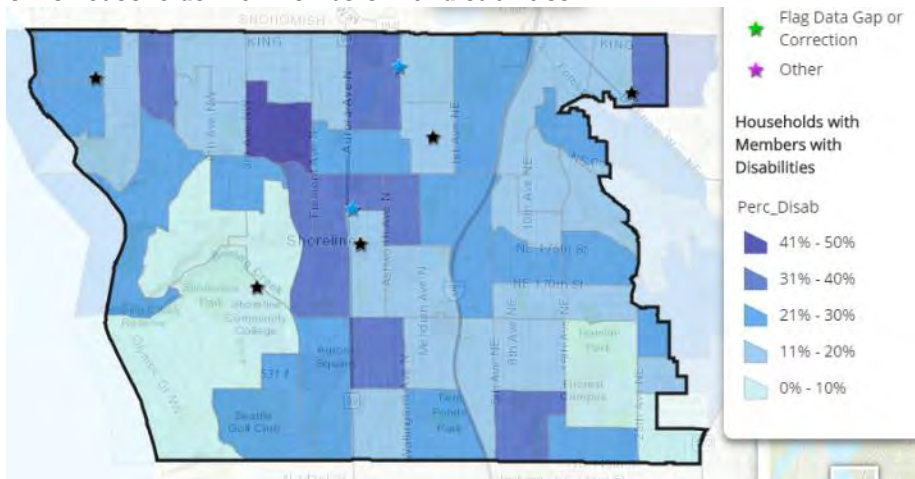


Figure 6: Shoreline households of one person 65 years or older.

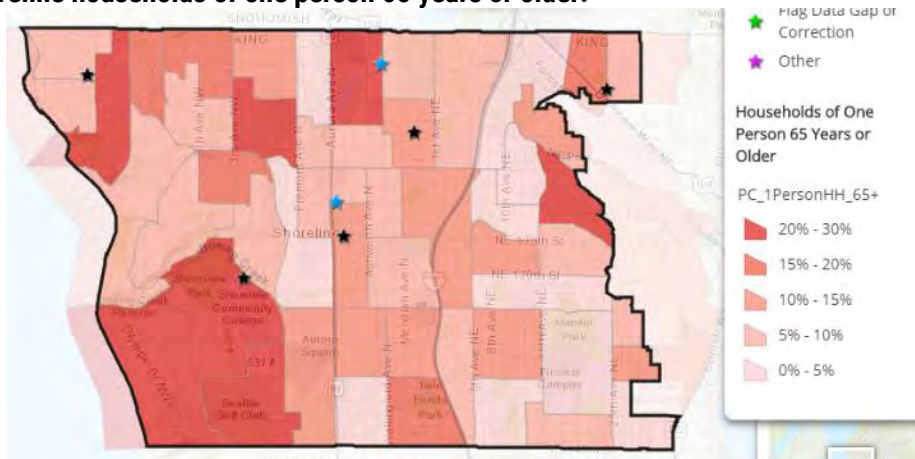
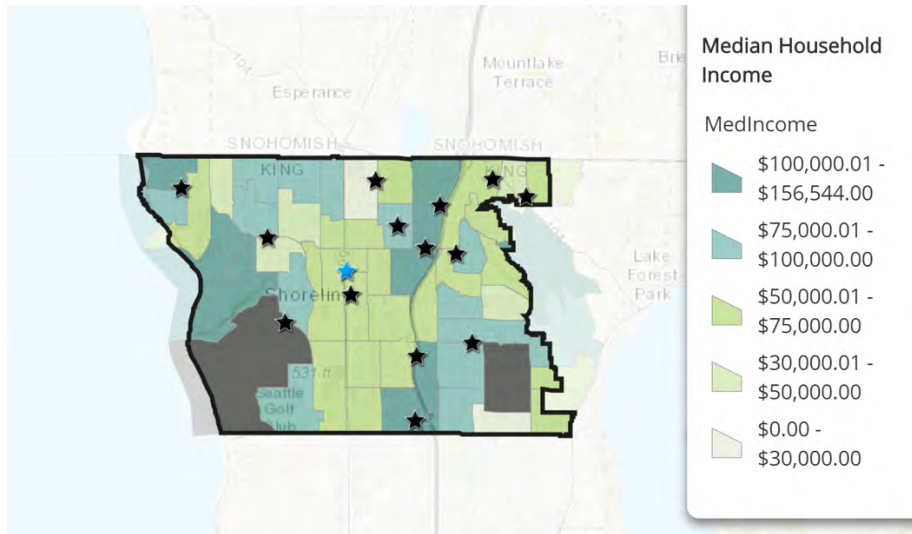


Figure 7: Median household income in Shoreline.



Step 5 | Wrap Up

All capital project managers should add their projects to the mapping tool, walk through each step of the tool, and record their assessment of vulnerabilities – and opportunities to address those vulnerabilities – in the project charter. Project managers should also answer the following questions in their project charter:

1. When did you use the Climate Impact Tool for this project?
2. Is your project located in an area with surface water vulnerabilities identified? If so, which vulnerabilities are of concern? What actions are included in project design to address these vulnerabilities?
3. Is your project located in an area of concern for urban heat island effects? If so, how significant is that concern (on the map scale of 1-5)? What actions are included in project design to address this vulnerability?
4. What equity and justice data from the map pertains to your project? How will you incorporate the City’s “Meaningful Community Engagement Guide” process into your project?

If a project does not have a charter, the project manager should answer the questions above and incorporate the applicable climate vulnerability considerations and resilience recommendations into any relevant project scope, planning, preliminary design, and/or design documents.

Next Steps

For each vulnerability identified in the map, there are many types of capital project and associated resilience measures that could be implemented. It is not currently possible, nor necessarily better, to provide a prescriptive menu of all potential actions for project managers to consult. Rather, this tool represents a first step for project managers to analyze and reflect on the information presented. It encourages critical thinking to assess vulnerabilities and resilience opportunities

when designing the project and community engagement. Staff anticipate reviewing tool outcomes and resulting strategies implemented by staff after the first 6-12 months to identify successful resilience strategies to potentially share with other project managers in the future.

This tool will likely evolve over time in partnership with Public Works and IT staff needs and resources.

Additional conversations are also needed with staff in Public Works to discuss the questions listed below regarding the best use of this tool.

- When should this tool be used – during project prioritization discussions or once a project is assigned to a project manager?
- If resilience strategies are identified for a project, what is an acceptable cost increase to ensure they are implemented?
- Are there specific policies to be implemented in capital projects based on mapping results? For example, if a project will be located in an area already identified as a 4 or 5 on the urban heat island map, and the project will likely exacerbate that effect, does it become a requirement to mitigate that increase in heat in the project design (vs. a strong recommendation to consider adjustments if the area is only identified as a 1 or 2)?

For more information about this tool, please contact Autumn Salamack at asalamack@shorelinewa.gov, or John Featherstone at jfeatherstone@shorelinewa.gov.

Appendix B. Recommended resilience strategies

APPENDIX B: RECOMMENDED RESILIENCE STRATEGIES

The consultant-recommended resilience strategies below will be reviewed with City staff in various departments to ascertain feasibility and alignment with existing plans and efforts.

Policies and Regulatory Changes

1. **Hazards** | Evaluate the development code related to landslide hazards to reduce risk. This action should be preceded by a detailed assessment and improved mapping of hazard areas (see Data Collection under City Programs and Services).
2. **Partnership** | Develop a framework for public and private partnerships that work towards a more resilient city through stormwater management strategies that increase green space, habitat connections, and mobility. Examples might include:
 - Green space management planning and permitting to streamline the City permitting process and facilitate climate-resilient best management practices for privately-owned and managed green spaces.
 - Opportunities for stormwater system easements to create habitat networks or to connect ecosystem services.
 - Opportunities to leverage green stormwater infrastructure (GSI) to expand and connect pedestrian/bicycle path networks for alternative transportation routes, including connections to the Interurban Trail.

City Programs and Services

3. **Street Sweeping** | Evaluate the street sweeping program to identify changes to sweeping locations, timing, and frequency that could increase resilience to climate change and equity, particularly reducing the likelihood that drain inlets clog during large storms and the potential to improve water quality in surface water bodies in the city, and potential benefit to benefit vulnerable populations. Expand or modify the street sweeping program based on the findings. Note that efforts to expand the urban forest canopy may contribute additional leaf litter that could clog storm drain inlets.
4. **Data Collection** | Implement proactive data collection and mapping of stormwater system components and critical areas to improve the City's ability to evaluate stormwater system deficiencies, improve system resilience, and protect critical areas (streams, wetlands, and geologic hazard areas). Improved hazard mapping (especially for slide areas) is recommended because seasonal changes in rainfall could impact the sensitivity of slide-prone areas.
 - Note: Some areas have been identified as "Data Gaps" in the Climate Impacts Tool. Notes associated with these locations indicate the type of data gap (e.g., flow monitoring, system investigation/mapping) that should be addressed to better understand flooding risks and identify possible improvements. The Climate Impacts Tool could be used to identify additional data gaps and to resolve all gaps.

5. **Regional Stormwater Facilities** | Plan and construct regional stormwater facilities to protect surface water bodies by providing flow control and/or water quality treatment. The City can take two primary approaches to regional stormwater facilities:
 - a. Redevelopment-focused regional stormwater facilities, i.e. those that are located downstream of areas that are expected to experience significant redevelopment. Redevelopment-focused facilities would be constructed to serve redevelopment in-lieu of, and generally equivalent to, onsite stormwater management.
 - b. Retrofit-focused regional stormwater facilities, i.e. those that are focused toward providing the maximum stormwater benefits downstream of developed areas, regardless of whether the tributary area is likely to experience significant redevelopment. Retrofit-focused facilities have more flexibility to be located in places that maximize the benefit to surface waters, flood reduction, and equity.

Either type of regional facility could be funded through a fee-in-lieu system and sited and designed to increase climate resilience; however, the two approaches have different advantages:

 - Redevelopment-focused facilities are likely to be reimbursed more quickly through a fee-in-lieu system, and therefore, less costly/risky for the City.
 - Retrofit-focused facilities have greater flexibility with siting and design, and therefore, can have more flexibility to maximize climate resilience benefits. The NPDES Phase II Municipal stormwater permit may require structural stormwater controls in the future and retrofit-focused facilities would satisfy that requirement.
6. **Capital Facilities Planning** | Require capital project managers to review near-term planned and proposed projects for their potential to improve surface water issues, reduce urban heat island effects, and/or increase equitable services by using the Climate Impacts Tool. This should be documented in the upcoming Project Manager Manual. As more information becomes available on stormwater system capacity and flooding problems, add this information to the Climate Impacts Tool.
7. **Proactive Maintenance Staffing** | Forecast City GSI installations to anticipate maintenance personnel shortages in the future, because GSI requires specialized maintenance and can be maintenance intensive. Incorporate any necessary increases in staffing into the next Surface Water Master Plan update and surface water utility rate assessment.
8. **More GSI** | Construct more GSI through retrofit programs or policies to include GSI on City projects. Retrofit planning for GSI could include identifying priority areas based on downstream system capacity limitations and aquatic resource prioritization. Continue to evaluate and modify codes and/or standards to make GSI the preferred choice for development. Target grant applications to support projects that plan and implement GSI retrofits. If possible, coordinate with sidewalk, bike lane, and other mobility improvements in the ROW. Develop GSI Design Standards, such as standard plans, details, and specifications with a focus on consistency, function, and consideration of climate impacts.
9. **Soak-it-Up Rebate Program** | Expand the Soak-it-Up program to further incentivize construction of GSI facilities. Improve the program to be more equitable, potentially through grants, targeted outreach and education, and actions that can benefit disadvantaged, including approaches that benefit individuals that don't own property.

10. **Retrofit Drain Inlets** | Identify high-priority inlets and implement a retrofit program to upgrade inlets for improved capacity. Consider equity issues when identifying the high-priority inlets.
11. **Manage Lake Eutrophication** | Rising temperatures may exacerbate water quality challenges associated with lakes. Evaluate the causes of lake eutrophication and proactively develop and implement lake management plans to include additional upstream stormwater requirements, stormwater retrofits, and/or in-lake remediation activities, depending on the identified causes.
12. **Evaluate Sea Level Rise** | Evaluate sea level rise in greater detail and develop strategy to address potential impacts to surface water outfalls, City property and park facilities, and private property.

Engineering Standards and Design Standards

13. **More Robust Downstream Analysis Requirements** | Develop more robust requirements for downstream analysis, including identification of existing stormwater problem areas. For example, Chapter 1 of the King County Surface Water Design Manual (KCSWDM) includes a section on Downstream Drainage Problems Requiring Special Attention. The KCSWDM lists four problem categories: (1) conveyance system nuisance, (2) severe erosion, (3) severe flooding, (4) potential impacts to wetland hydrology. The City could develop and adopt similar requirements to trigger special stormwater mitigation in places where existing problems are most severe.
14. **Drain Inlets** | Modify design standard to require combination inlets or dual inlets under certain conditions (e.g., sags in the roadway, areas with history of clogging or capacity-related flooding, areas with significant tree canopy) to increase capacity for higher-intensity storm events and reduce the risk of clogging. Increased inlet capacity may result in additional debris in the downstream pipe network, which can be partially offset by preventative programs such as street sweeping.
15. **Stormwater Facility Sizing** | Modify the standards for design of conveyance, flow control, and treatment facilities. Examples are given below.
 - Conveyance: Require application of a climate change safety factor on design flows used in conveyance sizing (near term).
 - Flow control and treatment facilities: Require analysis using a precipitation timeseries that has been modified to account for climate change impacts after a regionally accepted standard of practice has been defined (longer term).
16. **Resilient Planting** | Revise tree list and GSI planting requirements to create more resilient urban habitat and expand urban forest canopy. Based on a high-level review of the current tree list, preliminary suggestions include the following. Please note that street trees have several constraints and a very specific and involved processes for updating the street tree list. The parties involved with that process have not been consulted in the development of these recommendations but will be consulted in reviewing these recommendations moving forward.
 - Plant species that will survive in the long-term and create larger, longer-lived urban canopy. In particular, increasing the diversity of tree sizes and tree genetics will help with pest resilience, canopy size, and adaptability to climate change. For example, Shoreline’s current list has a lot of trees in the Rosaceae family (cherries,

crabapples, plums, pears), and while these are ornamental trees that fit in smaller planting spaces, they are weak-wooded, short-lived trees that are prone to pest issues and failure. Planting larger tree species as street trees where amenity zones are adequately wide will help with climate change resiliency in the future.

- Plant more evergreen trees. These species will improve water quality and catchment for stormwater, as well as increase carbon sequestration. Identifying places within the City that can accommodate larger conifers or broadleaf evergreen trees can help maximize the benefits of trees in the urban environment.
- Discuss removing trees from the list that are considered an invasive or nuisance species in King County or nearby areas. For example, horsechestnut is currently approved for planting in Shoreline, but it is a known nuisance tree and is likely to become more of an issue in the future.
- Remove tree species from the list that have ongoing pest problems. For example, the Himalayan Birch *Betula jacquemontii* has severe issues with a pest called Bronze Birch Borer and this species is currently dying en masse in multiple cities. Planting species vulnerable to pests is not a long-term solution to increasing urban canopy. Other types of birches or smaller deciduous trees that provide the same role should be considered for the approved tree list instead.
- Plant additional native trees, or native tree cultivars/ hybrids, to help support local habitat, fauna, and flora, and increase native canopy cover. Many of the trees on the current list are native to the East Coast, Europe, or Asia, and some of them have higher water needs in the summer than what is typical for the Pacific Northwest. Modifying the list to include native species will increase survival, reduce summertime water demand, and reduce maintenance needs over time.
- Discuss provenance of local seed sources for nursery material and experiment with obtaining tree stock from areas slightly south of Shoreline to monitor the adaptability of plant material from slightly warmer regions compared to stock sourced from areas north of the City or unknown seed sources.

17. **More Resilient Urban Design Standards** | Consider modifying design standards to ensure that future development increases city-wide resilience to climate change. As an example, modify design standards to encourage more vegetation and large trees. In addition to stormwater benefits, vegetation can improve urban habitat and provide shading to mitigate urban heat island effects.

PRIORITIZATION FRAMEWORK

This prioritization framework is intended to enable qualitative prioritization of the climate change resilience strategies for surface water. See above for a complete description each strategy. Each strategy was ranked as high, moderate, or low for each criterion. The "Criteria Definitions" table below provides more information on each criterium. An overall priority was assigned for each strategy based on qualitative consideration of all criteria. "High" strategies are highlighted in green below.

Resilience Strategy		Prioritization Criteria					Overall Priority
		Effectiveness and Impact	Ease of Implementation	Strategy has Co-benefits	Urgency	Equity	
		<i>How much will the strategy increase resilience? How large are the potential cost/damages that could result from inaction?</i>	<i>How affordable is the action given current staffing levels and budget? Is the action in line with current policies, regulations, and/or technology?</i>	<i>Does the strategy address multiple goals, or other City or community objectives?</i>	<i>How short is the window of opportunity? How quickly will the cost of inaction start accruing?</i>	<i>Does the action address the needs of vulnerable and historically marginalized populations?</i>	
Policies and Regulatory Changes							
1	Evaluate landslide hazard risk in development code	<i>Moderate</i> Only benefits a small area of the city but landslides are very damaging.	<i>Moderate</i> Will require a significant amount of staff time and/or external support, but there are no regulatory or technological barriers to implementing this strategy.	<i>Low</i> Strategy doesn't address other City goals or objectives.	<i>Low</i> The timing of landslides is difficult to predict and there is significant uncertainty surrounding how much climate change will affect the risk or frequency of landslides in the City.	<i>Moderate</i> Neither harms nor benefits vulnerable populations.	Low
2	Develop framework for public-private partnerships to support resilience	<i>Moderate</i> Moderate benefits to natural systems and mobility.	<i>Low</i> Historically public-private partnerships have been very time intensive for City staff to manage.	<i>High</i> Strategy addresses goals and objectives related to stormwater, natural systems, and mobility.	<i>Moderate</i> Redevelopment around light rail stations has begun. There are many public private partnership opportunities outside the light rail station area.	<i>Moderate</i> Neither harms nor benefits vulnerable populations.	Moderate
City Programs and Services							
3	Expand street sweeping program	<i>Moderate</i> The City currently has a robust sweeping program. This action would expand or fine tune the sweeping program to increase effectiveness, reduce drain inlet clogging and improve water quality.	<i>Moderate</i> May require more up front time to identify modifications to the sweeping program but will result in more efficient use of staff time.	<i>Low</i> Action doesn't address other City goals or objectives.	<i>Moderate</i> Debris clogging drain inlet is an issue periodically.	<i>Moderate</i> May benefit vulnerable populations if drain inlet clogging is found to be a problem in these areas.	Moderate



Resilience Strategy		Effectiveness and Impact	Ease of Implementation	Strategy has Co-benefits	Urgency	Equity	Overall
4	Enhance data collection and mapping to fill gaps regarding sensitive areas, hazard areas, and surface water issues	<i>High</i> Until more is known about the risk associated locations with missing data, neither high or low score is appropriate.	<i>Moderate</i> Many of the data gaps are in areas that are difficult to collect data, making the work more time consuming than typical data collection.	<i>Moderate</i> Data collection benefits surface water, critical areas planning, transportation, and general utility planning.	<i>Moderate</i> Lack of data on the system creates increasing risk for the City over time.	<i>Moderate</i> Neither harms nor benefits vulnerable populations.	Moderate
5a	Build redevelopment-focused regional stormwater facilities	<i>Moderate</i> The of benefits of redevelopment-focused regional facilities are not significantly greater than the benefits of meeting stormwater requirements parcel-by-parcel, though the benefits begin accruing sooner.	<i>Moderate</i> Planning, siting, and constructing regional facilities has a high cost, but can be reimbursed (at least partially) through a fee-in-lieu system.	<i>High</i> Well planned regional stormwater facilities could improve habitat, recreation, and mobility.	<i>Moderate</i> Significant redevelopment around light rail stations and other areas of the city has begun.	<i>Moderate</i> Neither harms nor benefits vulnerable populations.	Moderate
5b	Build retrofit-focused regional stormwater facilities	<i>High</i> Retrofit-focused regional facilities have large benefits when compared to business-as-usual approach to stormwater management and flexibility with siting and design to maximize flood reduction and climate resiliency benefits.	<i>Low</i> Planning, siting, and constructing regional facilities has a high cost.	<i>High</i> Well planned regional stormwater facilities could improve habitat, recreation, and mobility.	<i>Moderate</i> As development within the City becomes denser and land values increase, regional stormwater management facilities will become more challenging to site and costly to build.	<i>High</i> Has a high potential to integrate equity considerations in facility planning, design, and prioritization.	High
6	Require capital facilities planning to consider opportunities to increase resiliency using the Climate Impacts Tool	<i>High</i> Results in city-wide increases in resiliency.	<i>High</i> Low level of effort required to consider how each project can increase the City's climate change resiliency.	<i>High</i> Considering climate change impacts for each project increases the potential for projects to benefit multiple City goals/systems, including stormwater improvements, mobility improvements, reducing impervious surfaces, and improving tree canopy and habitat.	<i>High</i> If design standards are not modified, investment in new capital may be built to inadequate standards.	<i>High</i> Using the Climate Impacts Tool increases the likelihood that equity is considered on each project.	High



Resilience Strategy		Effectiveness and Impact	Ease of Implementation	Strategy has Co-benefits	Urgency	Equity	Overall
7	Proactively plan for increased staffing for GSI maintenance	<i>Moderate</i> Improved maintenance of City surface water facilities will improve facility performance but the benefit to climate resilience will be limited.	<i>High</i> Building staffing needs into surface water rate calculations will enable the utility to adequately staff for the need.	<i>Moderate</i> Well maintained GSI facilities will help ensure that the facilities benefit habitat and don't impair mobility or safety.	<i>Low</i> The surface water utility is constantly planning for staffing needs.	<i>Moderate</i> Neither harms nor benefits vulnerable populations.	Moderate
8	Construct more GSI	<i>Moderate</i> More GSI will help to reduce the impacts of larger storms, but not as much as regional facilities.	<i>Moderate</i> Staff are available to implement more GSI and a more detailed review of feasibility criteria and City policy surrounding GSI implementation may result in more GSI being constructed on private and public projects.	<i>High</i> More GSI benefits habitat and mobility goals.	<i>Moderate</i> Risk that redevelopment that is happening now and in the near future (near light rail stations) occurs in a way that doesn't maximize benefits towards City goals.	<i>Moderate</i> Neither harms nor benefits vulnerable populations.	Moderate
9	Expand the Soak-it-Up program, including enhancing the equity of the program	<i>Moderate</i> Residential GSI programs can have significant benefits if implemented broadly but typical GSI facility sizing is not focused on reducing runoff from the most severe storms.	<i>High</i> Cost of this program is low when compared to regional stormwater facilities and GSI retrofits.	<i>Moderate</i> More residential has numerous benefits, including improved habitat for native species, when properly implemented.	<i>Low</i> The window of opportunity for this strategy is long. The benefits of this program are happening now and will increase if more effort is focused on this program.	<i>Moderate</i> Neither harms nor benefits vulnerable populations if the program is expanded in a way that increases equity.	Moderate
10	Retrofit high-priority drain inlets to upgrade capacity	<i>Moderate</i> Retrofits at priority (problem) locations could reduce flooding potential at these locations.	<i>High</i> Inlet improvements are relatively low cost and do not have significant environmental (permitting) challenges.	<i>Low</i> Inlet improvement don't address other City goals and objectives.	<i>Moderate</i> Clogged inlets are occasionally problems in some parts of the City.	<i>Moderate</i> May benefit vulnerable populations if undersized inlets are found to be a problem in these areas.	Moderate
11	Manage lake eutrophication through planning, retrofits, and programs	<i>Low</i> Expected to result in small impact in resilience, but this rating could be revised depending on the outcome of further planning.	<i>Moderate</i> Causes of eutrophication can be difficult to fully assess and eliminate. Further study of this issue would not generally bear a high cost, but cost and effort required to fully manage eutrophication is unknown and may be extensive.	<i>High</i> Improving lake water quality has large potential benefits for habitat and recreation.	<i>Moderate</i> Poor water quality in lakes has hindered the recreational value of lake and is anticipated to become worse if not addressed.	<i>Low</i> Shoreline has only one small lake and the public can access only a small portion of the lake shoreline.	Low
12	Evaluate sea level rise to develop strategy for managing impacts	<i>Low</i> Only a small portion of the City is affected by sea level rise.	<i>Moderate</i> GIS data and standardized methodology will make sea level rise assessment a fairly low-effort task, though implementing adaptation actions will likely be high cost.	<i>Low</i> Limited benefits to other goals or objectives.	<i>Moderate</i> Sea level rise impacts are being experienced now and will continue to become more severe.	<i>Moderate</i> Though the private property owners along the marine shoreline are more advantaged, Richmond Beach Park is a major City asset that benefits all people in the City.	Low



Resilience Strategy	Effectiveness and Impact	Ease of Implementation	Strategy has Co-benefits	Urgency	Equity	Overall	
Engineering Standards and Design Standards							
13	Develop more robust downstream analysis requirements	<i>High</i> Would have direct impact on most severe flooding problems in the City on sites that don't already trigger significant onsite flow control.	<i>High</i> Will be challenging to manage the additional design review that is required on development projects and some may view this as an unnecessary burden on development.	<i>Low</i> Limited benefits besides flood reduction.	<i>Moderate</i> Most severe flooding problems can have large impacts every few years; and significant redevelopment around light rail stations has begun.	<i>Moderate</i> Addresses flooding impacts that may have disproportionate impacts on the most vulnerable through work being done by the least vulnerable.	Moderate
14	Modify design standard for drain inlets to increase capacity	<i>Moderate</i> Directly addresses a significant contributor to flooding problems in the city (clogged inlets).	<i>High</i> Requires limited staff time to develop standards that will be implemented during the normal course of business.	<i>Low</i> Limited benefits to other goals or objectives.	<i>High</i> Each storm drain inlet that is constructed to an inadequate standard is a missed opportunity.	<i>High</i> Flooding of inlets can have disproportionate impacts on vulnerable or marginalized populations.	High
15	Modify standards for stormwater facility sizing to increase capacity and ensure adequacy of flow control and water quality treatment facilities	<i>High</i> Some of the City's most significant flooding problems are a result of undersized facilities.	<i>High</i> Low level of effort and low cost to develop and implement standards for City capital projects, particularly those involving conveyance. In the longer-term moderate cost associated with implementing larger stormwater facilities at private developments.	<i>Moderate</i> Reduced flooding from undersized conveyance benefits many sectors of the City including transportation, parks, and ecosystems.	<i>High</i> Risk that redevelopment that is happening now and in the near future (near light rail stations) occurs in a way that doesn't maximize benefits towards City goals.	<i>Moderate</i> Neither harms nor benefits vulnerable populations.	High
16	Revise tree list and GSI planting requirements to be more resilient	<i>Moderate</i> Further updates to the City's tree list and GSI planting requirements will improve city-wide climate resilience.	<i>High</i> Low level of effort to identify and implement revisions.	<i>High</i> Strategy will benefit stormwater, habitat, mobility, and transportation system goals.	<i>High</i> The City is making significant right of way improvements in coordination with the new light rail stations so optimizing tree lists and GSI standards present a significant opportunity.	<i>High</i> More resilient trees will provide more shade, which will counter urban heat island effects and benefit vulnerable communities.	High
17	Modify urban design standards to ensure development increases city-wide climate resilience	<i>Moderate</i> The City has already completed some updates and additional updates could have significant benefits as redevelopment occurs.	<i>High</i> Low level of effort to identify and implement revisions.	<i>High</i> Strategy will benefit stormwater, habitat, mobility, and transportation system goals.	<i>High</i> The City is making significant right of way improvements in coordination with the new light rail stations so optimizing design standards presents a significant opportunity.	<i>High</i> Improved urban design standards will provide more shade, which will counter urban heat island effects and benefit vulnerable communities.	High



CRITERIA DEFINITIONS

Effectiveness and Impact	
High	Strategy will result in a large increase in resilience to an important asset or system. Failing to implement this action will risk significant costs/damage to a large portion of the community.
Moderate	Strategy will result in a moderate increase in resilience to an important asset or system.
Low	Strategy will result in a small increase in resilience or only benefit small or less important action. Failing to implement this action will risk minimal costs/damages to the community.

Ease of Implementation	
High	No challenges anticipated given the staff time required to implement this action, cost of external support, and current regulation, politics, and/or technologies.
Moderate	Strategy may encounter challenges given the staff time required to implement this action, cost of external support, and current regulation, politics, and/or technologies.
Low	Strategy will be very challenging given the staff time required to implement this action, cost of external support, and current regulation, politics, and/or technologies.

Strategy has Co-benefits	
High	Strategy addresses multiple high-priority City goals or objectives, in addition to the primary goal that the strategy is focused on.
Moderate	Strategy addresses at least one other high-priority City goals or objectives, in addition to the primary goal that the strategy is focused on.
Low	Strategy doesn't address any other City goals or objectives, besides the primary goal that the strategy is focused on.

Urgency	
High	Window of opportunity for this action is short and/or the cost of inaction will start accruing in a very short time period (less than five years).
Moderate	Window of opportunity for this action is moderate and/or the cost of inaction will start accruing in a moderate time period (five to 10 years).
Low	Window of opportunity for this action is long and/or the cost of inaction won't start accruing for a long time (more than 10 years).

Equity	
High	Strategy will definitely benefit vulnerable/marginalized populations in a significant way.
Moderate	Strategy does not harm nor benefit vulnerable/marginalized populations.
Low	Strategy will negatively affect vulnerable/marginalized populations.



Appendix C. Resiliency strategies and master plans



APPENDIX C: Comprehensive Review: Opportunities for Advancing Climate Resiliency in the City of Shoreline Master Planning

June 2020

Introduction

The Climate Impacts and Resiliency Study conducted for the City of Shoreline identified a set of seventeen strategies to increase climate resiliency. The consultant team carried out a comprehensive review of existing City master plans to identify opportunities to advance the resilience strategies in the next round of master plan updates, as well as increase climate resiliency in projects and operations across all City departments.

The scope of the Climate Impacts and Resiliency Study focused on resilience strategies specifically for the stormwater system, in part due to expected climate impacts leading to more intense rainstorms and greater flooding risk. However, these strategies also build resilience in other systems (e.g., transportation, wastewater, parks). There are many potential strategies less directly related to the stormwater system that can also contribute to climate resilience (e.g., creating cooling centers to provide relief from extreme heat); future City planning efforts to build holistic, citywide climate resilience could identify, develop, and integrate these types of strategies into City master plans as well.

The City provided the list of master plans for the consultant to include in this review, listed below with hyperlinks to the online documents, when available. The acronyms correspond to columns in Table 1, which provides a high-level summary of the seventeen climate resilience strategies and the master plans they most closely pertain to.

- ▶ [Comprehensive Plan \(COMP\)](#)
- ▶ [Climate Action Plan \(CAP\)](#)
- ▶ [Economic Development Strategy \(EDS\)](#)
- ▶ [Parks, Recreation, and Open Space Plan \(PROS\)](#)
- ▶ Ronald Wastewater District Comprehensive Plan (RWDCP)
- ▶ [Surface Water Master Plan \(SWMP\)](#)
- ▶ [Transportation Master Plan \(TMP\)](#)

CLIMATE IMPACTS & RESILIENCY STUDY

Table 1. Summary table of climate resilience strategies and alignment with City master plans. Strategies in bold font are high-priority strategies based on a prioritization process conducted during the Climate Impacts and Resiliency Study.

CLIMATE RESILIENCE STRATEGY	MASTER PLAN						
	COMP	CAP	EDS	PROS	RWDCP	SWMP	TMP
1. Hazards	●						
2. Partnership	●	●	●	●		●	●
3. Street Sweeping						●	
4. Data Collection	●		●	●	●	●	●
5. Regional Stormwater Facilities	●					●	
6. Capital Facilities Planning	●	●	●	●	●	●	●
7. Proactive Maintenance Staffing						●	●
8. More Green Stormwater Infrastructure	●	●	●	●	●	●	●
9. Soak-it-Up Rebate Program	●		●			●	
10. Retrofit Drain Inlets	●					●	
11. Manage Lake Eutrophication	●					●	
12. Evaluate Sea Level Rise	●				●	●	●
13. More Robust Downstream Analysis Requirements						●	
14. Drain Inlets						●	
15. Stormwater Facility Sizing						●	
16. Resilient Planting	●	●	●	●		●	●
17. More Resilient Urban Design Standards	●	●	●	●	●	●	●

The following sections, organized by master plan, identify the applicable resilience strategies for each plan and the corresponding plan component(s) where opportunities exist to advance the respective strategies. When appropriate, specific sub-section(s) were identified; otherwise, “All” is utilized to indicate that the strategy applies to the entire plan component and/or there was not a specific sub-section that was any more relevant than the others. The aim of this format is to provide a simple resource for planning managers to easily incorporate these strategies into the next planning updates.

For more information, please contact [Autumn Salamack](#) or [John Featherstone](#).

Comprehensive Plan

Current plan period: 2012-2023

Scheduled update: June 2023

Lead Department/Staff: Planning & Community Development, Planning Manager and/or Senior Planner

Climate Resilience Strategy	Comprehensive Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
<p>Strategy #1 – Hazards: Evaluate the development code related to landslide hazards to reduce risk. This action should be preceded by a detailed assessment and improved mapping of hazard areas (see Strategy #4 - Data Collection).</p>	Natural Environment	Geological and Flood Hazard Areas
<p>Strategy #2 – Partnership: Develop a framework for public and private partnerships that work towards a more resilient city through stormwater management strategies that increase green space, habitat connections, and mobility. Examples might include:</p> <ul style="list-style-type: none"> Green space management planning and permitting to streamline the City permitting process and facilitate climate-resilient best management practices for privately-owned and managed green spaces. Opportunities for stormwater system easements to create habitat networks or to connect ecosystem services. Opportunities to leverage green stormwater infrastructure (GSI) to expand and connect pedestrian/bicycle path networks for alternative transportation routes, including connections to the Interurban Trail. 	Land Use	Water Quality and Drainage (LU69)
	Community Design	Site and Building Design (CD3) Sidewalks, Walkways and Trails
	Transportation	Sustainability and Quality of Life (T10)
	Economic Development	Quality of Life
	Parks, Recreation & Open Space	Policy 4.4
<p>Strategy #4 – Data Collection: Implement proactive data collection and mapping of stormwater system components and critical areas to improve the City’s ability to evaluate stormwater system deficiencies, improve system resilience, and protect critical areas (streams, wetlands, and geologic hazard areas). Improved hazard mapping (especially for slide areas) is recommended because seasonal changes in rainfall could impact the sensitivity of slide-prone areas.</p>	Natural Environment	Geological and Flood Hazard Areas
<p>Strategy #5 – Regional Stormwater Facilities: Plan and construct regional stormwater facilities to protect surface water bodies by providing flow control and/or water quality treatment. The City can take two primary approaches to regional stormwater facilities:</p> <ul style="list-style-type: none"> Redevelopment-focused regional stormwater facilities, i.e. those that are located downstream of areas that are expected to experience significant redevelopment. Retrofit-focused regional stormwater facilities, i.e. those that are focused toward providing the maximum stormwater benefits downstream of developed areas, regardless of whether the tributary area is likely to experience significant redevelopment. 	Land Use	Water Quality and Drainage (LU69)
	Natural Environment	Geological and Flood Hazard Areas

CLIMATE IMPACTS & RESILIENCY STUDY

Climate Resilience Strategy	Comprehensive Plan	
	Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
Strategy #6 – Capital Facilities Planning: Require capital project managers to review near-term planned and proposed projects for their potential to improve surface water issues, reduce urban heat island effects, and/or increase equitable services by using the Climate Impacts Tool. This should be documented in the upcoming Project Management Manual. As more information becomes available on stormwater system capacity and flooding problems, add this information to the Climate Impacts Tool.	Land Use	Water Quality and Drainage (LU69)
	Housing	All
	Transportation	Master Street Plan
	Economic Development	Quality of Life
	Natural Environment	Geological and Flood Hazard Areas Sustainability (NE44)
	Parks, Recreation & Open Space	Policy 3.3
	Capital Facilities	Mitigation and Efficiency (CF15)
	Utilities	Mitigation and Efficiency (U6)
Strategy #8 – More GSI: Construct more GSI through retrofit programs or policies to include GSI on City projects. Retrofit planning for GSI could include identifying priority areas based on downstream system capacity limitations and aquatic resource prioritization. Continue to evaluate and modify codes and/or standards to make GSI the preferred choice for development. Target grant applications to support projects that plan and implement GSI retrofits. If possible, coordinate with sidewalk, bike lane, and other mobility improvements in the ROW. Develop GSI Design Standards, such as standard plans, details, and specifications with a focus on consistency, function, and consideration of climate impacts.	Land Use	Water Quality and Drainage (LU69)
	Community Design	Street Corridors (CD32) Residential (CD36)
	Natural Environment	Geological and Flood Hazard Areas Sustainability (NE45)
	Parks, Recreation & Open Space	Policy 1.1
	Capital Facilities	Mitigation and Efficiency (CF16)
Strategy #9 – Soak-it-Up Rebate Program: Expand the Soak-it-Up program to further incentivize construction of GSI facilities. Improve the program to be more equitable, potentially through grants, targeted outreach and education, and actions that can benefit disadvantaged, including approaches that benefit individuals that don't own property.	Land Use	Water Quality and Drainage (LU69)
	Natural Environment	Geological and Flood Hazard Areas
Strategy #10 – Retrofit Drain Inlets: Identify high-priority inlets and implement a retrofit program to upgrade inlets for improved capacity. Consider equity issues when identifying the high-priority inlets.	Natural Environment	Geological and Flood Hazard Areas
Strategy #11 – Manage Lake Eutrophication: Rising temperatures may exacerbate water quality challenges associated with lakes. Evaluate the causes of lake eutrophication and proactively develop and implement lake management plans to include additional upstream stormwater requirements, stormwater retrofits, and/or in-lake remediation activities, depending on the identified causes.	Natural Environment	Streams and Water Resources
Strategy #12 – Evaluate Sea Level Rise: Evaluate sea level rise in greater detail and develop strategy to address potential impacts to surface water outfalls, City property and park facilities, and private property.	Shoreline Master Program	All

CLIMATE IMPACTS & RESILIENCY STUDY

Climate Resilience Strategy	Comprehensive Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
Strategy #16 – Resilient Planting: Revise tree list and GSI planting requirements to create more resilient urban habitat and expand urban forest canopy. Based on a high-level review of the current tree list, preliminary suggestions include the following.	Community Design	Vegetation and Landscaping
	Transportation	Sustainability and Quality of Life
	Natural Environment	Vegetation Protection
	Parks, Recreation & Open Space	Policy 1.1
Strategy #17 – More Resilient Urban Design Standards: Consider modifying design standards to ensure that future development increases city-wide resilience to climate change. As an example, modify design standards to encourage more vegetation and large trees. In addition to stormwater benefits, vegetation can improve urban habitat and provide shading to mitigate urban heat island effects.	Land Use	All
	Community Design	All
	Transportation	Master Street Plan

Climate Action Plan

Current plan period: 2013-present

Scheduled update: 2021-2022

Lead Department/Staff: Community Services, Environmental Services Coordinator

Climate Resilience Strategy	Climate Action Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
<p>Strategy #2 – Partnership: Develop a framework for public and private partnerships that work towards a more resilient city through stormwater management strategies that increase green space, habitat connections, and mobility. For example, partnerships could support opportunities to leverage green stormwater infrastructure (GSI) to expand and connect pedestrian/bicycle path networks for alternative transportation routes, including connections to the Interurban Trail.</p>	Transportation, Land Use, and Mobility	Objective 8: Alternative Transportation
	Urban Trees, Parks, and Open Spaces	Objective 11: Parks & Open Spaces
<p>Strategy #6 – Capital Facilities Planning: Require capital project managers to review near-term planned and proposed projects for their potential to improve surface water issues, reduce urban heat island effects, and/or increase equitable services by using the Climate Impacts Tool. This should be documented in the upcoming Project Management Manual. As more information becomes available on stormwater system capacity and flooding problems, add this information to the Climate Impacts Tool.</p>	Energy and Water	All
	Materials and Waste	All
	Transportation, Land Use, and Mobility	All
	Urban Trees, Parks, and Open Spaces	All
<p>Strategy #8 – More GSI: Construct more GSI through retrofit programs or policies to include GSI on City projects. Retrofit planning for GSI could include identifying priority areas based on downstream system capacity limitations and aquatic resource prioritization. Continue to evaluate and modify codes and/or standards to make GSI the preferred choice for development. Target grant applications to support projects that plan and implement GSI retrofits. If possible, coordinate with sidewalk, bike lane, and other mobility improvements in the ROW. Develop GSI Design Standards, such as standard plans, details, and specifications with a focus on consistency, function, and consideration of climate impacts.</p>	Transportation, Land Use, and Mobility	Objective 8: Alternative Transportation
	Urban Trees, Parks, and Open Spaces	Objective 11: Parks & Open Spaces
<p>Strategy #16 – Resilient Planting: Revise tree list and GSI planting requirements to create more resilient urban habitat and expand urban forest canopy. Co-benefits include more resilient urban habitat, expanded urban forest canopy, reduced urban heat island effect, and greenhouse gas emissions mitigation.</p>	Energy and Water	Objective 3: Water Consumption
	Transportation, Land Use, and Mobility	Objective 8: Alternative Transportation
	Urban Trees, Parks, and Open Spaces	Objective 10: Tree Canopy & Health Objective 11: Parks & Open Spaces
<p>Strategy #17 – More Resilient Urban Design Standards: Consider modifying design standards to ensure that future development increases city-wide resilience to climate change. As an example, modify design standards to encourage more vegetation and large trees. In addition to stormwater benefits, vegetation can improve urban habitat and provide shading to mitigate urban heat island effects.</p>	Transportation, Land Use, and Mobility	Objective 8: Alternative Transportation



Economic Development Strategy

Current plan period: 2018-2023

Scheduled update: December 2023

Lead Department/Staff: Not specified in the Comprehensive and Master Plan Update Memo, August 15, 2019.

Climate Resilience Strategy	Economic Development Strategy Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
Strategy #2 – Partnership: Develop a framework for public and private partnerships that work towards a more resilient city through stormwater management strategies that increase green space, habitat connections, and mobility. For example, streamlining the City permitting process could facilitate climate-resilient best management practices for privately-owned and managed green spaces.	City-Shaping Areas	All
	Neighborhood Commercial Centers	All
	Non-geographic Placemaking Projects	Facilitating Collaboration With & Between Businesses
Strategy #4 – Data Collection: Use the inventory to implement proactive data collection of critical areas that experience erosion and/or flooding to inform improved mapping and evaluation of the City’s stormwater system. Also collect data about vulnerability to urban heat islands within business centers to evaluate areas with opportunity for building resilience.	Non-geographic Placemaking Projects	Increasing Inventory of Business Spaces
Strategy #6 – Capital Facilities Planning: Require capital project managers to review near-term planned and proposed projects for their potential to improve surface water issues, reduce urban heat island effects, and/or increase equitable services by using the Climate Impacts Tool. This should be documented in the upcoming Project Management Manual.	City-Shaping Areas	All
	Neighborhood Commercial Centers	All
Strategy #8 – More Green Stormwater Infrastructure (GSI): Construct more GSI through retrofit programs or policies to include GSI on City projects. Continue to evaluate and modify codes and/or standards to make GSI the preferred choice for development. Target grant applications to support projects that plan and implement GSI retrofits. If possible, coordinate with sidewalk, bike lane, and other mobility improvements in the ROW. Develop GSI Design Standards, such as standard plans, details, and specifications with a focus on consistency, function, and consideration of climate impacts.	City-Shaping Areas	All; especially Shoreline Place
	Neighborhood Commercial Centers	All; especially North City Business District & Downtown Ridgecrest
Strategy #9 – Soak-it-Up Rebate Program: Expand the Soak-it-Up program to further incentivize construction of GSI facilities. Improve the program to be more equitable, potentially through grants, targeted outreach and education, and actions that can benefit disadvantaged, including approaches that benefit individuals that don’t own property.	City-Shaping Areas	All
	Neighborhood Commercial Centers	All
	Non-geographic Placemaking Projects	Facilitating Collaboration With & Between Businesses
Strategy #16 – Resilient Planting: Create a safer and more enjoyable urban environment by increasing tree plantings and planting tree species that will be more resilient to climate impacts, particularly in priority	City-Shaping Areas	All; especially Shoreline’s Signature Boulevard & Shoreline Place



CLIMATE IMPACTS & RESILIENCY STUDY

Climate Resilience Strategy	Economic Development Strategy Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
development areas. Co-benefits include more resilient urban habitat, expanded urban forest canopy, reduced urban heat island effect, and greenhouse gas emissions mitigation.	Neighborhood Commercial Centers	All; especially Shoreline Town Center & Ballinger Commercial Center
Strategy #17 – More Resilient Urban Design Standards: Consider modifying design standards to ensure that future development increases city-wide resilience to climate change, especially for new developments and redevelopment. As an example, modify design standards to encourage more vegetation and large trees. In addition to stormwater benefits, vegetation can improve urban habitat and provide shading to mitigate urban heat island effects.	Non-geographic Placemaking Projects	Continually Improving Code & Policies

Parks, Recreation, and Open Space Plan

Current plan period: 2017-2023

Scheduled update: December 2023

Lead Department/Staff: PRCS, Director or designee

Climate Resilience Strategy	PROS Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
Strategy #2 – Partnership: Develop a framework for public and private partnerships that work towards a more resilient city through stormwater management strategies that increase green space, habitat connections, and mobility. For example, partnerships could support opportunities to leverage green stormwater infrastructure (GSI) to expand and connect pedestrian/bicycle path networks for alternative transportation routes, including connections to the Interurban Trail.	Recommendations & Implementation	Initiative 9: Improve walkability
Strategy #4 – Data Collection: Implement proactive data collection of critical areas that experience erosion and/or flooding to inform improved mapping and evaluation of the City’s stormwater system. Use the inventory to also collect data about vulnerability to urban heat islands within the parks, recreation, and open space system and evaluate areas with opportunity for building resilience.	Community Profile	All
Strategy #6 – Capital Facilities Planning: Require capital project managers to review near-term planned and proposed projects for their potential to improve surface water issues, reduce urban heat island effects, and/or increase equitable services by using the Climate Impacts Tool. This should be documented in the upcoming Project Management Manual.	Community Profile	All
	Demand & Needs Assessment	Goal 1: Preserve/enhance natural facilities
	Recommendations & Implementation	Initiative 1: New aquatic center Initiative 3: Expand amenities Initiative 9: Improve walkability Prioritization criteria
Strategy #8 – More Green Stormwater Infrastructure (GSI): Construct more GSI through retrofit programs or policies to include GSI on City projects. Continue to evaluate and modify codes and/or standards to make GSI the preferred choice for development. Target grant applications to support projects that plan and implement GSI retrofits. If possible, coordinate with sidewalk, bike lane, and other mobility improvements in the ROW. Develop GSI Design Standards, such as standard plans, details, and specifications with a focus on consistency, function, and consideration of climate impacts.	Recommendations & Implementation	Initiative 1: New aquatic center Initiative 3: Expand amenities
Strategy #16 – Resilient Planting: Create a safer and more enjoyable biking, walking, and transit experience by increasing tree plantings and planting tree species that will be more resilient to climate impacts. Co-	Facilities, Services & Programs	Park maintenance & urban forestry*



CLIMATE IMPACTS & RESILIENCY STUDY

Climate Resilience Strategy	PROS Plan	
	Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
benefits include more resilient urban habitat, expanded urban forest canopy, reduced urban heat island effect, and greenhouse gas emissions mitigation.	Recommendations & Implementation	Initiative 8: Urban forest
Strategy #17 – More Resilient Urban Design Standards: Consider modifying design standards for the transportation system to ensure that future development increases city-wide resilience to climate change.	Vision, Goals & Policies	Goal 1: Preserve/enhance natural facilities

*Note: There is no specific initiative or goal associated with the Park maintenance and urban forestry sub-section in the PROS Plan.

Ronald Wastewater District Comprehensive Plan

Current plan period: 2010-present

Scheduled update: 2021/2022

Lead Department/Staff: Public Works, Utility & Operations Manager

Climate Resilience Strategy	Ronald Wastewater District Comp. Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
Strategy #4 – Data Collection: Implement proactive data collection of critical areas that experience erosion and/or flooding to inform improved mapping and evaluation of the City’s stormwater system. Use the inventory to also collect data about vulnerability to urban heat islands within the wastewater system and evaluate areas with opportunity for building resilience.	Existing Sewer System	All
Strategy #6 – Capital Facilities Planning: Require capital project managers to review near-term planned and proposed projects for their potential to improve surface water issues, reduce urban heat island effects, and/or increase equitable services by using the Climate Impacts Tool. This should be documented in the upcoming Project Management Manual. Use the tool to assess the physical characteristics of the entire wastewater system as well.	Physical and Economic Considerations	All
	Capital Facilities Plan	All
Strategy #8 – More Green Stormwater Infrastructure (GSI): Construct more GSI through retrofit programs or policies to include GSI on City projects, specifically identifying opportunities to incorporate GSI in wastewater system improvements. Continue to evaluate and modify codes and/or standards to make GSI the preferred choice for development. Target grant applications to support projects that plan and implement GSI retrofits. If possible, coordinate with sidewalk, bike lane, and other mobility improvements in the ROW. Develop GSI Design Standards, such as standard plans, details, and specifications with a focus on consistency, function, and consideration of climate impacts.	Capital Facilities Plan	All
Strategy #12 – Evaluate Sea Level Rise: Evaluate sea level rise in greater detail and develop strategy to address potential impacts to the wastewater system and City property.	Physical and Economic Considerations	All
Strategy #17 – More Resilient Urban Design Standards: Consider modifying design standards to ensure that future development increases city-wide resilience to climate change, especially for new developments and redevelopment.	Design Criteria	All

Surface Water Master Plan

Current plan period: 2018-2023

Scheduled update: December 2023 (to inform 2025/2026 budget, due June 2024)

Lead Department/Staff: Public Works, Surface Water Utility Manager

Climate Resilience Strategy	Surface Water Master Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
<p>Strategy #2 – Partnership: Develop a framework for public and private partnerships that work towards a more resilient city through stormwater management strategies that increase green space, habitat connections, and mobility. Examples might include:</p> <ul style="list-style-type: none"> Green space management planning and permitting to streamline the City permitting process and facilitate climate-resilient best management practices for privately-owned and managed green spaces. Opportunities for stormwater system easements to create habitat networks or to connect ecosystem services. Opportunities to leverage green stormwater infrastructure (GSI) to expand and connect pedestrian/bicycle path networks for alternative transportation routes, including connections to the Interurban Trail. 	Policies and Procedures	6 Policies and Procedures
	Utility Programs	7.3 Public Involvement Programs
<p>Strategy #3 – Street Sweeping: Evaluate the street sweeping program to identify changes to sweeping locations, timing, and frequency that could increase resilience to climate change and equity, particularly reducing the likelihood that drain inlets clog during large storms and the potential to improve water quality in surface water bodies in the city, and potential benefit to benefit vulnerable populations. Expand or modify the street sweeping program based on the findings. Note that efforts to expand the urban forest canopy may contribute additional leaf litter that could clog storm drain inlets.</p>	Utility Programs	7.2.1 Street Sweeping
<p>Strategy #4 – Data Collection: Implement proactive data collection and mapping of stormwater system components and critical areas to improve the City’s ability to evaluate stormwater system deficiencies, improve system resilience, and protect critical areas (streams, wetlands, and geologic hazard areas). Improved hazard mapping (especially for slide areas) is recommended because seasonal changes in rainfall could impact the sensitivity of slide-prone areas.</p>	Systems Evaluation	4.2 Conveyance Capacity
	Utility Programs	7.1.6 Asset Management
<p>Strategy #5 – Regional Stormwater Facilities: Plan and construct regional stormwater facilities to protect surface water bodies by providing flow control and/or water quality treatment. The City can take two primary approaches to regional stormwater facilities:</p>	Policies and Procedures	6 Policies and Procedures

CLIMATE IMPACTS & RESILIENCY STUDY

Climate Resilience Strategy	Surface Water Master Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
<p>a. Redevelopment-focused regional stormwater facilities, i.e. those that are located downstream of areas that are expected to experience significant redevelopment.</p> <p>b. Retrofit-focused regional stormwater facilities, i.e. those that are focused toward providing the maximum stormwater benefits downstream of developed areas, regardless of whether the tributary area is likely to experience significant redevelopment.</p>	Implementation	10.3 Projects
<p>Strategy #6 – Capital Facilities Planning: Require capital project managers to review near-term planned and proposed projects for their potential to improve surface water issues, reduce urban heat island effects, and/or increase equitable services by using the Climate Impacts Tool. This should be documented in the upcoming Public Works’ Project Management Manual. As more information becomes available on stormwater system capacity and flooding problems, add this information to the Climate Impacts Tool.</p>	Levels of Service	2.2 Defining Levels of Service
	Drainage Systems	All
	Utility Programs	7.1.4 Drainage Assessment
	Management Strategies	8.1 Prioritization Process
	Implementation	10.3 Projects
<p>Strategy #7 – Proactive Maintenance Staffing: Forecast City GSI installations to anticipate maintenance personnel shortages in the future, because GSI requires specialized maintenance and can be maintenance intensive. Incorporate any necessary increases in staffing into the next Surface Water Master Plan update and surface water utility rate assessment.</p>	Levels of Service	2.2 Defining Levels of Service
	Policies and Procedures	6 Policies and Procedures
	Utility Programs	7.2.7 Low Impact Development Maintenance
	Implementation	10.2.1 Staffing Needs
<p>Strategy #8 – More GSI: Construct more GSI through retrofit programs or policies to include GSI on City projects. Retrofit planning for GSI could include identifying priority areas based on downstream system capacity limitations and aquatic resource prioritization. Continue to evaluate and modify codes and/or standards to make GSI the preferred choice for development. Target grant applications to support projects that plan and implement GSI retrofits. If possible, coordinate with sidewalk, bike lane, and other mobility improvements in the ROW. Develop GSI Design Standards, such as standard plans, details, and specifications with a focus on consistency, function, and consideration of climate impacts.</p>	Systems Evaluation	4.3 Water Quality
	Policies and Procedures	6.2.2 Engineering Development Manual
	Implementation	10.3 Projects
<p>Strategy #9 – Soak-it-Up Rebate Program: Expand the Soak-it-Up program to further incentivize construction of GSI facilities. Improve the program to be more equitable, potentially through grants, targeted outreach and education, and actions that can benefit disadvantaged, including approaches that benefit individuals that don’t own property.</p>	Utility Programs	7.3.1 Soak It Up Low Impact Development Rebate
	Implementation	10.3 Projects
<p>Strategy #10 – Retrofit Drain Inlets: Identify high-priority inlets and implement a retrofit program to upgrade inlets for improved capacity. Consider equity issues when identifying the high-priority inlets.</p>	Utility Programs	7.1.4 Drainage Assessment
	Implementation	10.3 Projects

CLIMATE IMPACTS & RESILIENCY STUDY

Climate Resilience Strategy	Surface Water Master Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
Strategy #11 – Manage Lake Eutrophication: Rising temperatures may exacerbate water quality challenges associated with lakes. Evaluate the causes of lake eutrophication and proactively develop and implement lake management plans to include additional upstream stormwater requirements, stormwater retrofits, and/or in-lake remediation activities, depending on the identified causes.	Drainage Systems	All
	Systems Evaluation	4.3 Water Quality
Strategy #12 – Evaluate Sea Level Rise: Evaluate sea level rise in greater detail and develop strategy to address potential impacts to surface water outfalls, City property and park facilities, and private property.	Systems Evaluation	4.2 Conveyance Capacity
Strategy #13 – More Robust Downstream Analysis Requirements: Develop more robust requirements for downstream analysis, including identification of existing stormwater problem areas. For example, Chapter 1 of the King County Surface Water Design Manual (KCSWDM) includes a section on Downstream Drainage Problems Requiring Special Attention. The KCSWDM lists four problem categories: (1) conveyance system nuisance, (2) severe erosion, (3) severe flooding, (4) potential impacts to wetland hydrology. The City could develop and adopt similar requirements to trigger special stormwater mitigation in places where existing problems are most severe.	Systems Evaluation	4.2 Conveyance Capacity
	Policies and Procedures	6.2.2 Engineering Development Manual
Strategy #14 – Drain Inlets: Modify design standard to require combination inlets or dual inlets under certain conditions (e.g., sags in the roadway, areas with history of clogging or capacity-related flooding, areas with significant tree canopy) to increase capacity for higher-intensity storm events and reduce the risk of clogging. Increased inlet capacity may result in additional debris in the downstream pipe network, which can be partially offset by preventative programs such as street sweeping.	Systems Evaluation	4.2 Conveyance Capacity
	Policies and Procedures	6.2.2 Engineering Development Manual
Strategy #15 – Stormwater Facility Sizing: Modify the standards for design of conveyance, flow control, and treatment facilities. Examples are given below. <ul style="list-style-type: none"> • Conveyance: Require application of a climate change safety factor on design flows used in conveyance sizing (near term). • Flow control and treatment facilities: Require analysis using a precipitation timeseries that has been modified to account for climate change impacts after a regionally accepted standard of practice has been defined (longer term). 	Systems Evaluation	4.2 Conveyance Capacity
	Policies and Procedures	6.2.2 Engineering Development Manual
Strategy #16 – Resilient Planting: Revise tree list and GSI planting requirements to create more resilient urban habitat and expand urban forest canopy. Based on a high-level review of the current tree list, preliminary suggestions include the following.	Policies and Procedures	6.2.5 City of Shoreline Comprehensive Plan



CLIMATE IMPACTS & RESILIENCY STUDY

Climate Resilience Strategy	Surface Water Master Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
<p>Strategy #17 – More Resilient Urban Design Standards: Consider modifying design standards to ensure that future development increases city-wide resilience to climate change. As an example, modify design standards to encourage more vegetation and large trees. In addition to stormwater benefits, vegetation can improve urban habitat and provide shading to mitigate urban heat island effects.</p>	Policies and Procedures	<p style="text-align: center;">6.2.5 City of Shoreline Comprehensive Plan</p>

Transportation Master Plan

Current plan period: 2011-2021

Scheduled update: December 2022

Lead Department/Staff: Public Works, Transportation Division

Climate Resilience Strategy	Transportation Master Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
Strategy #2 – Partnership: Develop a framework for public and private partnerships that work towards a more resilient city through stormwater management strategies that increase green space, habitat connections, and mobility. For example, partnerships could support opportunities to leverage green stormwater infrastructure (GSI) to expand and connect pedestrian/bicycle path networks for alternative transportation routes, including connections to the Interurban Trail.	Bicycle Plan	System Continuity
	Pedestrian Plan	System Continuity
Strategy #4 – Data Collection: Collect data on areas in the transportation system that experience erosion and/or flooding to inform improved mapping and evaluation of the City’s stormwater system. Use the inventory to also collect data about vulnerability to urban heat islands within the transportation system and evaluate areas with opportunity for building resilience.	Inventory	All
Strategy #6 – Capital Facilities Planning: Require capital project managers to review near-term planned and proposed projects for their potential to improve surface water issues, reduce urban heat island effects, and/or increase equitable services by using the Climate Impacts Tool.	Inventory	All
	Pedestrian Plan	Prioritization – Equity
Strategy #7 – Proactive Maintenance Staffing: Forecast GSI installations within the transportation system to anticipate maintenance personnel shortages in the future. Incorporate any necessary increases in staffing into the next Transportation Master Plan update.	Sustainability & Quality of Life	Maintenance
Strategy #8 – More Green Stormwater Infrastructure (GSI): Inventory current GSI installations within the transportation system (if such an inventory does not already exist) and specifically flag locations where GSI provides co-benefits, such as increasing connectivity of pedestrian and bike networks. Construct more GSI through retrofit programs or policies to include GSI on City projects. Coordinate GSI with sidewalk, bike lane, and other mobility improvements in the ROW.	Inventory	All
Strategy #12 – Evaluate Sea Level Rise (SLR): Assess SLR impacts to the transportation system.	Inventory	All
Strategy #16 – Resilient Planting: Create a safer and more enjoyable biking, walking, and transit experience by increasing tree plantings and planting tree species that will be more resilient to climate impacts. Co-	Sustainability & Quality of Life	All



CLIMATE IMPACTS & RESILIENCY STUDY

Climate Resilience Strategy	Transportation Master Plan Section(s) Most Aligned with Strategy	
	PLAN COMPONENT	SUB-SECTION
benefits include more resilient urban habitat, expanded urban forest canopy, reduced urban heat island effect, and greenhouse gas emissions mitigation	Bicycle Plan	Safety and Quality
	Pedestrian Plan	Safety and Quality
	Transit Plan	Improving Key Passenger Facilities
Strategy #17 – More Resilient Urban Design Standards: Consider modifying design standards for the transportation system to ensure that future development increases city-wide resilience to climate change.	Sustainability & Quality of Life	All
	Bicycle Plan	Safety and Quality
	Pedestrian Plan	Safety and Quality