



CITY OF BELLEVUE

Comprehensive Plan 2044

Climate Vulnerability Assessment



City of Bellevue

Community Development Department

450 110th Avenue NE

Bellevue, WA 98004



Environmental Science Associates

2801 Alaskan Way, Suite 200

Seattle, WA 98121



BERK Consulting

2200 Sixth Avenue, Suite 1000

Seattle, WA 98121

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SECTION 1 Summary and Introduction

The City of Bellevue conducted a Climate Vulnerability Assessment to determine the extent to which climate change is likely to affect people, the built environment, and natural systems. With this information, the City of Bellevue can consider adapting its policies and strategies to be more prepared and more resilient to climate impacts. Bellevue will likely experience the following changes over the next 50 years (University of Washington Climate Impacts Group [UW CIG] 2009; Roop et al. 2020), which will have impacts on human health and the built and natural environment:

- Increasing average annual air temperatures leading to:
 - More frequent and extreme heat events,
 - More prolonged periods of drought, particularly during summers, in soil moisture and streambeds, and
 - Increasing stream temperatures;
- Increasing extreme precipitation events, particularly during the winter, leading to:
 - Increased risk of runoff, erosion, and landslides or mudslides, and
 - Increased frequency and extent of flood events;
- Increasing frequency, severity, and extent of regional wildfires leading to:
 - Increasing frequency and severity of poor air quality (local risk of wildfires is low, but wildfire smoke will be an issue as fires increase across the Pacific Northwest).

The vulnerability of a community or particular resource (e.g., sector, neighborhood) to climate change is determined by evaluating its exposure, sensitivity, and adaptive capacity. **Exposure** refers to the degree of climate change impacts that occur, while **sensitivity** is the degree to which a community or resource is affected by some amount of exposure. Exposure and sensitivity combined provide an understanding of the potential impacts posed by climate change to a resource. **Adaptive capacity** refers to the degree to which a community or resource is able to cope with those potential impacts. When combined, these three factors—exposure, sensitivity, and adaptive capacity—provide a fuller picture of vulnerability (Figure 1). To reduce

vulnerability, communities like Bellevue can engage in adaptation planning. A suite of adaptation strategies are available for the City of Bellevue to explore integrating into its Comprehensive Plan and other projects and planning efforts.



FIGURE 1 Elements of Climate Vulnerability

In collaboration with the City of Bellevue, the consultant team identified 10 topics to cover in the vulnerability assessment, including:

- Buildings and Energy
- Cultural Resources
- Economic Development
- Ecosystems
- Emergency Management
- Human Health
- Transportation
- Waste Management
- Water Resources
- Zoning and Development

The purpose of this report is to summarize the vulnerabilities posed to people and resources in the city by climate change and identify potential adaptation strategies for the City of Bellevue to consider in planning and projects. The report includes regional climate trend data and a climate vulnerability index, which is a spatial map incorporating data from 30 different indicators considering local information about exposure, sensitivity, and adaptive capacity in Bellevue. Environmental and land use planners, biologists, engineers, and other professionals on the project team considered climate science, social and economic conditions, land cover, infrastructure systems, programs and plans, and more to develop vulnerability summaries of community assets, hazards, risks, and opportunities for each sector described above.

Adaptation strategies were derived from a review of the Washington State Department of Commerce’s Model Climate Resilience Element and Menu of Measures,¹ the King County–Cities Climate Collaboration (K4C), and other municipal adaptation plans. The summary of adaptation strategies begins with an audit of current policies, and identification of gaps or opportunities to strengthen or add policies. The questions below guided the audit of existing policies:

- What goals and policies (measures) explicitly or implicitly build climate resilience?
- How can the measure be amended or supplemented by a new goal or policy to better address Bellevue’s climate-related hazards and impact(s)?

¹ Menu of Measures: <https://app.smartsheet.com/b/publish?EQBCT=ac5e7c0a46e54f779f35588b1fa2a9c7>

1.1 People Vulnerable to Climate Change

Communities that tend to be more vulnerable to climate stressors are those that are already at social and economic risk, including older people, children, low-income families, immigrant communities, and Black, Indigenous, and people of color (BIPOC) individuals. For example, persons that are elderly may have more limited mobility or preexisting health conditions, and children under 5 years old may have a harder time regulating temperature and may have underdeveloped immune systems. Low-income households may be more susceptible to illnesses and have limited resources to adapt or respond to climate change. Communities of color may have cumulative exposures to pollution and health and social disparities. Persons that speak English less than very well may have more difficulties during evacuation and difficulties accessing post-disaster funding.

Although Bellevue is a largely affluent community, some demographic risk factors include a high share of non-White residents including those that are foreign born and speak English less than very well, older adults, and those living alone (Table 1). A lack of quality affordable housing is also a risk.

TABLE 1 City of Bellevue Demographic Risks Associated with Neighborhoods

Bellevue Demographic Indicators	Citywide Statistics: 2021	Neighborhoods with Greater Share
Children, <5 years old	4.4%	BelRed, Crossroads, Eastgate, Newport, West Bellevue, West Lake Sammamish
Older Adults, > 65 years old	15.0%	Crossroads, Northeast Bellevue
Communities of Color (non-White including Hispanic)	56.5%	BelRed, Bridle Trails, Cougar Mountain, Crossroads, Lake Hills, Somerset, West Bellevue
Low-Income Communities (Poverty Rate)	7.4%	BelRed, Crossroads, Lake Hills, Factoria, Newport
Living Alone	14.6%	BelRed, Downtown
Immigrants (including limited English)		
Foreign Born	42.0%	
Speak English less than “very well”	16.5%	Linguistic Isolation: Downtown
Disabled	9.5%	Unmapped
Unemployment	3.8%	Crossroads, Newport, Northeast Bellevue, Northwest Bellevue, Woodridge
Outdoor workers	4.1%	Eastgate, Newport, Northeast Bellevue, West Lake Sammamish, Woodridge
Persons with pre-existing or chronic medical conditions, Fair or poor health	8.5%	Crossroads, Eastgate, Factoria, Lake Hills, Newport, Somerset, West Lake Sammamish
Education – less than high school degree	10%	Northwest Bellevue

SOURCE: 2021 ACS 5-Year Estimates (ACS 2020); Seattle-King County Health Department n.d.

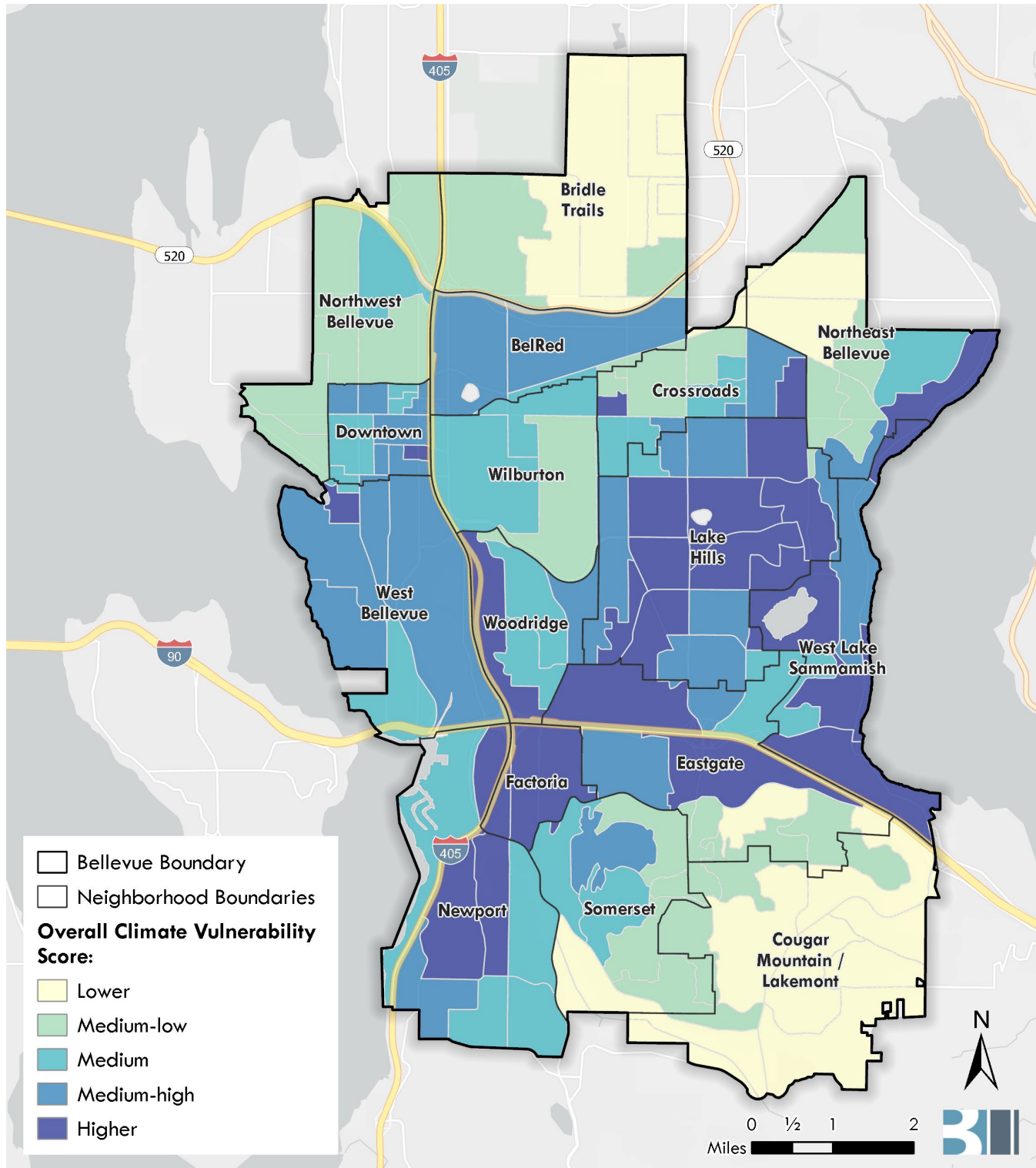
Potential impacts to vulnerable populations include:

- An increase in heat-related deaths and illnesses, particularly among the elderly, poor, and other vulnerable populations. A study in King County showed an increase in basic life services (BLS) and advanced life services (ALS) with extreme heat events (DeVine et al. 2017).
- Rising temperatures and wildfires and decreasing summer precipitation will lead to increases in ozone and particulate matter, elevating the risk of cardiovascular and respiratory illnesses and death (Yu 2021).
- Increased vulnerability of residents, particularly those who live in poverty and polluted and/or high-risk hazard areas. Bellevue has identified about 13 percent of the city's land area is within an Air Pollution Exposure Zone (APEZ; 500 feet of a major road such as I-405) and about 18 percent of that area is zoned for multifamily or mixed-use residential use.

1.2 Places Vulnerable to Climate Change

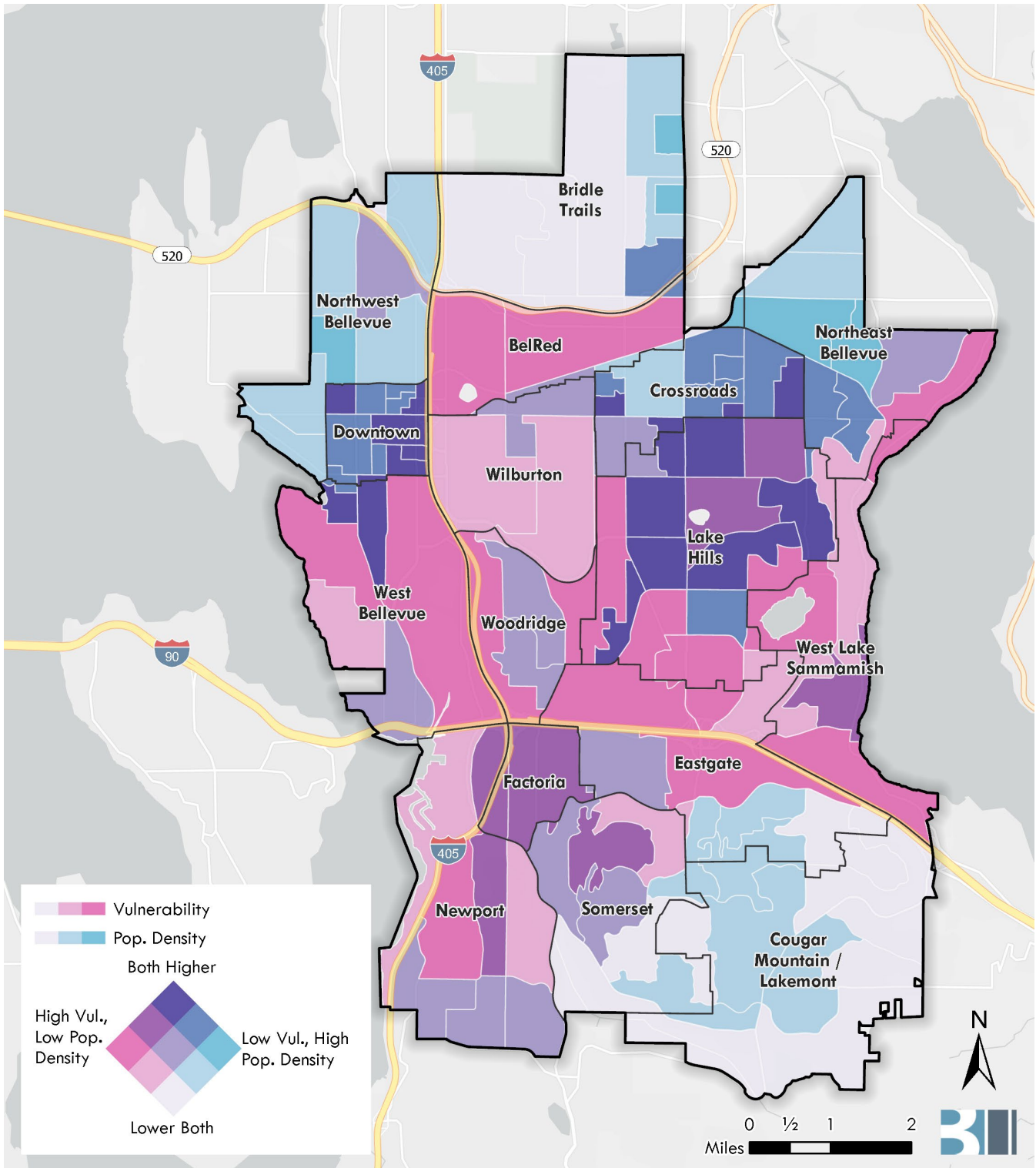
The Bellevue Climate Vulnerability Index (CVI) was developed as part of the vulnerability assessment and is explained in detailed in Section 2. The CVI includes 30+ indicators and combines them to form an index that supports a planning-level view of climate vulnerability in Bellevue to help identify areas of the city that may be more or less vulnerable to the impacts of climate change. The indicators include metrics for climate stressors, demographics, community health, critical areas, and others relevant to the spatial variability of climate vulnerability. The overall index combines the results of the three subindices for exposure, sensitivity, and adaptive capacity. Two illustrations of the index results demonstrate the effect of climate vulnerabilities with and without population density.

- For example, BelRed has a medium-high index score on Figure 2 without population density accounted for. With population accounted for in Figure 3, BelRed is noted as a higher vulnerability and lower population density area. As the area grows, the City of Bellevue can consider the factors that identify this area as higher vulnerability (e.g., extreme heat exposure, urban heat island, and lower tree canopy) and employ strategies to reduce vulnerability (e.g., green infrastructure, passive cooling, etc.).
- Downtown has moderate vulnerability in the general index due to extreme heat exposure and air quality exposure, and a higher share of older adults and foreign-born persons who may be more vulnerable. The standard index shows a moderate-high level of vulnerability but the index combined population density identifies a higher level of vulnerability.



SOURCE: BERK 2023

FIGURE 2 Climate Vulnerability Index without Population Density



SOURCE: BERK 2023

FIGURE 3 Climate Vulnerability Index with Current Population Density

1.3 Overall Climate Vulnerability Summary

VULNERABILITY SUMMARY

For each sector, the project team evaluated: assets (e.g., people, places, infrastructure, and resources); climate-related hazards; risks and vulnerabilities; and gaps and opportunities for adaptation action. At a high level, the potential impacts and risks to sectors of importance in the city include:

- Increased cooling demand in summer and more frequent power loss;
- Increased flooding and stormwater runoff;
- Loss of or damage to cultural/historic sites and culturally significant foods;
- Disruptions of business continuity;
- Shifts in business and recreation opportunities;
- Increased demand for emergency services;
- Damage to infrastructure due to flooding or extreme precipitation;
- Exacerbated public health conditions due to heat and smoke;
- Challenges to preparing for/recovering from events;
- Degradation and loss of habitat and trees (e.g., erosion, water quality, canopy loss); and
- Damage to housing/risk of displacement.

For many of these impacts, the City of Bellevue has policies or programs to expand resilience such as energy conservation and tree canopy plans and protections. High-level qualitative climate vulnerability scores for each sector included in this assessment (Table 2) were developed using the following rubrics:

- **Potential Impacts** (assumes assets are exposed to climate change)
 - High: Likely to experience major damage or disruption
 - Moderate: Likely to experience minor damage or disruption
 - Low: Unlikely to experience damage or disruption

		Potential Impact		
		Low	Moderate	High
Adaptive Capacity	Low	Low	High	Highest
	Moderate	Low	Moderate	High
	High	Lowest	Moderate	Moderate

- **Adaptive Capacity** (based on ability to cope or recover or moderate impacts)
 - High: Able to rebound quickly
 - Moderate
 - Low: Unable to rebound quickly

TABLE 2 Vulnerability Summary by Sector

Topic	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Buildings & Energy	Moderate-High	Moderate	Moderate-High
Cultural Resources & Practices	Moderate-High	Moderate	Moderate-High
Economic Development	Moderate-High	Moderate	Moderate-High
Ecosystems	Moderate-High	Moderate-High	Moderate
Emergency Management	Moderate-High	Moderate	Moderate-High
Human Health	Moderate-High	Moderate	Moderate-High
Transportation	Moderate	Low-Moderate	Moderate
Waste Management	Moderate	Low-Moderate	Moderate
Water Resources	Moderate	Moderate-High	Moderate
Zoning & Development	High	Moderate	Moderate-High

SOURCE: ESA & BERK 2023

Full details and detailed evaluations of climate-related vulnerabilities are presented by sector in Section 3.

ADAPTATION SUMMARY

While the focus of this report is on identifying climate-related vulnerabilities posed to sectors of concern in Bellevue, the consultant team also identified some potential adaptation measures for consideration, including existing Comprehensive Plan policies that are responsive to climate change and additional strategies that can be considered in departmental programs and projects. Strategies are presented by sector in Section 4. Below are some high-level adaptation measures organized by sectors/themes. Many of these are listed as high-performing measures in the Washington State Department of Commerce Model Climate Element Menu of Measures. The high performing strategies are illustrated in Figure 4.

Buildings & Energy, Economic Development, Zoning & Development

- Minimize power outages from the local electric utility during extreme weather events by identifying and protecting critical energy facilities.
- Encourage facility owners to develop decentralized power generation and fuel flexibility capabilities.
- Increase energy efficiency across all sectors through education, efficiency retrofits, and building management systems.
- Increase solar readiness for new residential and commercial buildings.
- Ensure backup power generation for critical facilities and identified key infrastructure during power outages
- Support retrofits to public facilities and housing to improve indoor air quality.
- Develop an ordinance incorporating reflective surfaces (“cool paving” or “cool roofs”) into all municipal projects (e.g., parking lots and streets) and new private parking lot projects.
- Install energy-efficient and low-water-use equipment during renovations in all buildings owned by the City of Bellevue.

- Encourage sustainability certification for public infrastructure projects (e.g., Envision) to increase resilience of infrastructure.
- Promote green jobs and invest in a resilient economy as directed by Bellevue’s Economic Development Plan and Sustainable Bellevue: Environmental Stewardship Plan.
- Support local businesses’ efforts to generate and store renewable electricity on-site, which can provide back-up power during emergencies and help ensure continuity of operations.

Cultural Resources & Practices, Ecosystems

- Identify and protect historic and cultural sites that may be acutely sensitive to climate hazards such as flooding (e.g., raising, retrofitting, relocating structures).
- Create and implement culturally contextualized outreach and education initiatives and materials that will inform the community about near-term and longer-term climate change threats and ways that the community can prepare and build resilience to these changes.
- Enhance urban tree canopy initiatives and use shade trees (e.g., canopy-forming trees) in all projects.
- Develop a comprehensive list of plant and tree species known to have a broad range of environmental tolerances (e.g., heat, drought, pest, and disease resilient species).
- Manage local forest density to reduce susceptibility to drought stress, pests, and diseases and plant trees that are compatible with future climate conditions.
- Preserve and enhance critical areas, considering the long-term impacts of climate change.
- Work with private property owners to build resilience of critical areas to the impacts of climate change.
- Reduce water use in parks and streetscapes to conserve water during droughts.

Water Resources, Waste Management

- Increase capacity of stormwater systems to manage increases in precipitation and higher peak flows
- Educate residents and businesses about the benefits and appropriate uses of local water supplies (including recycled water and onsite water reuse systems) and further integrate recycled water (if available) and onsite water reuse systems into new development and redevelopment plans.
- Encourage projects that capture and reuse stormwater onsite.
- Encourage use of permeable pavement in non-critical areas—low-use roadways, sidewalks, parking lots and alleys where soils permit proper drainage.
- Ensure all water and wastewater pumping stations have off-grid, onsite energy sources and/or reliable backup power sources by increasing the number of backups and pulling electricity from different grids.
- Improve stormwater quality to help keep lakes clean and free of algae.

Emergency Management, Human Health

- Increase local access to healthy and affordable foods to reduce stress and capacity constraints during extreme events.

- Ensure that emergency response plans incorporate possible climate changes that could impact the protection of staff, infrastructure, and facilities during emergencies and extreme weather events.
- Support retrofits to public facilities and housing to improve indoor air quality.
- Evaluate, improve, and build redundancy into all public and inter-agency warning and communication systems.
- Identify additional alternative routes and modes for effective transport and evacuation efforts during emergency situations.
- Ensure access to cooling centers, parks, and shorelines through transit and pedestrian/bicycle infrastructure.
- Build and foster community connections and resilience through neighborhood programming and outreach. Explore the creation and implementation of community-based Resilience Hubs to provide support during and after extreme events.
- Support vulnerable populations during smoke events.
- Develop strategies to support the homeless population during climate events.

Transportation

- Prioritize infrastructure upgrades for roads at risk of flooding.
- Raise streets in identified flood-prone areas as they are redeveloped.
- Implement a repaving strategy that reduces heat-related damage to asphalt and incorporates maintenance and operations that extend the life of the road surface.
- Develop deicing strategies and materials that are effective in extreme cold temperatures and prolonged events to stabilize roadway and bridge surfaces.
- Ensure vulnerable populations are served by transit during climate events or emergencies.
- Provide reliable infrastructure for walking and biking.
- Provide backup power for electric vehicle charging for fleets and critical facilities and publicly accessible charging stations.

CLIMATE ADAPTATION MEASURES

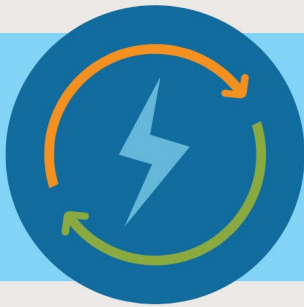
Urban Forest

Add tree canopy especially within urban heat islands. Update tree species selection to be resilient to climate change.



Renewable Energy

Install distributed renewable energy (solar, combined heat and power) on sites or microgrids to provide electricity during power outages or high energy demand days.



Design with Nature

Build green infrastructure projects. Consider stormwater capacity with new climate projections. Restore streams and manage floodplains to be climate resilient.



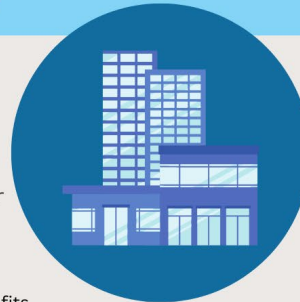
Connected Communities

Provide parks and trails to connect housing, schools, and businesses across the community. Provide multimodal travel options for all including frontline communities. Raise streets in flood-prone areas



Retrofits & Design

Promote resilient building retrofits and designs. Increase passive survivability. Add cool roofs, green roofs or facades, and exterior shade features. Floodproof or relocate structures.



See Commerce Menu of Measures, K4C Climate Toolkit, ULI Resilient Retrofits.

SOURCES: Commerce Menu of Measures, K4C Climate Toolkit 2021, Urban Land Institute (ULI) Resilient Retrofits 2022

FIGURE 4 High Performing Adaptation Measures

1.4 Next Steps

Bellevue can address the results of the Climate Vulnerability Assessment in its Comprehensive Plan growth strategy and goals and policies. As part of the public engagement process associated with the Comprehensive Plan update, engagement with overburdened communities, the broader community, and decision makers can help prioritize efforts both citywide and by neighborhood.

SECTION 2 Climate Change in Bellevue

2.1 Regional Climate Trends

Climate is the average weather for a region expected at different times of the year. Climate is usually reported over a span of 30 years. Climate change means a difference in the average conditions in a region such as temperature and rainfall.² As noted in Section 1, Bellevue and King County will likely experience a wide range of climate-driven changes:






- Rising air temperatures, extreme heat events, drought, and low soil moisture;
- Low streamflows and increasing water temperatures;
- Wildfire smoke from fires in the Pacific Northwest; and
- Extreme precipitation and flooding.

For this assessment, climate projections were evaluated for the 2050s (2040–2069) or the 2080s (2070–2099), as compared to the historical period of 1981–2010. The climate projections are all based on Representative Concentration Pathway (RCP) 8.5, a global emissions scenario developed for the Intergovernmental Panel on Climate Change (IPCC), in which global emissions continue unabated throughout the rest of the century. There are other less extreme scenarios that were considered, namely RCP 4.5, in which emissions stabilize by mid-century then decline sharply after. Projections also exist for the 2030s, however they show very little variability and as such, are not recommended for use in this project. For the purpose of long range climate planning, the 2080s are used as the timeframe to look at climate projections.

Information about climate change considers hazards based on climate and hydrologic models. The direction of climate trends in the county plus local information about conditions in Bellevue can be useful for general planning and assessment, such as climate vulnerability assessments, climate resilience plans, climate action plans, or climate resilience elements in comprehensive plans. Table 3 shares climate change trends expected in 2050 for King County and communities within, including Bellevue. It is generally based on county-level information provided in the *Climate Mapping for a Resilient Washington* tool (UW CIG 2022). Local stream information is included as well for Kelsey Creek.

² NASA Climate Kids: <https://climatekids.nasa.gov/climate-change-meaning/#>.

TABLE 3 King County Median Changes by 2050

	Description of Likely Changes	Indicators
 <p><small>Created by Adrien Coquet from the Noun Project</small></p> <p>Extreme Heat</p>	<p>An increase in average summer temperatures is expected. This could affect people, landscaping, agriculture, and natural areas like wetlands, wildlife habitats, and other ecosystems.</p> <p>More days above 90°F humidex (humidity and heat) are expected, which can affect public health.</p> <p>An increase in the number of cooling degree days is an indicator of greater potential for more cooling demand for buildings in the summer.</p> <p>Hotter days can increase ground-level ozone, a greenhouse gas (GHG).</p>	<p>+ 6.3°F Change in Average Summer (June - August) Maximum Temperature</p> <p>+ 20.1 days above 90°F humidex</p> <p>+ 287°F-days change in cooling degree days (base 65°F)</p>
 <p><small>Created by Laynik from the Noun Project</small></p> <p>Wildfire & Smoke</p>	<p>There would be more fire-danger days that could affect homes and businesses where forests and wildland vegetation meet or intermingle.</p> <p>More wildfire smoke can result in particulates affecting those with health conditions (e.g., heart and lung disease, pregnancy, etc.).</p>	<p>+ 10 days Change in High Fire Danger Days</p>
 <p>Extreme Precipitation</p>	<p>More frequent and intense storms are expected. This could affect flooding, erosion, and runoff and impact stormwater systems, transportation, and emergency responses.</p> <p>Summer precipitation below 75% of normal is an indicator of drought because it is a consideration in the legal definition of drought in Washington State, which includes less than 75% of normal water supply.</p>	<p>+ 13% Change in the Magnitude of 25-Year Storm</p> <p>+ 9% Change in the Magnitude of 2-Year Storm</p> <p>25% Chance that a year in the 2040-2069 period will have summer precipitation at or below 75% of normal.</p>
 <p><small>Created by Adrien Coquet from the Noun Project</small></p> <p>Flooding</p>	<p>The county would experience increases in peak stream flows, more areas flooded. This could impact more homes, businesses, farms, and infrastructure.</p>	<p>82% of stream lengths in King County would see Across the county streams could see 10-50% more streamflow on the day of the year with the highest streamflow.</p> <p>Values mapped in Bellevue: Kelsey Creek +12%</p>
 <p>Reduced Snowpack</p>	<p>In winter, there would be less stored water in snow, and less water available for streams, soil, and reservoirs.</p> <p>This could affect aquatic species, trees, vegetation, and water supply.</p>	<p>-76 % Change in April 1 Snowpack</p> <p>Most stream lengths would see -10 to -100% change from historic low streamflow in summer (June-September).</p> <p>Values mapped in Bellevue: -6%</p>

SOURCES: UW CIG 2022; U.S. Environmental Protection Agency (EPA) 2022

2.2 Climate Vulnerability Index

PURPOSE

The Bellevue CVI was developed as part of the Bellevue Climate Vulnerability Assessment. The CVI includes 30+ indicators and combines them to form an index that supports a planning level view of climate vulnerability in Bellevue to help identify areas of the city that may be more or less vulnerable to the impacts of climate change. The indicators include metrics for climate stressors, demographics, community health, critical areas, and others relevant to the spatial variability of climate vulnerability.

Climate vulnerability in this context is defined as exposure to a changing climate based on regional climate trends for extreme heat and precipitation, and an overall vulnerability index made up of subindices:

- A sub-index reflecting local environmental conditions including flooding, air quality, and heat data
- A sub-index reflecting the inherent sensitivity of people (e.g., health or age) or environments (e.g., geologic hazards, water quality) to a changing climate
- A sub-index regarding the capacity of the community and place to cope or adapt to the impacts of a changing climate

The conceptual formula is:

$$\text{Climate Vulnerability} = \text{Regional Climate Change Exposures} + \text{Local Environmental Exposures Sub-index} + \text{Sensitivity Sub-index} + (\text{Low}) \text{ Adaptive Capacity Sub-index}$$

The CVI sums over 30 indicators of climate vulnerability at the parcel level and displayed at larger and/or generalized geographies (e.g., census block groups, heat maps, etc.), which help to identify where Bellevue is more or less vulnerable to climate change. The indicators are drawn from literature and studies regarding social vulnerability, health, environment, and climate change. For example, some areas are more vulnerable due to extreme heat, such as “heat islands” with more pavement and fewer trees, or areas with a higher concentration of older residents. Some areas are vulnerable to extreme precipitation such as floodplains and landslide hazard areas, along with populations that live alone or have less access to a vehicle. The index provides information useful for Bellevue to develop strategies to enhance the city’s resilience over the medium and long term and include the strategies in plans, budgets, partnerships, and more.

INDEX INDICATORS

An index is a calculation used to summarize multiple datasets into one measure and normalizes or standardizes dissimilar data. This index uses the standard score, or z-score, which is a statistical measure that describes how many standard deviations away from the mean a given value is. Scores greater than the mean have a positive value, and scores less than the mean have a negative value. For each indicator dataset, values are standardized by calculating the corresponding z-score for each value, creating an “apples-to-apples” measure by which these dissimilar datapoints are compared.

For each component of climate vulnerability (exposure, sensitivity, and adaptive capacity), the indicators are standardized and then averaged to create an average z-score for each component. These three component z-scores are then averaged together to create the final CVI value. To visually present the CVI, final index values are classified based on quintile categorization, which distributes the values into five groups of an equal number of values based on the total range of scores. The final group results in lower, medium-low, medium, medium-high, and higher vulnerability classifications, emphasizing the relative nature of the calculation.

Table 4 shows the exposure, sensitivity, and adaptive capacity indicators selected for the index.

- **Regional Exposure:** Exposure indicators for extreme heat and extreme precipitation are considered in relation to local environmental exposures, sensitivity conditions, and adaptive capacity conditions in Bellevue. These extreme heat and extreme precipitation data are outside of the CVI given the fairly constant increase within the Bellevue city limits.
- **Local Exposure Sub-index:** This sub-index contributes to the CVI and is comprised of equal parts flooding, air quality, and heat considering local conditions. Regional climate exposures such as extreme precipitation could exacerbate the depth and extent of flooding. Extreme heat can exacerbate the health conditions of persons also exposed to air pollution, and extreme heat can be magnified by local environmental conditions (e.g., less trees, more pavement).
- **Sensitivity Sub-index:** Sensitivity is the component of the CVI addressing attributes inherent to the population or place that make them predisposed to increased impacts from climate exposure. The indicators for sensitivity are categorized into sub-categories of age, environment, and health conditions.
- **Adaptive Capacity Sub-index:** Adaptive capacity is the component of the CVI addressing attributes related to a population or environment's capacity to adapt to increased exposure to climate change. The indicators for adaptive capacity are categorized into sub-categories of socioeconomic, transportation, housing/built environment, employment, health, and environment/ecologic.

These components—exposure, sensitivity, and adaptive capacity—taken together create the CVI.

TABLE 4 Indicators for Bellevue CVI

Sub-Category	Indicator
LOCAL EXPOSURE	
Extreme Heat	(+) Urban heat island
Air Quality	(+) Air Quality (PM2.5)
Extreme Precipitation	(+) 100-yr Floodplains (potentially include 500-yr Floodplains)
	(+) Historically Flood-Prone Areas
SENSITIVITY	
Age	(+) Under 5 years old
	(+) Over 65 years old
Environment	(+) Steep Slopes/Geologic Hazards (liquefaction/ landslide hazards)
	(+) Poor Stream/Waterbody Health – 303d list for bacteria, dissolved oxygen, and temperature
Health Conditions	(+) Diabetes – crude rate in population >= age 18
	(+) Asthma – crude rate in population >= age 18
	(+) Respiratory Disease - COPD – crude rate in population >= age 18
	(+) Coronary Heart Disease – crude rate in population >= age 18
	(+) Poor Physical Health – crude rate in population >= age 18
	(+) Poor Mental Health – crude rate in population >= age 18
ADAPTIVE CAPACITY	
Socioeconomic	(+) People of Color
	(+) Population Experiencing Poverty
	(+) Low Educational Attainment – less than high school degree
	(+) Linguistic Isolation – households with limited English speaking at home
	(+) Living Alone – households comprised of householder living alone

Sub-Category	Indicator
	(+) Housing Cost Burden – renter households spending >30% of income on housing
	(+) Access to Vehicle – households without access to a vehicle
Transportation	(-) Access to Frequent Transit
Housing/Built Environment	(+) Housing Condition – houses built before 1960
	(+) Affordable Housing Inventory
	(+) Impervious Surfaces
Employment	(-) Proximity to City-Owned Facilities that increase adaptive capacity (libraries, community centers, fire stations)
	(+) Unemployment
Health	(+) Outdoor Professions – jobs likely to be performed outside (NAICS codes 11, 21, and 23)
	(+) Adult Population Without Health Insurance
Environment/ Ecologic	(-) Tree Canopy Coverage
	(-) Access to Parks/Open Space

NOTES: A (+) means that a higher indicator value contributes to a *higher* index value, while a (-) means that a higher indicator value contributes to a *lower* index value.

COPD = chronic obstructive pulmonary disease.

NAICS = North American Industry Classification System

REGIONAL CLIMATE EXPOSURE

Exposure of people, ecosystems, and infrastructure to climate change could include:

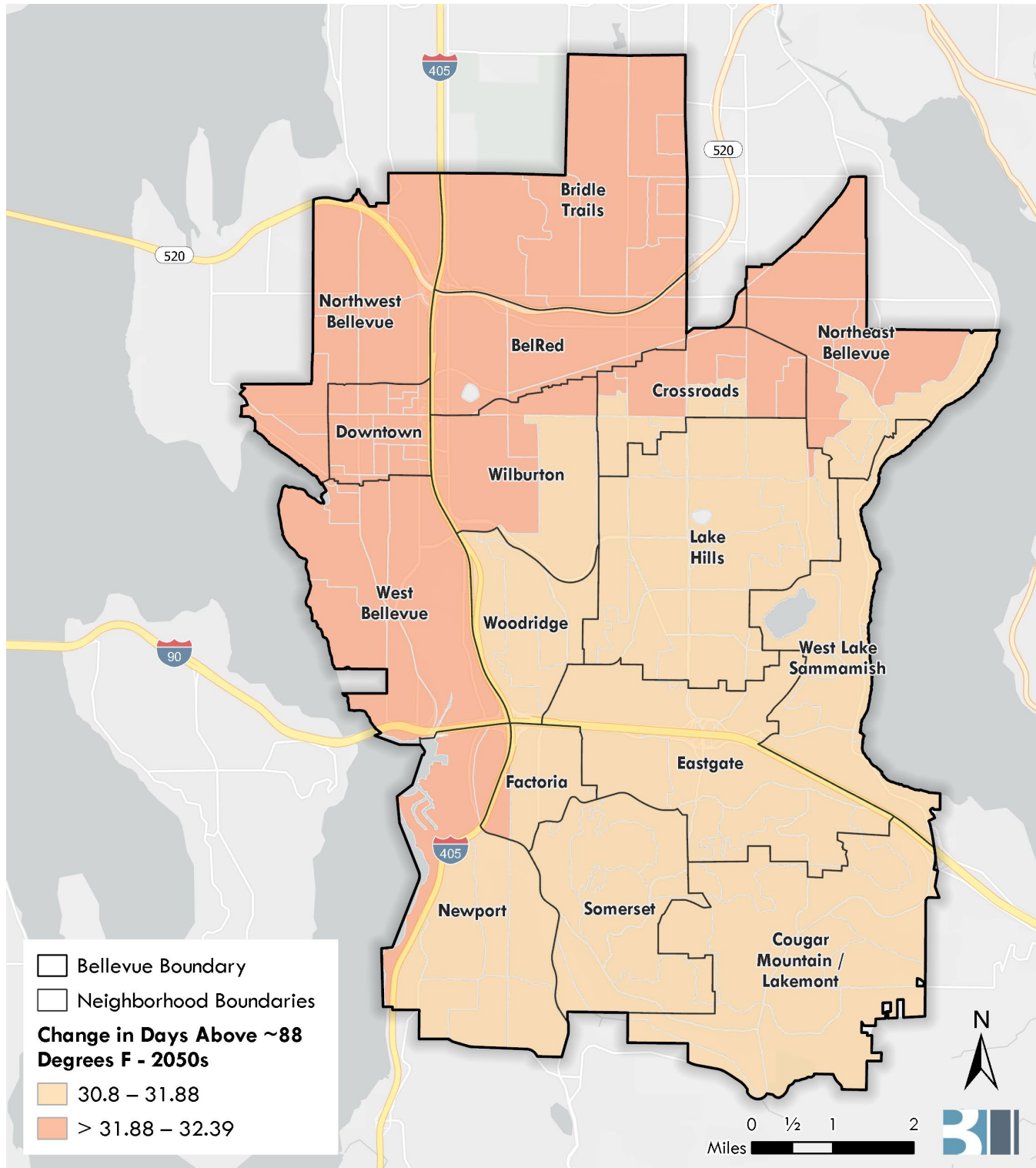
- Extreme precipitation
- Extreme heat

These are the regional exposures of focus in this document. Other climate exposures such as wildfire smoke could also affect Bellevue and are addressed in the Climate Vulnerability Assessment qualitatively.

Extreme Heat

Extreme high temperatures are anticipated to increase over historic conditions. In Bellevue by 2050 the change in the number of days above 88 degrees Fahrenheit (°F) humidex (heat and humidity) are projected to increase by 30.8 to 32.4 days (Figure 5). Because the change in extreme heat days is less than 1-2°F across the city, it is not part of the CVI.

The change in the number of 88°F humidex days is an indicator of stress on public health. Local exposure data regarding heat islands can provide local geographic information where extreme heat would be more or less felt. Combined with impervious area, lack of tree canopy, and populations with age or health conditions, some areas of Bellevue could be more vulnerable.

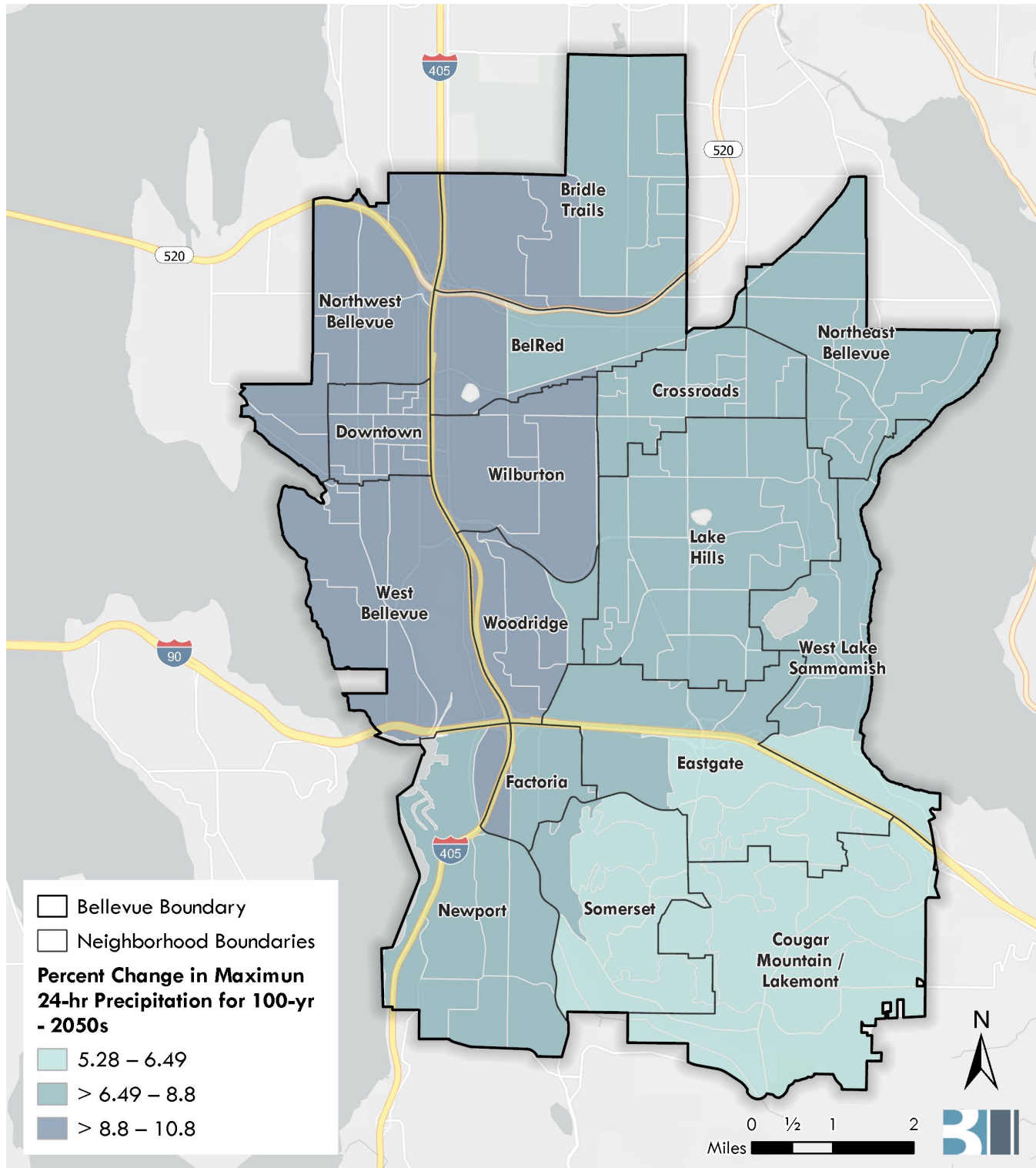


SOURCE: BERK 2023; DeVine et al. 2017

FIGURE 5 Extreme Heat Change in Days above 88°F Humidex – 2050s

Extreme Precipitation

The intensity of rainstorms is anticipated to increase at greater likelihood intervals (2-year or 25-year) and at lesser likelihood storms (100-year) stressing stormwater systems. Figure 6 illustrates the percent change in the Maximum 24-Hour Precipitation for the 100-Year Storm by the 2050s. The percent change could differ by 5.3% to 10.8% from south to central to west Bellevue. Although the percentage change is measurable across the city, it is not part of the CVI. In the future if the City of Bellevue determines that the precipitation data is sufficiently granular, it could include it in the CVI in the future. This indicator can be used to consider how climate change could affect stormwater system capacity, floodplain conditions, and erosion and landslide potential.



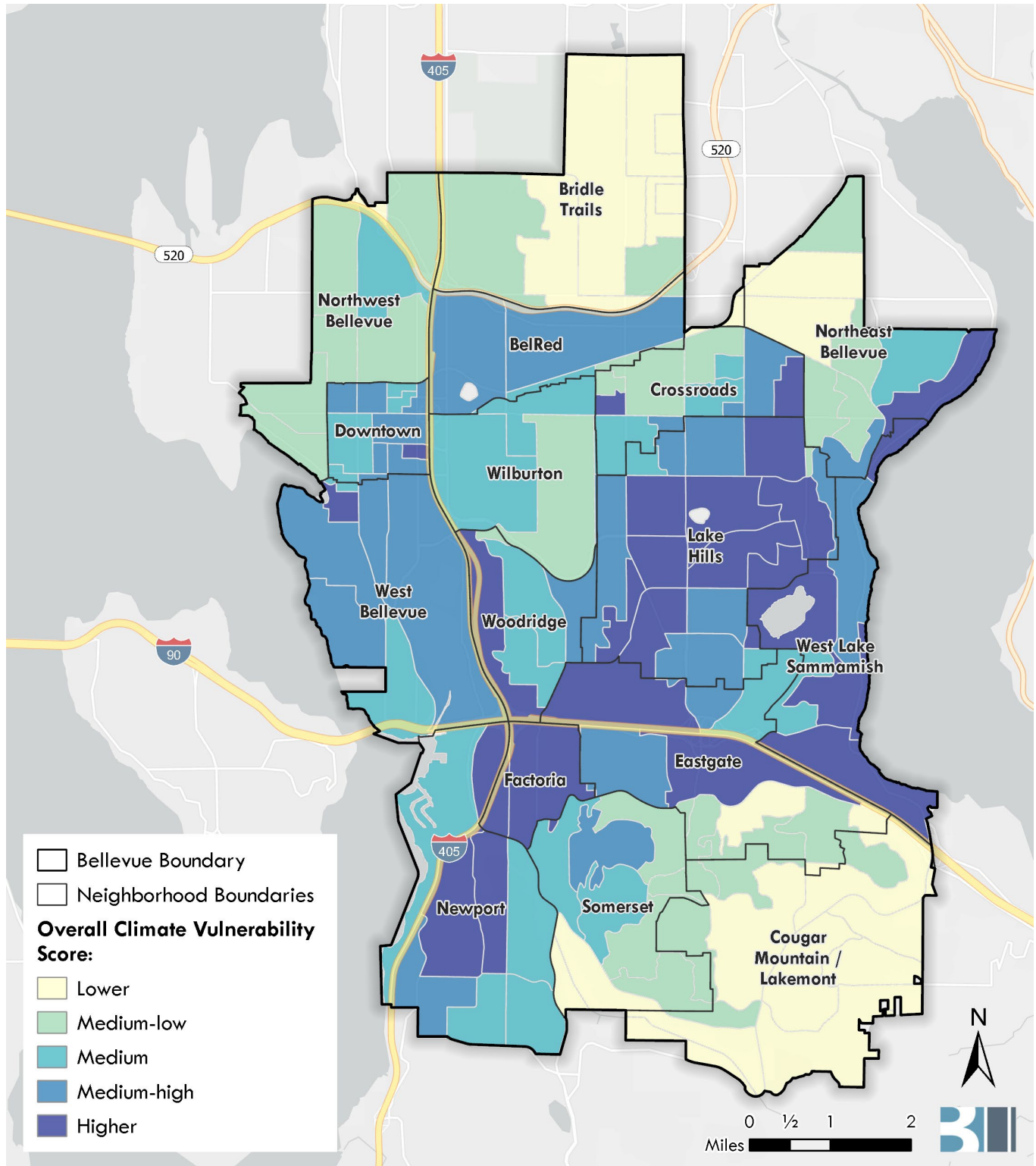
SOURCE: UW CIG 2022; BERK 2023

FIGURE 6 Extreme Precipitation Exposure

VULNERABILITY INDEX

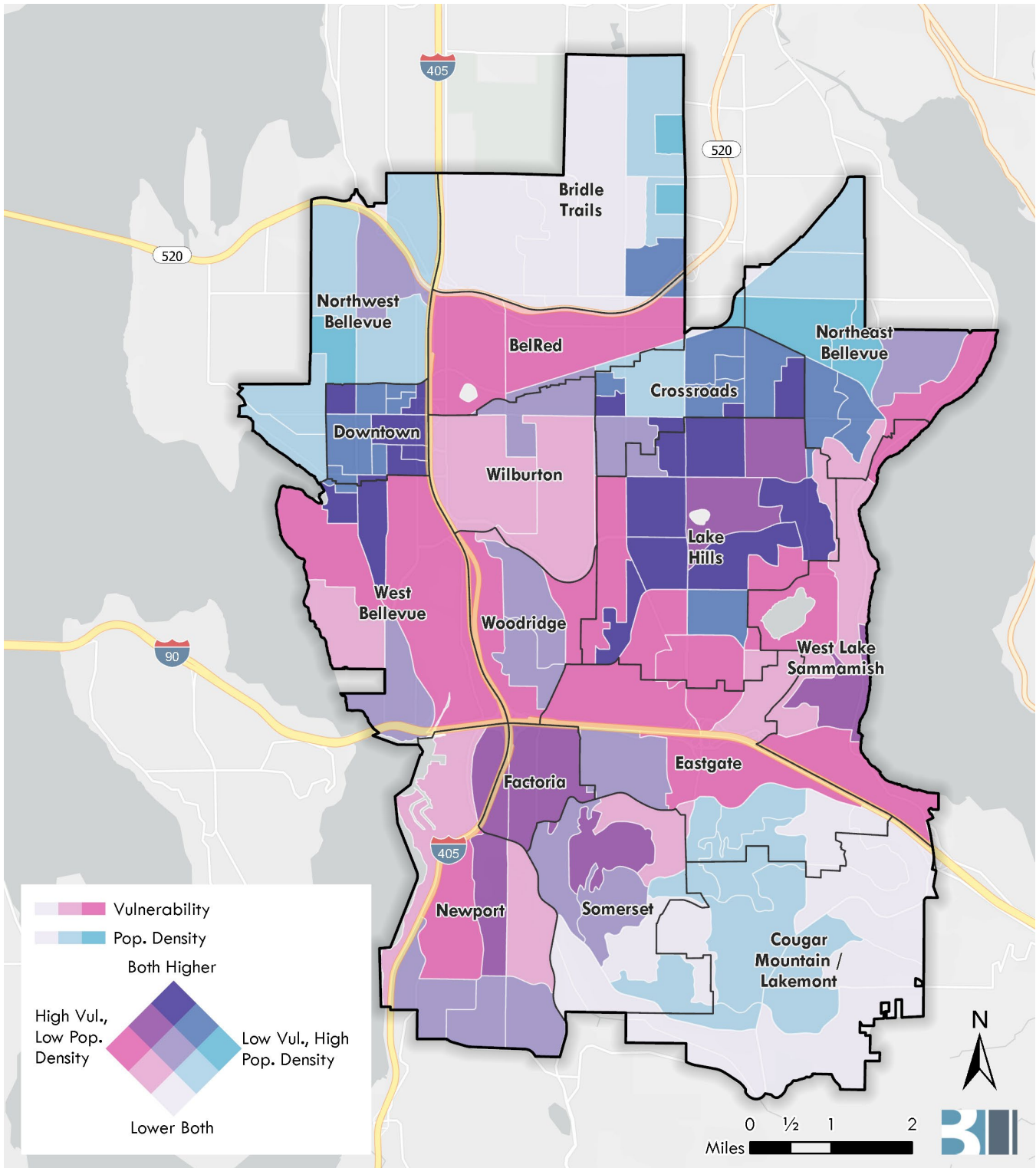
The indicators in Table 4 were used to calculate index values and a CVI map is shared below without population density (Figure 7) and with population density (Figure 8). **These indices may change over time as the data changes or improves.** Maps showing individual exposures are also provided for additional context. This climate vulnerability information is meant to support the planning level review of Comprehensive Plan growth alternatives. The City of Bellevue will consider multiple factors in its selection and refinement of a preferred alternative.

This map illustrates the effect of population density together with climate vulnerabilities. For example, BelRed has a medium-high index score on Figure 7 without population density accounted for. With population accounted for in Figure 8, BelRed is noted as a higher vulnerability and lower population density area. As the area grows, the City of Bellevue can consider the factors that identify this area as higher vulnerability (e.g., extreme heat exposure, urban heat island, and lower tree canopy) and employ strategies to reduce vulnerability (e.g., green infrastructure, passive cooling, etc.).



SOURCE: BERK 2023

FIGURE 7 Climate Vulnerability Index without Population Density



SOURCE: BERK 2023

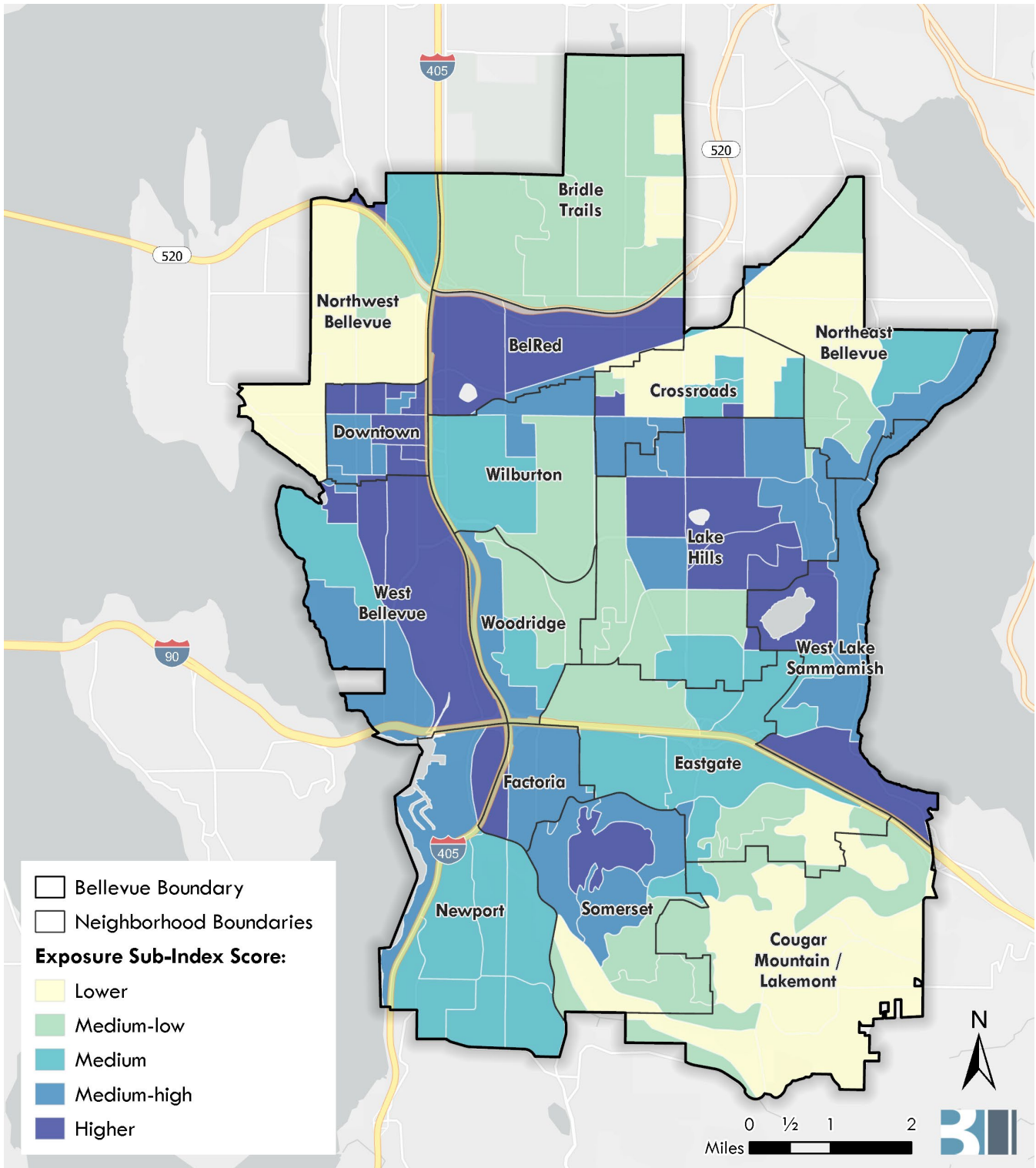
FIGURE 8 Climate Vulnerability Index with Current Population Density

LOCAL EXPOSURE SUB-INDEX

Data in the sub-index includes the following, which are equally weighted by category:

- **Flooding:** Floodplains and Historical flooding hot spots
- **Air Quality:** CLINE modeled PM2.5 concentrations. This represents Average Modeled Concentration of Particulate Matter 2.5 (e.g., air particles that are 2.5 microns or less in width that pose a high risk to human health)
- **Heat:** King County evening heat index. Generally there are heat islands in west, central, and east Bellevue.

The results of the sub-index show relatively higher exposure to local environmental conditions in BelRed, Lake Hills, West Lake Sammamish, Somerset, Factoria, West Bellevue, and Downtown, in clockwise order (Figure 9). In Downtown and BelRed there is greater local exposure to air pollution and heat islands. In Lake Hills and West Lake Sammamish there is local exposure to heat islands and floodplains. In West Bellevue and Factoria, there is exposure to flooding hot spots, air pollution, and heat islands.

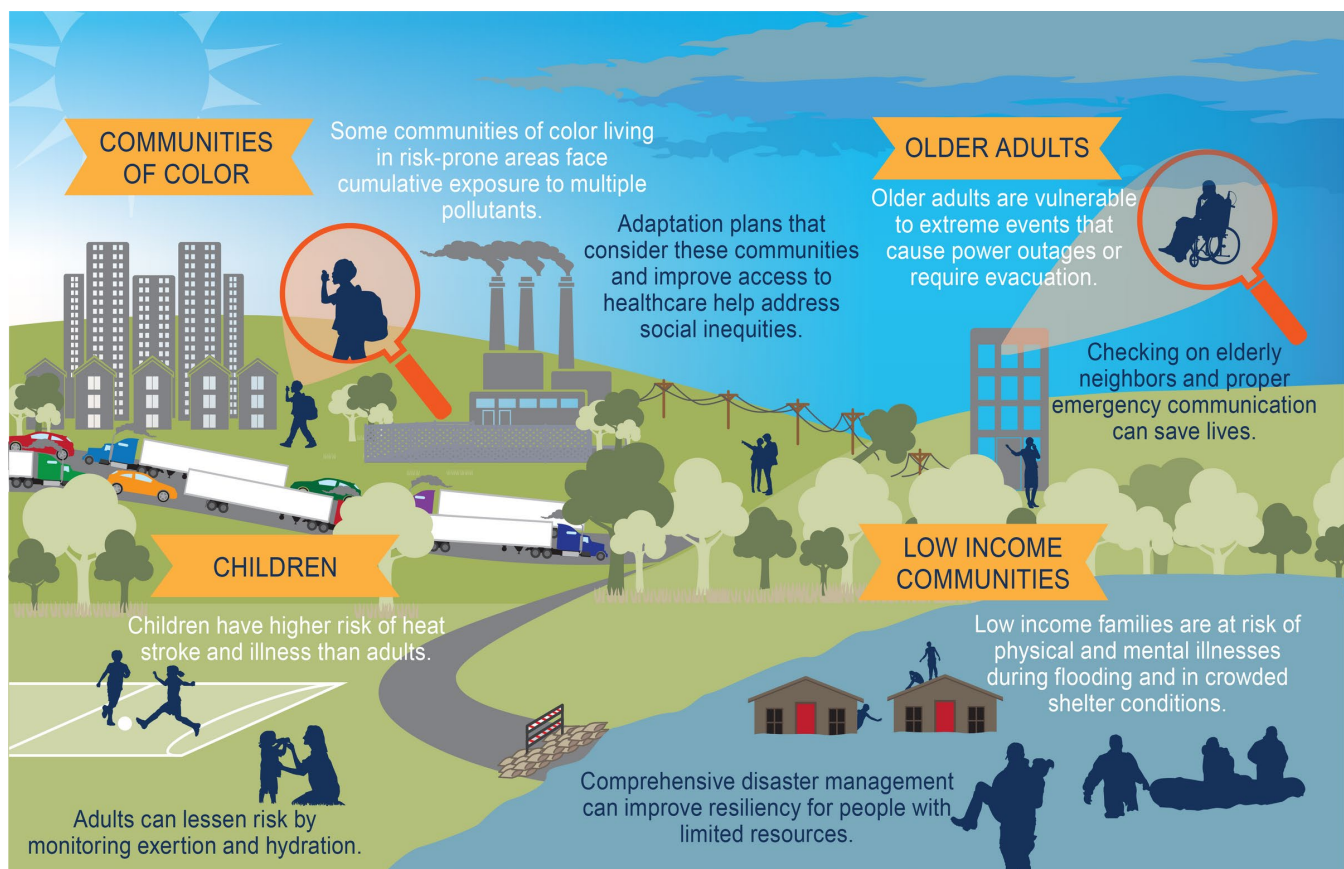


SOURCE: BERK 2023

FIGURE 9 Local Environmental Exposure Sub-Index

SOCIAL VULNERABILITY AND SENSITIVITY AND ADAPTIVE CAPACITY SUB-INDICES

Based on social vulnerability and climate change research, communities that tend to be more sensitive to climate stressors include older people, children, low-income families, and people of color and immigrant communities (Figure 10). People that are elderly may have more limited mobility or preexisting health conditions, and children under 5 years old may have a harder time regulating temperature and may have underdeveloped immune systems. Low-income households may be more susceptible to illnesses and have limited resources to adapt or respond to climate change. Communities of color may have cumulative exposures to pollution and health and social inequities. People who speak English less than very well may have more difficulties during evacuation and difficulties accessing post-disaster funding and other resources.



SOURCE: EPA 2018

NOTES: Examples of populations at higher risk of exposure to adverse climate-related health threats are shown, along with adaptation measures that can help address disproportionate impacts. When considering the full range of threats from climate change as well as other environmental exposures, these groups are among the most exposed, most sensitive, and have the least individual and community resources to prepare for and respond to health threats. White text indicates the risks faced by those communities, while dark text indicates actions that can be taken to reduce those risks.

FIGURE 10 Vulnerable Populations

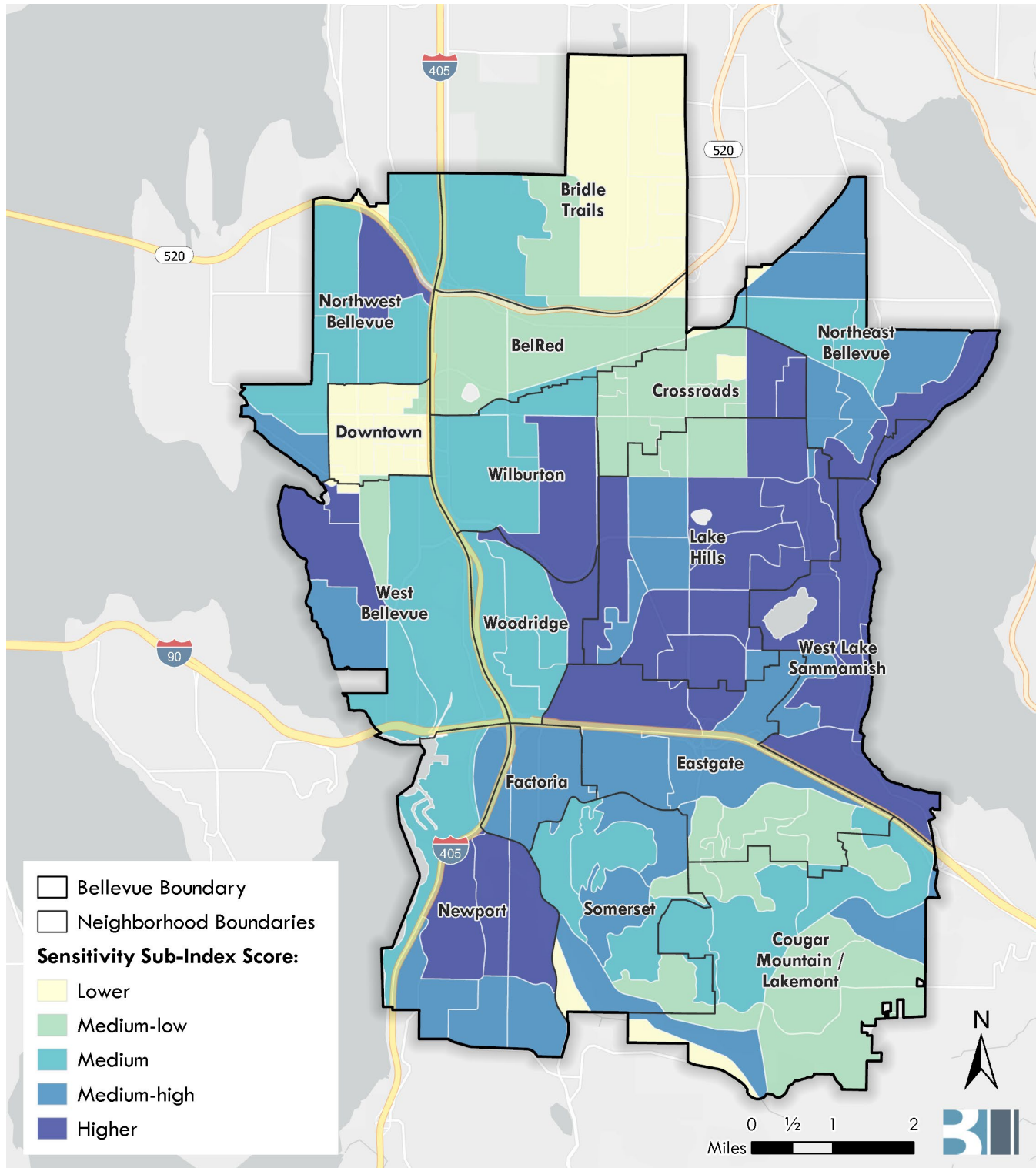
Understanding the location and number of populations that are more sensitive or less adaptable to climate change events can help communities develop strategies to increase resilience.

Examples of sensitivity indicators (e.g., under 5 years old, over 65 years old, air quality) and adaptive capacity indicators (e.g., heat island, linguistic isolation) in Bellevue are shared below in the sub-indices for sensitivity and adaptive capacity.

Sensitivity Sub-Index

The sensitivity sub-index addresses a variety of health or environmental conditions that represent conditions unchangeable at the time of the climate stressor (Figure 11):

- **Age:** Under 5 years old and Over 65 years old:
 - *Population Age 65 Years or Older:* Generally higher shares in north and east Bellevue.
 - *Age under 5 Years:* Generally higher in central and west Bellevue.
- **Environment:** Steep Slopes/Geologic Hazards (liquefaction, erosion, steep slopes) and Poor Stream/Waterbody Health – 303d list for bacteria, dissolved oxygen, and temperature:
 - Seismic/liquefaction hazards are along West Lake Sammamish and West Bellevue.
 - Steep slopes are found in most neighborhoods with greater concentrations in east, south, and west areas of Bellevue.
 - Erosion is more prevalent in the northern half of Bellevue and along both lakes.
 - Poor waterbody health is found in Wilburton, West Bellevue, and the south end.
- **Health Conditions:** Diabetes, Asthma, Respiratory Disease – COPD, Coronary Heart Disease (Adults), Poor Physical Health (Adults), Poor Mental Health (Adults):
 - Poor Physical Health: Generally central and south Bellevue



SOURCE: BERK 2023

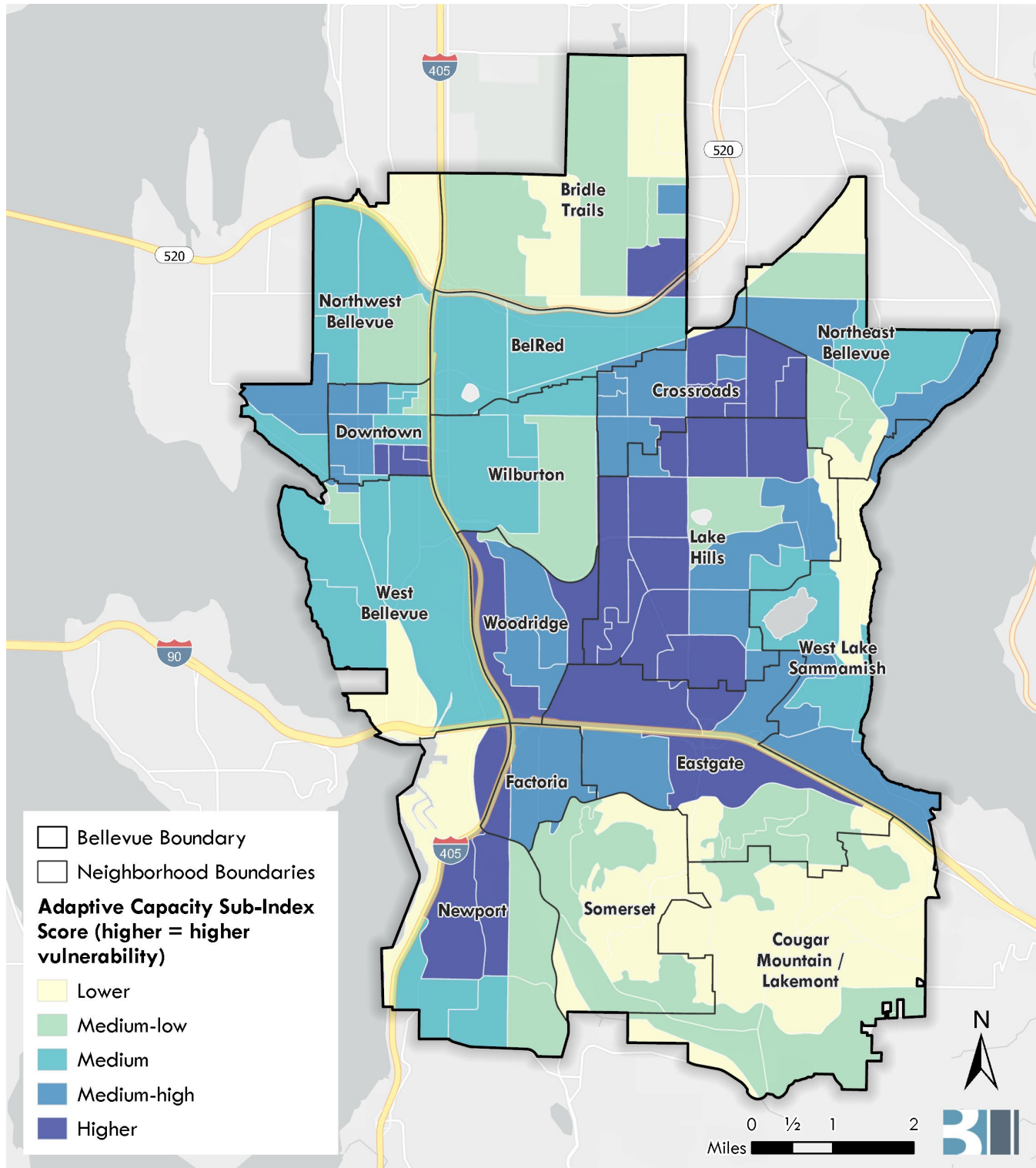
FIGURE 11 Sensitivity Sub-Index

Adaptive Capacity Sub-Index

A wide variety of indicators are part of the adaptive capacity sub-index including:

- **Socioeconomic:** race, poverty, lesser education, linguistic isolation, lack of vehicle, other
- **Transportation:** Access to Frequent Transit (current)
- **Housing/Built Environment:** housing condition (built before 1960), affordable housing inventory, impervious surfaces, proximity to libraries, community centers, fire stations
- **Employment:** Unemployment, Outdoor Professions
- **Health:** Adult Population Without Health Insurance
- **Environment/Ecologic:** Tree Canopy Coverage, Access to Parks

The areas with more vulnerable populations and lower quality built environment conditions (e.g., less tree canopy, more impervious) are shown in Figure 12. There are more areas with higher vulnerability in Crossroads, Lake Hills, Eastgate, Newport, Factoria, Woodridge, and Downtown.



SOURCE: BERK 2023

FIGURE 12 Adaptive Capacity Sub-Index

2.3 Planning for Climate Change in Bellevue

The City of Bellevue has developed several plans and programs addressing climate change mitigation and adaptation. Highlights of these plans and efforts are listed below.

BELLEVUE COMPREHENSIVE PLAN

The Comprehensive Plan sets forth a growth strategy for the year 2035 (see below for the 2044 update underway), with a future land use plan and many elements describing goals, policies, and implementation strategies. The Comprehensive Plan policies are used to guide decisions on capital investments, development permits, and more. Bellevue has addressed climate change in its Comprehensive Plan Environment Element with some key policies, such as:

- EN-6. Establish an achievable citywide target and take corrective actions to reduce greenhouse gas emissions such as reducing energy consumption and vehicle emissions, and enhancing land use patterns to reduce vehicle dependency.

ENVIRONMENTAL STEWARDSHIP PLAN

Bellevue adopted the *Sustainable Bellevue: Environmental Stewardship Plan* with 77 actions meant to be a strategic roadmap to achieving the following targets over the 2020-2030 period (City of Bellevue Community Development 2020a):

- Reducing GHG emissions by 50% and prepare for a changing climate.
- Using 15% less energy and the energy used will be 80% renewable.
- 80% of households will live within a third of a mile of a park, open space, or trail and tree canopy will be increased by 200+ acres.
- 1 in 4 vehicles will be electric and less than 60% of the time will be spent driving alone.
- 50% or more of all waste will be recycled.
- The city will lead by example.

REGIONAL PLANNING K4C

Bellevue is a key member of the King County–Cities Climate Collaboration or K4C. In addition to King County, 24 cities participate, representing 85% of the county population. The collaborative offers workshops, resources, and other information for staff and legislative representatives. A recent tool helpful to long-range planning includes a Climate Action Toolkit looking at the effectiveness of different climate strategies (K4C 2021).

STEWARDSHIP PLAN PROGRAMS

Bellevue has set up programs or initiatives to help fulfill its Stewardship Plan including:

- **Buildings and Energy:** Bellevue has a Clean Buildings Incentive Program with a team of experts to help benchmark buildings' energy use and strategies to save energy. Bellevue has partnered with Issaquah, Kirkland, Mercer Island, and Redmond to offer workshops with a vendor on the potential to upgrade to an energy efficient heat pump as part of a "Energy Smart Eastside Heat Pump Campaign."
- **Climate Change and Air Quality:** Bellevue has developed a Greenhouse Gas Emissions Inventory to track communitywide emissions. The City of Bellevue has also committed to reducing emissions associated with its government operations.
- **Green Business:** Bellevue offers a Refresh Recycling program with consultation to understand services for businesses. Bellevue offers a Commute Trip Reduction program that fulfills state requirements and helps manage transportation demand. Bellevue also participates in EnviroStars a free one-stop hub to get information, resources, and recognition for businesses.
- **Transportation and Electric Vehicles:** Bellevue plans for active transportation through a Pedestrian and Bicycle Transportation Plan. The City of Bellevue owns and operates 15 electric vehicle charging stations available for public use at city facilities. Bellevue is also working on facilitating permitting for installing charging stations on private properties.
- **Trees:** Bellevue assesses its tree canopy every 5-10 years and has a 39% tree canopy as of 2019. The City of Bellevue also has a tree code meant to protect larger trees and replace trees.
- **Bellevue Climate Challenge:** The Bellevue Climate Challenge is a program of the Eastside Climate Challenge, along with Redmond, Issaquah, and Mercer Island. It includes a voluntary online tool to allow households to develop an energy profile and identify how to reduce impacts.

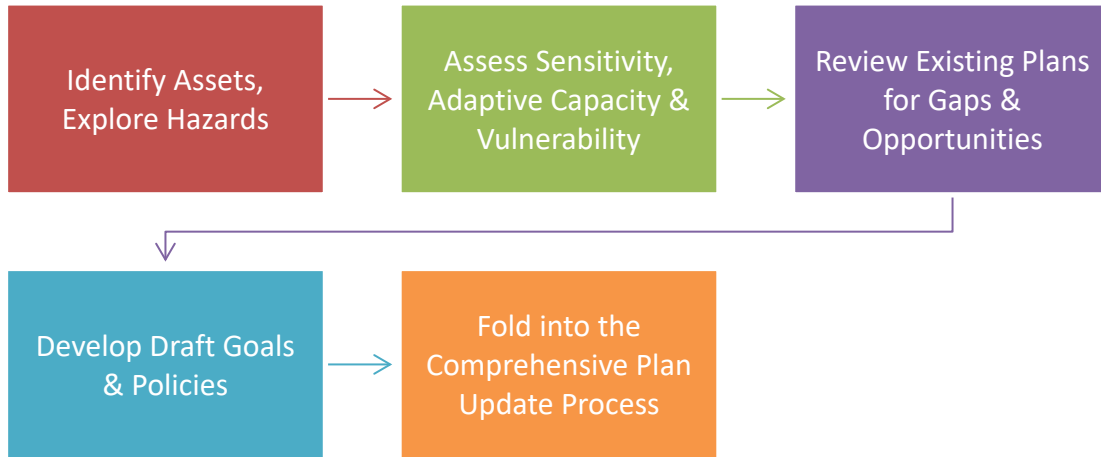
BELLEVUE 2044 AND COMMERCE MODEL CLIMATE ELEMENT

Bellevue is working on its Comprehensive Plan Update called Bellevue 2044, a plan that is anticipated to be adopted in 2024 covering a 20-year period and setting a new plan for growth and sustainability through 2044. Bellevue received a grant to prepare this Climate Vulnerability Assessment from the Washington State Department of Commerce. This assessment will help the City of Bellevue respond to new legislation that requires a climate change element ([HB 1181](#)) as part of a comprehensive plan. The climate change element will address both greenhouse gas emissions reductions (mitigation) and resilience (adaptation).

Through an interagency effort,³ Commerce developed a Model Climate Element with resilience planning guidance to illustrate how counties and cities can develop and implement plans, goals, and policies that build communitywide climate resilience (Washington State Department of Commerce 2023). The Model Climate Element recommendations have been considered in this document, including identifying for each sector local assets (people, places, infrastructure), potential climate change-related hazards, and

³ Washington State [Department of Commerce](#), Washington State Department of Transportation, Department of Ecology, Department of Health, Department of Fish & Wildlife, Department of Natural Resources, and Military — Emergency Management Division. The core team also includes members from the UW Climate Impacts Group, Municipal Research & Services Center, and Association of Washington Cities.

vulnerability in Bellevue. Based on a review of gaps and opportunities, the City of Bellevue can develop draft goals and policies and fold them into the comprehensive plan update (Figure 13).



SOURCE: Washington State Department of Commerce 2023

FIGURE 13 Model Climate Element Resilience Sub-Element Development Process

SECTION 3 Climate Vulnerability Assessment

3.1 Buildings & Energy

3.1.1 Sector Overview

The City of Bellevue regulates buildings and construction and applies energy codes. It also incentivizes green buildings. The City of Bellevue is setting ambitious goals to promote renewable energy and reduce greenhouse gas emissions with a large focus on Buildings & Energy to improve energy efficiency and decarbonization. Many green building strategies also increase resilience.

Local resources reviewed for this section include the following:

- Bellevue Buildings and Energy programs: <https://bellevuewa.gov/city-government/departments/community-development/environmental-stewardship/buildings-energy>
- Bellevue Environmental Performance Dashboard: <https://cobgis.maps.arcgis.com/apps/MapSeries/index.html?appid=be30baa631864324bd2119db1b48514e>
- Energize Eastside Need and Solution: <https://energizeeastside.com/need>

ASSETS – BUILDINGS

Bellevue is growing. Over the past several decades, the city has accommodated new residents and employees primarily in mixed use centers such as Downtown and more recently BelRed. Table 5 shows the breakdown of commercial square feet and housing units within each neighborhood area in 2019. Since much of this growth occurred within the last 30 years, many of these buildings were constructed under energy codes. Office square footage is predicted to grow. The city incentivizes LEED and Built Green certification. Today, Bellevue has over 100 certified green buildings, including high rises in Downtown as well as schools and municipal facilities across the city (Table 6). Future investment in energy-efficient and green building construction will help Bellevue reach its climate goal of using 15% less energy, and 80% renewable per the Sustainable Bellevue: Environmental Stewardship Plan. Some energy conservation strategies can help building resilience such as designing for passive cooling in the case of power outages and extreme heat. During building weatherization, attention to indoor air quality as well as energy conservation is a best practice.

The greatest amount of recent residential growth has occurred within Downtown in mixed use and high rise residential construction, which has also been subject to more recent energy codes. Housing in single-family areas built prior to 1980 was more likely constructed under older standards (State Energy Code adopted in 1985). Over 50 percent of Bellevue's housing stock was built prior to 1980 (American Community Survey [ACS] 2020), and a share of the homes likely need energy efficiency updates. The CVI shared in Section 2 used information about housing built prior to 1960 as having a lower adaptive capacity (e.g., less likely to

have air conditioning). Neighborhoods with more homes built prior to 1960 are Lake Hills, Eastgate, and Newport, The City of Bellevue is working towards incentivizing property owners to update their homes to make them more energy efficient and resilient, through the installation of energy efficient heat pumps that include air conditioning.

TABLE 5 Commercial Square Feet and Housing Units by Neighborhood (2019)

Neighborhoods	Commercial Square Feet	Housing Units
BelRed	8,501,986	1,835
Bridle Trails	1,715,871	4,944
Cougar Mountain / Lakemont	232,106	4,184
Crossroads	1,786,601	6,651
Downtown	17,267,637	9,963
Eastgate	6,389,929	2,722
Factoria	2,901,091	1,405
Lake Hills	2,648,172	6,911
Newport	299,179	3,811
Northeast Bellevue	1,096,979	4,053
Northwest Bellevue	2,143,997	4,414
Somerset	306,066	2,906
West Bellevue	2,693,040	3,962
West Lake Sammamish	204,964	2,424
Wilburton	2,259,333	1,948
Woodridge	279,292	2,239
Total	50,726,243	64,372

SOURCE: City of Bellevue, BERK 2023

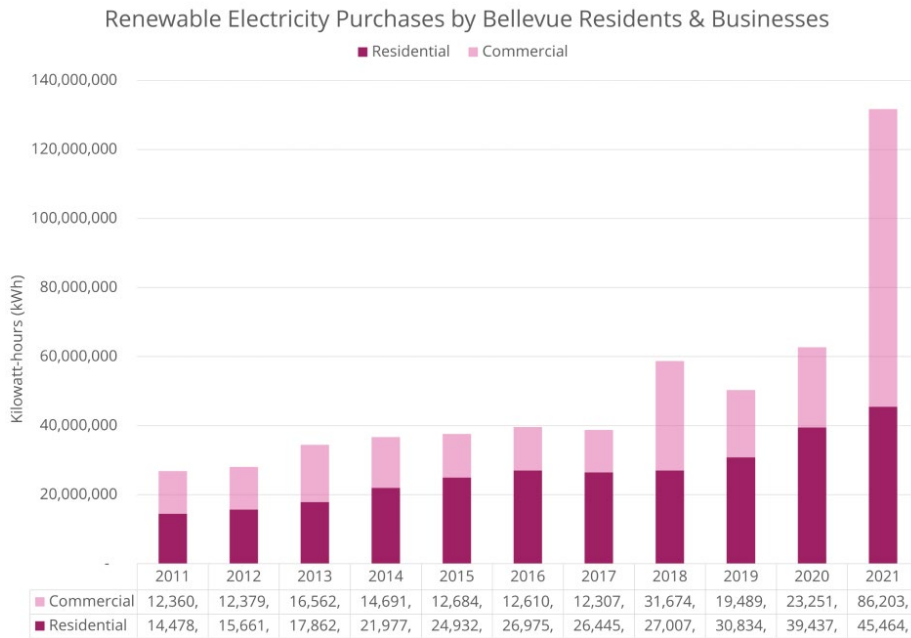
TABLE 6 Buildings: Space by Sector

Sector	2019 Base Year Square Feet
Education	4,727,218
Food	2,206,951
Government	1,260,267
Industrial	3,896,804
Medical	2,985,105
Office	18,981,286
Other	1,144,448
Retail	5,595,326
Service	9,928,837
Total	50,726,243

SOURCE: City of Bellevue, BERK 2023

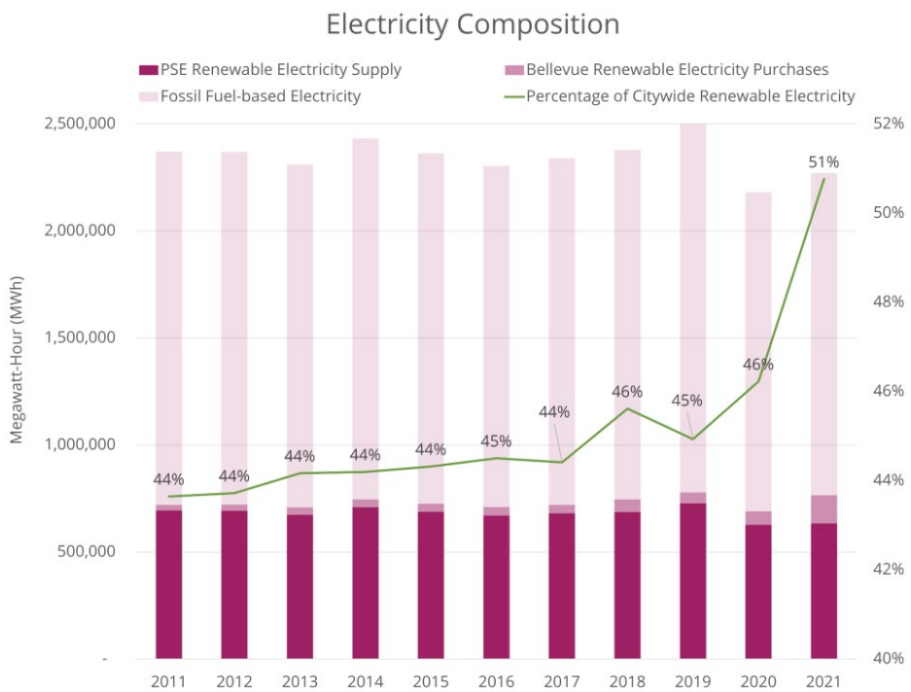
ASSETS – ENERGY

Energy sources for Bellevue are hydroelectric, coal, natural gas, and some renewables. The city is served by the investor-owned utility company, Puget Sound Energy (PSE), for both electricity and natural gas. The City of Bellevue has strategic plan goals to move to renewable energy sources. For example, it has held Solarize Campaigns to support residents to install rooftop solar panels to generate power for themselves and to provide clean energy back into the grid. The City of Bellevue is also continuing to pursue grants to grow the capability of clean energy. In Figure 14 and 15, the growth of renewable energy has been increasing the past 10 years, with a large increase in 2021. The goal is to be running on 100% renewable energy by 2050 (Environmental Dashboards).



SOURCE: PSE 2020

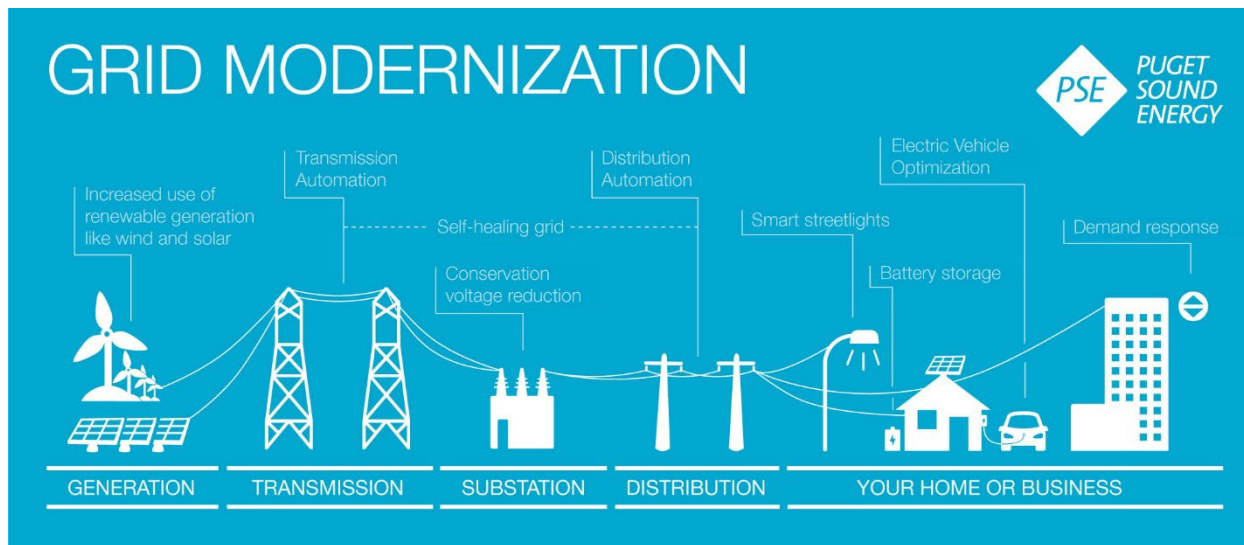
FIGURE 14 Renewable Electricity Purchases by Bellevue Residents and Businesses



SOURCE: PSE 2020

FIGURE 15 PSE and Bellevue Fossil Fuel and Renewable Electricity Purchases

PSE has a holistic program to develop a resilient power grid involving activities such as renewable power, smart streetlights and electric vehicles, as well as actions that homeowners and business owners can take to build resilience (Figure 16).



SOURCE: PSE 2020

FIGURE 16 PSE and Resilient Power Grid

ASSETS – BUILDINGS, FLOODPLAINS, AND STORMWATER SYSTEMS

Just over two percent of land in Bellevue is in a floodplain (FEMA 2020; BERK 2023), which is concentrated on the eastern side of the city in the Lake Hills neighborhood. Other areas in the city such as West Bellevue, Factoria, Somerset, Eastgate, and West Lake Sammamish are prone to flooding due to poor drainage. The drainage system is comprised of natural and manufactured solutions. Bellevue provides real-time tracking of water levels in high flood areas. The City of Bellevue regulates development in flood hazard areas, requires stormwater management in all new development, and operates its stormwater system to enable storage, infiltration and safe conveyance of stormwater to reduce flooding and provide solutions for those who are impacted by it. Retaining and enhancing stream and floodplain functions including wetland and riparian protections are also addressed in critical area regulations to support surface and groundwater quality and wildlife habitat.

3.1.2 Potential Impacts

Buildings and energy systems and the people and businesses reliant on them are more likely to be vulnerable to extreme heat and smoke, as well flooding and drought. Due to climate change stressors, Bellevue could face the following risks to buildings and the energy system:

- Increased cooling demand during summer months, and extreme heat events, and increased heating demand during cold weather events.
- Risk of power failures during extreme heat events due to higher need for electricity for cooling.

- Changes in provider hydroelectric generating capacity due to potential for higher or lower streamflow.
- More frequent power loss due to extreme storms and other hazard events.
- Increased stormwater runoff from impervious surfaces that could create localized flooding around buildings.
- Increased risk of flooding due to rising water levels and more intense storms.
- More extreme weather events (such as hailstorms and strong storms) that can cause damage to buildings and energy systems.

The ability to keep cool as temperatures rise during the summer, is important especially in the neighborhoods of Crossroads, Lake Hills, and Downtown where the CVI found these neighborhoods the most vulnerable. Keeping cool is a function of how well insulated the building structures are, the presence or capacity of mechanical and/or natural cooling systems, and the ability of the structure to reflect heat during the summer and absorb it during the winter. As described above, a concentration of older homes built prior to 1960 appears to be in Eastgate, Lake Hills, and Newport neighborhoods.

The increase in heavy rainfalls is likely to lead to more frequent and severe flood events that can cause damage to property and structures. Extreme precipitation could enlarge floodplains or cause increased runoff and erosion. With the increase in flooding, water tables could rise to cause below-grade flooding in areas such as basements. Property in floodplains or areas with poor drainage would be more severely or frequently impacted, and new structures may be subject to damage that were not in defined flood hazard areas before. The neighborhoods within the central area of Bellevue, West Bellevue, Woodridge, Lake Hills, and West Lake Sammamish could be more at risk.

3.1.3 Adaptive Capacity

Adaptive capacity for buildings and energy refers to the ability of buildings to adapt to changing requirements and circumstances during their existence, in a sustainable and economically beneficial way. It includes all characteristics that enable the building to maintain its functionality through climate change events such as extreme heat and extreme precipitation. As described in prior sections, there are buildings built prior to more modern energy codes and locations in the city that are more likely to flood.

As growth occurs with new construction, the City of Bellevue will have more opportunities to promote programs that address energy conservation and resilience, such as these offered or promoted:

- [Clean Buildings Incentive Program](#): Bellevue’s team of experts can help you benchmark your buildings energy use and identify strategies and incentives for saving energy.
- [Energy Smart Eastside Heat Pump Campaign](#): Opportunity to learn about the benefits of energy efficient heat pumps and incentives and financing options for making the switch to cleaner heating and cooling.
- [Green Building Incentives](#): The City of Bellevue offers land use incentives for certified green buildings such as LEED, Built Green, Living Building, and Passive House in designated neighborhoods, including Downtown, BelRed, and East Main subareas.

- [PSE Green Direct Program](#): The program allows Bellevue to purchase renewable energy for about 70% of the city's electricity use.
- [Solar Washington](#) and [Bellevue Development Services](#): As part of a federal Department of Energy grant, Bellevue and other grant partners (Seattle, Edmonds and Ellensburg) developed a streamlined process for the permitting of small-scale solar installations for single-family residential customers, and have been recognized by the State of Washington as part of the Evergreen State Solar Partnership.

3.1.4 Vulnerability Summary

Bellevue’s buildings and energy system is very likely to be vulnerable to climate change. Infrastructure may be damaged or destroyed by climate-related hazards such as severe storms and flooding. Energy supplies may be also affected by extreme weather events. Energy conservation and education programs are available in the city, but improvements to policies and standards related to infrastructure could be made to bolster the resilience of the sector overall.

Table 7 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Buildings & Energy sector in Bellevue.

TABLE 7 Buildings & Energy: Potential Impacts, Adaptive Capacity, and Vulnerability Scores

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Air Temperature/Extreme Heat	High (Energy) Moderate (Buildings)	Moderate	Moderate-High (Energy) Moderate (Buildings)
Extreme Precipitation/Flooding	Moderate	Low-Moderate	Moderate
Stream Temperature	N/A	N/A	N/A
Drought	Moderate	Moderate	Moderate
Wildfire/smoke	Low	Moderate	Low

SOURCE: BERK 2023

3.2 Cultural Resources & Practices

3.2.1 Sector Overview

This section examines the projected impacts of climate change on Bellevue’s cultural and historic resources and practices, such as archaeological sites, historical buildings and landmarks, heritage sites, and arts and culture festivals. Climate change projections of concern include increased stream temperatures, increased extreme precipitation and associated flooding events, and increases in extreme heat events.

Local resources reviewed for this section include the following:

- Bellevue Map Viewer of heritage sites, historic buildings, and environmental layers (e.g., floodplains, steep slopes):
<https://www.arcgis.com/apps/webappviewer/index.html?id=e1748172d4f34f1eb3710032a351cd57>
- Bellevue Community, Cultural, and Art Resources map:
<https://www.arcgis.com/apps/webappviewer/index.html?id=f06d4fa34e9041408cac1fd8fad9deec&exte nt=-13614209.0189%2C6028590.5003%2C%0213580309.1969%2C6054082.2492%2C102100>

3.2.2 Potential Impacts

SIGNIFICANT STRUCTURES

- Changing climate patterns including increased exposure to extreme heat, heightened precipitation, and increased storm intensity may accelerate the degradation of historic structures (Sesana et al. 2021).
- Increases in extreme precipitation events may lead to increased risk of landslides (Handwerger et al. 2022), which may cause damage to several historically significant structures including the Burrows Cabin and the Calvert House.
- Public art installations may be exposed to climate change impacts such as flooding and landslides, though sensitivity will vary by installation.

CULTURAL LANDSCAPES AND NATURAL RESOURCES

- Mercer Slough and Larsen Lake Farm are managed by the City of Bellevue as berry farms to preserve the area's agricultural heritage. Potential climate change impacts to the operations of these farms include flooding, crop damage due to extreme heat, increased irrigation requirements during periods of drought (Schreiber 2016), and increased hazard to u-pick visitors and operating staff due to increased incidence of extreme heat and poor air quality from wildfires in the greater region (Kearl and Vogel 2023; UW CIG et al. 2018).
- Bellevue Botanical Garden is managed by the City of Bellevue and faces exposure to climate change impacts such as drought and extreme heat, which will have operational implications for the gardens such as increased plant mortality, increased competition from invasive species and pests, and increased need for irrigation. Additionally, the Botanical Garden contains areas that may be susceptible to landslides during extreme precipitation events creating a hazard for users and an operational challenge for resource managers.
- Ecosystem health is intractably connected to human and cultural health in Native American worldviews (UW CIG et al. 2018). Further damage or degradation of natural areas that exist within Bellevue threatens this already diminished aspect of cultural well-being for Indigenous individuals residing in and originating from the area. This includes rising stress on Chinook, coho, and sockeye salmon due to increased water temperatures, more severe winter streamflow, increased pollutant concentration in waterways, decreased water levels in summer and fall, and other ecological shifts (WDFW 2022).
- Community garden spaces and the P-Patch program are likely to experience a variety of climate change impacts. The primary impact will be increased heat with those working in gardens more exposed to

higher temperatures and crops experiencing increased stress due to increasing air temperatures (Bisbis et al. 2018; UW CIG et al. 2018).

- Assets such as urban parks and the urban tree canopy support Bellevue's cultural identity as embodied in their motto: "A City in a Park." Increases in extreme heat events, drought, and rising temperatures will all negatively impact these assets through increasing tree mortality (COB and UW 2019) and susceptibility to infestation (Raymond et al. 2014).

CULTURAL AND COMMUNITY CENTERS AND EVENTS

- Libraries in Bellevue may be exposed to climate change risks owing to their proximity to the Wildland Urban Interface (WUI) (e.g., Newcastle Library), steep slopes, or floodplain hazards. The sensitivity of individual structures is determined by site characteristics and the elements of each structure exposed and thus varies accordingly.
- Several faith-based centers including the Korean Pilgrim Presbyterian Church, Eastside Friends Meeting, Eastside Christian Community Church, Seattle Washington LDS Temple, Westminster Chapel, Eastside Baha'i Center, and Hosana Asambla de Dios appear to be near steep slopes potentially at risk for landslides exposing them to increased risk. The sensitivity of individual structures is determined by site characteristics and the elements of each structure exposed and thus varies accordingly.
- Bellevue is host to many multicultural celebrations and events. Depending on circumstances, these events may be vulnerable to climate change impacts. Events held outside or in venues with exposure to climate change impacts may be affected by poor air quality, extreme heat events, floods, or landslides.
- Climate change impacts to the transportation system may cause difficulties in accessing resources for individuals who live long distances from these centers or who rely on transit and active transportation or those who require mobility devices.

3.2.3 Adaptive Capacity

- Adapting cultural resources to climate change impacts can be challenging because many are unique, irreplaceable, and location based.
- Due to their historic nature and the associated limitations on structural adaptation some historic structures have very constrained adaptive capacity.
- Bellevue has invested in creating culturally responsive governance structures: e.g., creation of the Diversity Advantage Team (staff within City Manager's Office), Bellevue's Diversity Advisory Network (community members appointed by City Manager), and its Communities of Color Coordinating Team.
- Community owned and operated cultural resources may experience difficulties in adapting to climate change due to factors including a lack of knowledge about effective adaptation strategies and/or insufficient resources.
- Adaptive capacity of certain natural resources such as the Botanical Gardens and farms operated by the City of Bellevue may be limited by clashes between resource needs and climate adaptation policies surrounding water use during periods of drought.

- Projects that adapt resources to flood and landslide risk are often expensive and occasionally infeasible depending on resource location, surrounding uses, and applicable polices.
- Salmon populations in the Salish Sea are already threatened by human disturbances to the environment. Compounding exposures from climate change complicate salmon recovery efforts, although many organizations and governments are aligned in their efforts to support and restore these populations.

3.2.4 Vulnerability Summary

While the vulnerability of cultural resources and practices to climate change varies by resource, overall vulnerability is moderate to high. This is due to the large role natural systems and resources play in the cultural environment and identity of Bellevue. Salmon populations in particular present a substantial challenge. Similar levels of vulnerability can be seen in certain historic resources such the Burrows Cabin and the Larsen Lake Farm. Conversely, many modern cultural resources have low to moderate vulnerability to climate change impacts due to low exposure and sensitivity as well as higher adaptive capacity given updated building codes and regulations compared to their historical counterparts. Table 8 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Cultural Resources & Practices sector in Bellevue.

TABLE 8 Cultural Resources & Practices: Potential Impacts, Adaptive Capacity, and Vulnerability Scores

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Air Temperature/Extreme Heat	Moderate-High	Moderate-High	Moderate
Extreme Precipitation/Flooding	Moderate-High	Moderate	Moderate-High
Stream Temperature	High	Moderate	High
Drought	Low-Moderate	Moderate	Low-Moderate
Wildfire/smoke	Moderate-High	Moderate-High	Moderate

SOURCE: ESA 2023

3.3 Economic Development

3.3.1 Sector Overview

Bellevue is the second largest job center in Washington with an emphasis on information technology (City of Bellevue Community Development 2020b). It has a low unemployment rate, and a large proportion of its residents are highly educated. Recently, jobs in the information, tourism, health and fitness, construction, retail, and services sectors have grown in Bellevue while and jobs in manufacturing have declined, following a long-term trend given redevelopment of industrial areas to office and mixed uses (e.g., in BelRed).

Changes in climate due to extreme heat, extreme precipitation, wildfire smoke, and other events can affect Bellevue’s economy by disrupting business continuity, increasing insurance costs, disrupting supply chains, altering the timing and rate of construction, increasing infrastructure costs, and other aspects of the economy. Climate change can also present opportunities with increased demand for environmentally sensitive products and services, greater investment in green and low carbon technologies, improved local production and supply, and economic demand in areas with lower climate risks.

Local resources reviewed for this section include the following:

- Bellevue Economic Development Plan (City of Bellevue Community Development 2020b)
- Bellevue Community Profiles 2016-2020 ACS (Puget Sound Regional Council [PSRC] 2022)
- Bellevue Environmental Stewardship Plan (City of Bellevue Community Development 2020a)

PHYSICAL AND SOCIAL ASSETS

Job estimates vary by source, but all show Bellevue as a major job center in the county and state. Total jobs in the city based on 2019 Census on the Map information indicates 157,810 jobs. About 4.1% of the jobs are potential outdoor jobs (e.g., construction, maintenance, emergency response) (Table 9). In 2019, the city had a total of 50.1 million square feet of employment space and a total of about 137,700 jobs (Table 10).

TABLE 9 Total Jobs (2019)

Geography	2019 Total Jobs	Bellevue Share of Jobs
City of Bellevue	157,810	100.0%
King County	1,379,863	11.4%
State of Washington	3,282,974	4.8%

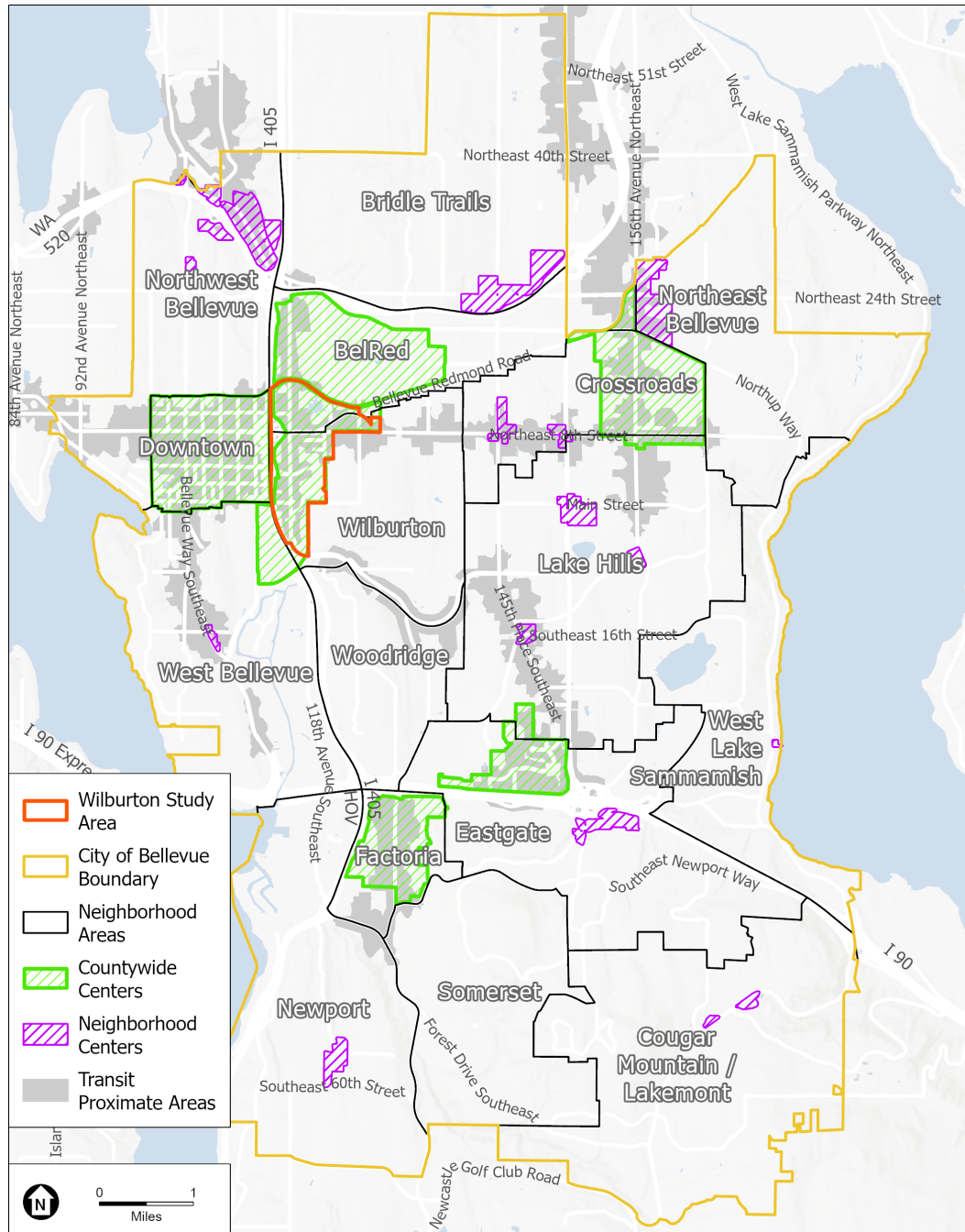
SOURCE: U.S. Census Bureau 2019

TABLE 10 Employment Space by Neighborhood

Neighborhoods	Square Feet	Jobs
Downtown	17,267,637	59,865
BelRed	8,501,986	18,796
Eastgate	6,389,929	17,054
Factoria	2,901,091	8,879
Wilburton	2,259,333	6,455
West Bellevue	2,693,040	5,112
Lake Hills	2,648,172	4,961
Northwest Bellevue	2,143,997	4,942
Crossroads	1,786,601	3,859
Bridle Trails	1,715,871	3,772
Northeast Bellevue	1,096,979	2,146
Newport	299,179	583
Cougar Mountain / Lakemont	232,106	432
Woodridge	279,292	332
Somerset	306,066	310
West Lake Sammamish	204,964	222
Total	50,726,243	137,722

SOURCE: City of Bellevue 2023

Most jobs and commercial buildings are in Downtown, BelRed, and Eastgate neighborhoods. Within these neighborhoods, the City of Bellevue has identified centers in its Comprehensive Plan; these centers are areas of focus for jobs, housing, and shopping (Figure 17).



SOURCE: City of Bellevue, BERK 2023

FIGURE 17 Neighborhood Centers

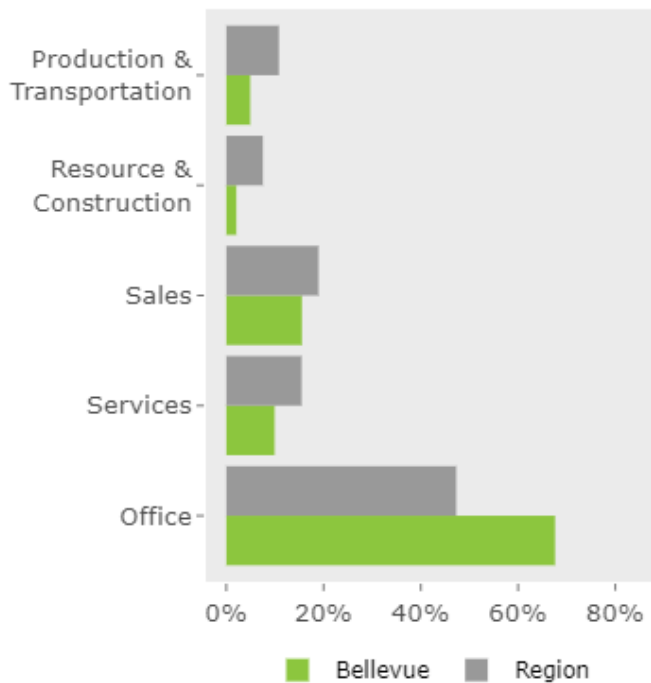
By sector, office has the most building space, followed by services and retail (Table 11).

TABLE 11 Employment Space by Sector

Sector	Square Feet
Office	18,981,286
Service	9,928,837
Retail	5,595,326
Education	4,727,218
Industrial	3,896,804
Medical	2,985,105
Food	2,206,951
Government	1,260,267
Other	1,144,448
Total	50,726,242

SOURCE: City of Bellevue 2023

Bellevue has a higher share of residents with office jobs, and less production and construction jobs (PSRC 2022) (Figure 18).



SOURCE: PSRC 2022

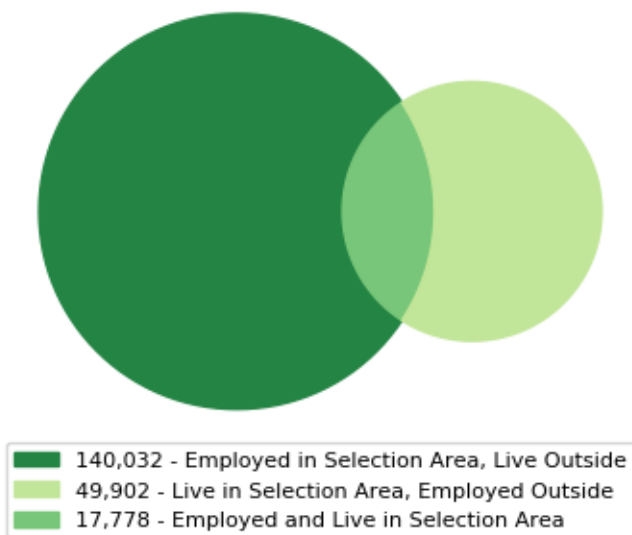
FIGURE 18 Occupation of Bellevue Residents (2020)

2021 Heat Dome, Seattle Region

“...health officials urged people to reschedule outdoor activities and to stay hydrated. Over the next two days, officials said 223 people visited emergency rooms with heat-related illnesses and at least 13 people in King County had died from heat exposure. Restaurants and some grocery stores closed early or altogether on June 28, and hotels saw a flood of people wanting air-conditioned rooms. At 4:14 p.m., the Bellevue Fire Department announced a burn ban, including all recreational fires. Amazon sent workers home from a Kent warehouse, while some office workers at Amazon's Doppler building in downtown Seattle said it felt like the most crowded day since before the pandemic, as workers flocked to air-conditioned offices.” (McNerthney 2021)

While most Bellevue residents have office-related jobs, they work mostly in cities outside of Bellevue. This has implications for business continuity and recovery in the case of a climate hazard (Figure 19).

Inflow/Outflow Job Counts in 2019



SOURCE: U.S. Census Bureau 2019

FIGURE 19 Commuting Inflow and Outflow (2019)

3.3.2 Potential Impacts

Bellevue is a regional job center and is expected to experience more days of extreme heat, increases in extreme precipitation, and increases in the frequency or extent of flooding. Broad effects across the city could include:

- Increased disruptions of business continuity from hazards. Business disruptions could include closures due to climate events affecting customers or employees. For example, with extreme heat, the region saw retail and restaurant business closures, restrictions on recreation and outdoor work, as well as greater demand for hotel rooms with air conditioning (McNerthney 2021).
- Increased insurance premiums due to more extreme weather. Insurance coverage rates or mortgage interest rates could increase for properties at greater risk of exposure, and conversely lower rates in areas with lower risks. Washington State’s Office of the Insurance Commissioner has coordinated with other national efforts to address future risks (Office of the Insurance Commissioner n.d.)
- Impacts on business infrastructure. Extreme precipitation events are anticipated to occur citywide. Neighborhood areas with smaller employment, such as West Bellevue and Lake Hills, have higher percentages of properties in the floodplain or in flooding hotspots. The intensity and frequency of storms could affect roads, stormwater systems, and result in greater costs to the city or businesses.

- Shifts in business opportunities. Businesses that promote renewable energy and low carbon technologies could grow with climate change, consistent with Sustainable Bellevue’s Environmental Stewardship Plan. The Economic Development Plan does not reference green technology, but it calls for facilitating and encouraging desirable business investment and small businesses. Supporting green technology could help accomplish this. The Environmental Stewardship Plan notes:

All three of these elements—economic competitiveness, social vibrancy, and environmental stewardship—are needed to protect human health and quality of life, support well-paying green jobs, sustain a healthy environment, and generate long-term cost savings and resilience to economic and environmental challenges. (City of Bellevue Community Development 2020a)

- Shifts in tourism dollars from jurisdictions losing recreational opportunities to jurisdictions gaining opportunities. Tourism is a sector of focus in the Economic Development Plan, and the City of Bellevue desires to increase the number of conventions, performances, and special events as well as increase dining and bars, lodging, and arts/culture/recreation (City of Bellevue Community Development 2020b). Outdoor recreation could be limited during climate events such as extreme heat and precipitation, yet recreation could be increased indoors where temperatures are regulated such as at the Meydenbauer Center, which hosts indoor events.

Based on the combination of exposure, sensitivity, and adaptive capacity, employment centers with greater vulnerability and population density include Crossroads, Downtown, and Factoria. Other employment centers such as BelRed, Eastgate, and Wilburton have high or medium high exposure yet low population densities currently. Yet, in the future, they are locations where the City of Bellevue is anticipated to add more mixed use growth. In both existing and new centers, implementation of climate adaptation strategies would increase resilience (Table 12).

TABLE 12 Top 5 Neighborhoods with Employment and Climate Vulnerability

Center	Exposure*	Sensitivity*	Adaptive Capacity*	Vulnerability Index: Center Areas	Vulnerability Index with Population: Center Areas
BelRed	Heat island, Air Quality, Floodplain (Moderate)	Age (Under 5)	Public Facility Access, Parks Access, Tree Canopy, Impervious, Single Householders, Poverty, BIPOC	Moderate-High	Higher Vulnerability / Lower Pop. Density
Crossroads	Heat Island, Air Quality	Age (65+, Under 5), Health	Health Insurance, Unemployment, Tree Canopy, Impervious, Affordable Housing, Cost Burden, Poverty, BIPOC	Higher (east) Moderate-Low (central) Moderate-High (west)	Higher Vulnerability / Higher Pop. Density (east and west) Low/Moderate Vulnerability/Higher

Center	Exposure*	Sensitivity*	Adaptive Capacity*	Vulnerability Index: Center Areas	Vulnerability Index with Population: Center Areas
					Vulnerability (central)
Downtown	Urban Heat Island, Air Quality	Age (over 65) (Moderate)	Impervious, Tree Canopy, Impervious, Cost Burden, Single Householders, Linguistic Isolation	Moderate-High/High (northwest, southeast) Medium (north and southwest) Medium Low (southwest)	Partial: Higher Vulnerability / Higher Pop. Density Partial: Moderate Vulnerability / Higher Pop. Density
Eastgate	Air Quality	Age (Under 5), Health	Public Facility Access, Affordable Housing, Housing Quality (Year)	Lower	Higher Vulnerability / Lower Pop. Density
Factoria	Heat (Moderate), Air Quality, Flooding hotspots (Moderate)	Health	Parks Access, Low Educational Attainment	Higher	Higher Vulnerability / Moderate Pop. Density
Wilburton	Flooding (Moderate), Heat (Moderate), Air Quality (Moderate)	Water Quality (Moderate), Health (Moderate)	Transit, Poverty, BIPOC	Moderate- High (north and southwest) Moderate (center)	Partial: Higher Vulnerability / Lower Pop. Density Partial: Lower Vulnerability / Lower Pop. Density

*Higher unless stated

3.3.3 Adaptive Capacity

Cities play an important role in lowering greenhouse gas emissions and combatting climate change (Nunn et al. 2019). Relevant to economic development, Bellevue has set goals to increase jobs near frequent transit and to increase energy conservation, which help mitigate greenhouse gases and support local economic resilience. Building retrofits to address distributed renewable energy, passive cooling, and other features can also be resilience measures. Having redundant and flexible transportation options also help reduce greenhouse gas emissions and support resilience in human health and emergency management.

- Sustainable Bellevue Key Performance Indicator: Jobs located within 1/4 mile of a frequent transit stop (% of jobs): 75% short term and 85% long term.
- Sustainable Bellevue Strategy E.2.1: Commercial energy efficiency. Provide technical assistance for commercial energy benchmarking and retrofits for large buildings to support compliance with the statewide program and leverage early adoption incentives.

The City of Bellevue also has set an equity priority for sustainability priorities: *"Does the proposed action support communities of color and low-income populations through workforce development, contracting opportunities, or the increased diversity of city staff?"* The City of Bellevue has the opportunity to build off its existing programs and develop more climate-informed strategies.

3.3.4 Vulnerability Summary

Disruptions to business continuity and economic activities in Bellevue are likely in a changing climate. These impacts may be felt more acutely in specific neighborhoods and employment centers, which affects both residents in and commuters to the city. In addition, economic vitality associated with tourism and cultural events that are held outdoors could be impacted by extreme heat, wildfire smoke, and sites could be damaged by drought and extreme precipitation; indoor recreation and cultural venues could alternatively see more demand as a result. The ability of this sector to prepare for and adapt to climate change depends on impacts to and adaptation measures enacted for other sectors, such as transportation, ecosystems, and zoning and development.

Table 13 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Economic Development sector in Bellevue.

TABLE 13 Economic Development: Potential Impacts, Adaptive Capacity, and Vulnerability Scores

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Air Temperature/Extreme Heat	High	Moderate	High
Extreme Precipitation/Flooding	Moderate	Low-Moderate	Moderate
Stream Temperature	N/A	N/A	N/A
Drought	N/A	N/A	N/A
Wildfire/smoke	High	Moderate	High

SOURCE: BERK 2023

3.4 Ecosystems

3.4.1 Sector Overview

This section examines the projected impacts of climate change on Bellevue's ecosystems and natural features, such as parks, open space, and other terrestrial and aquatic habitats and species. In general, climate change projections of concern for ecosystems include increases to annual average air temperatures, increases in heavy rainfall and extreme precipitation events, increased frequency and extent of flood events, more prolonged and intense periods of drought, and an increase in wildfire risk due to compounding factors.

Ecosystem features and resources within Bellevue are many and varied including 79 miles of streams within the city limits; approximately 13 miles of large-lake shoreline; 3 small lakes; 650 acres of open space and gardens; and an urban canopy that covers 36% of land area (Comp Plan Env and Parks Chapters). These natural resources provide habitat for many species of aquatic and terrestrial wildlife, play a critical role in water management and erosion control, and support human health and wellbeing.

Local resources reviewed for this section include the following:

- City of Bellevue Comprehensive Plan – Environment and Parks, Recreation, and Open Space Chapters (City of Bellevue Community Development 2015)
- Bellevue Parks & Open Space System Plan (City of Bellevue Parks & Community Services 2022)
- Urban Tree Canopy Assessment (Plan-It Geo LLC 2018)

3.4.2 Potential Impacts

- The effects of climate change have already been felt in the city including increased storm intensity and changes in streamflows due to changes in precipitation patterns. Record-setting temperatures experienced in the summer of 2021 also may be an indicator of climate change. Climate change may also result in tree mortality and an increase in invasive species.
- Changes to temperature patterns over the course of a year are likely to impact the onset of spring conditions. These shifts will impact food availability for species creating mismatches with established migratory and reproductive timings diminishing survival rates and reproductive success.
- Increasing air temperatures, in concert with decreasing summer precipitation are projected to decrease the species range for birds such as the bald eagle, black oystercatcher, western grebe, trumpeter swan, and others (Mauger et al. 2015).
- Some species (such as Douglas-fir) require sufficiently low winter temperatures to be reached before they begin spring growth cycles. Increasing winter temperatures could present challenges to such species (Mauger et al. 2015).
- Higher temperatures and increased incidence of extreme heat are likely to increase resident demand for access to shaded natural areas and recreational facilities with water access. This will likely contribute to increased use of parks and open spaces, which will both place additional burden on ecological processes and potentially expose residents to hazards such as algal blooms (Mauger et al. 2015).

- Increased air temperatures and extreme heat events may cause stress for species of local importance such as the Oregon Spotted Frog and other amphibians that will also be impacted by changes in precipitation patterns and the projected decline in wetland habitat (Mauger et al. 2015; WDFW 2015).
- Warming of lakes may alter the timing of critical biological events such as the spring plankton bloom, which are tied to the onset of thermal stratification. This may alter predator-prey interactions or cause the decline of certain species such as *Daphnia pulicaria*, a keystone herbivore whose peak abundance has not shifted to match phytoplankton availability (Mauger et al. 2015).
- Warming lake temperatures will likely stress native kokanee fish in Lake Sammamish as waters become more stratified. These coldwater fish thrive within a narrow band of suitable temperature and dissolved oxygen conditions. During summers, these waters become too warm and dissolved oxygen levels drop, creating physiological stress on kokanee and other species. As lake temperatures rise with climate change, the suitable temperature-dissolved oxygen band will be severely limited or eliminated (King County 2013).
- More intense precipitation events are likely to periodically increase the intensity of flows in streams and rivers, particularly those that receive stormwater runoff. These heightened flows may increase erosion of stream banks and scouring around developed areas. Erosion of banks is likely to be exacerbated by degradation of vegetation, which is likely due to forecasted increases in drought conditions (Mauger et al. 2015).
- More intense precipitation events may lead to higher incidence of landslide events. Many parks and open spaces including Weowna Park and Woodridge Open Space contain steep slopes. Should landslides occur in these areas, there may be damage to trail networks, which would reduce access for residents and increase maintenance demand.
- Many Bellevue parks and open space areas are susceptible to flooding including the Lake Hills Greenbelt, Richards Creek Open Space, and Kelsey Creek Park. While some open spaces may be designed to accommodate flooding and may even play a role in mitigating the impacts of high streamflow, others may experience damage to trail networks and other recreational facilities because of increased flood exposure increasing maintenance requirements and decreasing access.
- Urban flooding impacts resulting from intense precipitation events will likely occur more often in drainage basins with higher percentages of their land covered with impervious surfaces.
- The 2016 Storm and Surface Water System Plan reports few incidences of structural flooding between 1996 and 2011 and identifies 11 street locations that are commonly at risk of flooding during large storms. Flooding due to debris is a recognized concern at 64 city-owned drainage facilities. As extreme precipitation occurs more frequently than during the reference period these impacts can be expected to increase.
- Increased polarization in storm systems may exacerbate current conditions related to groundwater infiltration. If rain falls primarily in large storms that exceed absorption rates of existing wetlands and other infiltration sites, a greater proportion of annual precipitation will be lost as runoff. This may result in declining streamflows due to decreased aquifer reserves impacting wildlife and recreation opportunities.

- Soil moisture is expected to decrease with climate change during summer months and periods of drought. Decreased soil moisture will cause lower vegetation moisture, which increases stress on trees and plants as well as diminishing the cooling effects of vegetation of the surrounding environment.
- Drought will increase stress on trees and plants. Declines in groundwater availability may drive increased demand for irrigation, particularly in settings that are less drought tolerant such as sports fields and agricultural uses.
- Declines in the groundwater stores that replenish streams in Bellevue will diminish streamflow, degrading habitat conditions through stagnation, warming, and potentially even ecosystem failure if historically annual streams become seasonal.
- Lower water availability and increased demand during periods of drought may diminish water levels in Bellevue's lakes. Declining water levels will diminish recreational value and contribute to warmer water temperatures, which may cause increases in hazardous algal blooms and harm cool-water aquatic species.
- Drier conditions due to drought, increased temperatures, and extreme heat events may increase the risk of wildfires occurring in large open spaces. These fires may originate in these areas as a result of human activity (e.g., grills, cigarette butts, fireworks, electricity transmission infrastructure, etc.) or result from the spread of fire that originated in adjacent developed areas.
- Some invasive species and pests benefit from changing climatic conditions. Changing environmental conditions and increasing stress to host species and natives will give a competitive edge to nonnative and invasive species that may experience expansion in their ranges or may be more adaptable to changes.
- Riparian corridors that have been degraded by urbanization and development are more susceptible to erosion and instability (May et al. 1998), processes and effects, which will be exacerbated by changing climate patterns.
- Warm stream temperatures (influenced by ambient temperatures and streamflow rates) can affect adult salmon spawning and migration by way of changes to dissolved oxygen availability, levels of heat stress, and competition faced from less heat sensitive species. These conditions may become more common as annual average air temperatures increase and precipitation patterns become more polarized.
- As precipitation events are forecast to become more polarized in nature (bigger storms are more intense, smaller storms are lessened), runoff that originates in developed and impervious areas is likely to increase. This comes with an increase in pollutant transportation into waterways and decreases in groundwater infiltration (Lake Sammamish Watershed Assessment).
- More intense streamflow events due to increased precipitation, increased runoff, and decreased groundwater infiltration may increase erosion and sediment transport while decreasing dissolved oxygen levels having the overall effect of lowering water quality for aquatic species (CIG 2009).

3.4.3 Adaptive Capacity

- Increased occurrence of events such as landslides, flooding, or other storms may create a need for additional resources for cleanup and restoration projects.

- Bellevue’s Parks and Community Services Department manages the city’s street trees and arterial landscapes; works to protect and enhance wildlife habitat, water quality, and forest condition; and manages 92 miles of multi-use trails.
- Bellevue’s Shoreline Master Program establishes goals of maintaining shoreline ecological function, facilitating improvement of degraded conditions, and ensuring no net loss of ecosystem function.
- Some native plant and tree species are projected to respond well or be less impacted by climate change and may be suitable for use in future restoration projects.
- Many plans in Bellevue identify and prioritize restoration and conservation of habitat. These plans may be informed by reporting on climate change impacts and can help to adapt ecosystems to climate change impacts.
- Expansion of low-impact development practices can help mitigate runoff pollution and decrease incidence of urban flooding, promoting ecosystem health.
- The success of many programs such as the reduction of non-point pollution sources requires the public to take initiative in making modifications to their own properties.
- Some large wetland habitats within Bellevue are protected from development pressure and managed to restore ecosystem function. These ecosystems can help to mitigate flooding severity by capturing, storing, and filtering stormwater.
- Some species may be adaptable to changing temperatures and precipitation patterns. Certain significant local species such as salmon and the Douglas Fir show high levels of susceptibility to climate change impacts. Urbanization and resultant ecosystem fragmentation can block naturally occurring species migrations in response to changing climate conditions.
- Bellevue has completed a series of Urban Tree Canopy Assessments, the most recent in 2019. These assessments serve to guide the city as they aim to protect and expand the urban canopy from 39% of the city’s land area towards a goal of 40% canopy coverage. These aims are aided in part by strategies included in the 2021-2025 Environmental Stewardship plan:
 - 8% of the urban tree canopy overhangs impervious surfaces
 - Bellevue gained 2% tree canopy between 2011 and 2019.
 - 22% of the city has been identified as possible planting area while 39% has been identified as unsuitable.
 - Tree canopy varies between neighborhoods. For example: Downtown, BelRed, and Factoria all have 20% or less coverage while Bridle Trails and Cougar Mountain/Lakemont exceed 50% coverage.
- The 2021-2025 Environmental Stewardship Plan includes strategies to improve stormwater systems through the expansion of green infrastructure and system retrofits. Strategies to reduce municipal water usage by 10% are also included.
- The 2022 Parks & Open Space System Plan lays out a framework for the acquisition and development of new and existing parks and open spaces, including waterfront access. These plans will compete with the

demand for new residential and commercial development to accommodate a projected increase in population.

- Bellevue anticipates substantial population growth. Policies in the Environmental Stewardship Plan consider climate change impacts in land use planning. Implementation of these policies will be essential to minimize encroachment on undeveloped or rehabilitated ecosystems.
- Changes to the level of tree canopy and green space has secondary impacts on a number of factors including stormwater retention and ambient air quality. The benefits of increasing green space and tree canopy is reflected throughout the Bellevue Comprehensive Plan and the 2021-2025 Environmental Stewardship Plan.
- An updated Watershed Management Plan is currently being developed by the City of Bellevue, which will address projects to improve runoff pollution and habitat protection.

3.4.4 Vulnerability Summary

The vulnerability of ecosystems in Bellevue to climate change impacts is moderate to moderate-high. Non-climate stressors including development pressure, adjacent land use, and historic land uses all magnify the level of sensitivity of many ecosystems experience in Bellevue. High levels of exposure and sensitivity are partially offset by moderate to high adaptive capacity in the form of substantial planning for the future of resources such as the Urban Tree Canopy and each of the city’s watersheds. Table 14 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Ecosystems sector in Bellevue.

TABLE 14 Ecosystems: Potential Impacts, Adaptive Capacity, and Vulnerability Scores

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Air Temperature/Extreme Heat	High	Moderate	High
Extreme Precipitation/Flooding	High	High	Moderate
Stream Temperature	High	Moderate	High
Drought	Low-Moderate	Moderate-High	Low
Wildfire/smoke	Low	Low	Low

SOURCE: ESA 2023

3.5 Emergency Management

3.5.1 Sector Overview

The City of Bellevue performs emergency management through four phases: mitigation, preparedness, response, and recovery. Many departments contribute to mitigation of potential hazards and emergencies through planning, regulation, and capital improvements. Emergency preparedness involves education,

establishing procedures for continuity of operations, maintaining assets, and coordination with partners. While day-to-day emergency response is primarily handled by the Fire, Police, and other operational departments, larger emergencies can require disseminating information, coordinating resources, and activation of an interdepartmental Emergency Operations Center (EOC). Recovery involves damage assessment, conducting repairs, and providing assistance to impacted people and organizations.

Emergency management is a complex system of efforts to ensure that protocol and resources are in place to minimize negative impacts from emergencies. Climate change presents a threat to the emergency management system, with increases in the frequency and severity of extreme weather events. These changes could strain capacity and challenge current approaches to mitigation, preparedness, response, and recovery. Climate change may not substantially alter Bellevue’s emergency management protocol, but managing greater and more frequent climate extremes could require adapting equipment, facilities, and services.

Local resources reviewed for this section include the following:

- 2018-2023 Bellevue Comprehensive Emergency Management Plan (City of Bellevue Office of Emergency Management 2019)
- 2018-2023 Hazard Inventory and Risk Assessment (City of Bellevue 2019)

3.5.2 Potential Impacts

- During extreme weather events, departments of the City of Bellevue that provide emergency support functions may have resources strained due to increased demand for emergency response and challenges to response. Increased frequencies of precipitation and flood events could result in compounding impacts or prolonged emergency situations, which could overwhelm emergency management services and disrupt the continuity of operations. If emergency management personnel or systems are under-resourced for future climate conditions, they may struggle to maintain standard operating procedures that are lower priority short-term response activities, such as documentation of efforts, status reports, or other administrative processes.
- Increased temperatures will result in more heat-related illness, especially among older residents, young children, and people with existing health issues. Increased heat-related illnesses will result in more emergency calls, which could strain emergency response capacity. Increases in the frequency of heat-related illness calls could demand that emergency response apparatus carry more fluids or ice than they currently do or are able to. There may be increased demand for emergency medical services outside of the Bellevue Fire District as Bellevue provides advanced life support services to numerous communities with only basic life support training (e.g., Issaquah). Basic life support training does not allow for intravenous medical procedures, such as providing intravenous (IV) fluids, which is a standard procedure for people suffering from heat-related illness.
- Bellevue Fire CARES outreach efforts to vulnerable populations for welfare checks and to offer assistance will be required with greater frequency in a changing climate. Secondary resources to which CARES refers residents may become overwhelmed, which could direct the need for response back to police and fire departments.

- There will be increased demand for cooling centers and capacity of existing cooling centers may be exceeded. Information about cooling centers is not clearly publicized in a consistent manner. Having inconsistent hours and locations may increase the public's exposure to extreme heat if they travel to locations that are not serving as cooling centers. Seniors, low-income populations, people who are not fluent in English, and other vulnerable populations may not as easily access information online and could rely on established procedures when seeking respite or assistance. In addition, individuals without reliable transportation means may not easily access these sites.
- Greater numbers of people will seek out opportunities for swimming during extreme heat events, which could lead to a higher number of calls for water search and rescue operations. Lifeguards monitor beaches for part of the day at Meydenbauer Bay, Enatai Beach, Newcastle Beach, Clyde Beach, Chism Beach, and Chesterfield Beach. While there are a small number of other public waterfront access, a majority of water access likely occurs on private land that cannot be monitored. As such, there can be additional challenges to quickly and safely accessing the location of water-based emergencies. Increasing occurrences or risks of drowning may increase demand for water rescue training and education around water safety.
- Extreme heat events increase the risk of power outages, due to overwhelmed energy infrastructure and increased energy demand. Power outages can disrupt emergency management activities, including communications, office operations, and response procedures, depending on the availability of battery-powered equipment. While personnel may be equipped with portable radios, centralized communication equipment and other technology at emergency management facilities are more likely to rely on the power grid.
- Response personnel may be more likely to experience heat-related illness due to exposure to the elements and exertion in extreme heat conditions, which could be exacerbated by wearing heavy uniforms. Increased exposure to extreme heat may necessitate additional education or training to remind emergency management personnel to take precautions to avoid heat-related illness.
- Response personnel may need additional education or training to remind them to take precautions to avoid heat-related illness.
- Drought conditions will heighten wildfire risk, which would likely result in more calls about brush fires and yard fires. The Fire Department may have to dedicate greater resources to communicating and enforcing burn bans.
- Wildfire smoke from outside of the city would present health risks, especially to elderly populations and those with existing health issues, which could increase emergency calls. Poor air quality from wildfire smoke is not easily mitigated and public safety alerts would need to be communicated widely to the public to convey best practices for preventing exposure. CARES or other human services workers may have strained capacity doing outreach to vulnerable populations and could be exposed to unhealthy air quality conditions.
- Drought conditions may strain the availability of water for emergency services, including firefighting and medical services. Demand for medical services and firefighting is likely to be somewhat elevated during a drought, especially in an emergency that has disrupted the availability of water. Firefighters can draw water from surface water sources, but medical services would require disinfected water sources that would be less readily available during a water supply emergency.

- If drought conditions strain drinking water resources, there may be a need for water distribution or assistance from emergency management personnel. Long-term disruptions to water service could entail additional planning for emergency assistance.
- Extended drought conditions may require stricter and more active enforcement of water bans.
- Extreme precipitation events will strain stormwater systems, especially in urban areas, which could necessitate closures, inspections, and evacuations of affected areas by emergency personnel. A concentrated response to urbanized areas of Bellevue could delay response to more remote areas of the city.
- Storm events may result in power outages, which could impact emergency operations for facilities without backup power. Communications and utility systems may especially be vulnerable to storm events. Loss of communications would inhibit critical information-sharing procedures established by the Comprehensive Emergency Management Plan .
- Power outages at water facilities can result in loss of pressure in hydrants, which can harm fire response. Power outages may result in failure of other utilities and safety systems at private buildings that could increase calls for emergency response.
- Extreme precipitation events may affect the ability of emergency management personnel to respond to calls or require additional precautions. Heavy rain may require slower, cautious response from emergency vehicles. Roads inundated from stormwater may also require slower driving or alternative routes to destinations. Extreme precipitation in winter may result in ice that creates unsafe conditions in vehicles and on foot.
- Increased demand for technical rescues in various disciplines, including structural collapse, may occur due to increased potential for landslides.
- Erosion or landslides can damage roads, which would require emergency management coordination for road closure and redirecting traffic.
- Floodwaters could inundate the Lake Hills Connector and SE 7th Place with greater frequency and severity, which could restrict or slow responses by Fire Station 7 to areas west of the station. Lake Hills Connector also serves as a critical access route to I-405 and 116th Avenue SE, which are primary routes to the Overlake Medical Center, the only acute care hospital in Bellevue. Flooding over the Lake Hills Connector may also necessitate detouring the public to alternative evacuation routes that provide access to I-405 or I-90.
- Floodwaters may incapacitate certain emergency response vehicles and demand for amphibious vehicles or boats may increase.
- Demand for technical rescue from floodwaters and inundated vehicles may increase due to increased frequency and severity of flood events.

3.5.3 Adaptive Capacity

- The City of Bellevue maintains a Comprehensive Emergency Management Plan, an all-hazards plan that provides a framework for how the city would respond to and recover from an emergency. As such, there

are established methods of emergency management that can be implemented under any of the projected extreme weather events.

- Climate change, as a long-term shift, will allow for planning to prepare and adapt to projected future conditions. This could include training, risk assessment, and communicating risks to the public.
- Climate change in the present could have short-term effects on the continuity of operations and delivery of services in Bellevue, which will provide opportunities to observe specific impacts and prepare for them before these impacts become more frequent or severe.
- Both the Fire and Police Departments have personnel who write proposals for and administer grants to support additional training, equipment, or resources for emergency management departments. The City of Bellevue has historically participated in emergency management grant programs to support training and equipment for emergency preparedness. The Bellevue Police Foundation also provides annual grants to the Bellevue Police Department, most of which are for equipment and training. Continuing to pursue these grants will provide future opportunities for improving the resilience of Bellevue's emergency management operations to climate change.
- Recurring updates to plans for hazard mitigation, emergency management, growth management, and other affected areas of city operations will allow for opportunities to reassess historical impacts and projected changes, which can inform future adaptation.
- The City of Bellevue maintains development regulations that aim to prevent the creation of new risks to people and property by restricting impactful land use activities in hazard areas. Outcomes of the implementation of these regulations can be assessed to determine their effectiveness. Modifications to regulations can be made to account for climate change and related increases in risk to public health and safety, such as accounting for future flood extents.
- The City of Bellevue has numerous active channels for communicating with the public, including Bellevue Alerts, Bellevue Television, the city website, and social media. These communications channels are used to send out emergency information. There are also resources through King County's Office of Emergency Management (e.g., King County Alert, Reverse 9-1-1) that can be used to issue alerts directly to members of the public. These media could be used to increase education around risks, directing the public to emergency assistance and resources, and conveying further information about ongoing emergencies, which will be especially useful as emergency weather events become more severe in their impacts.
- The city has upsized culverts in the past to reduce the risk of flooding and has identified many capital projects to enhance the resilience of the drinking water supply during emergencies. Improvements could similarly be made to transportation infrastructure, such as evacuation routes or those to the hospital, or utilities at critical facilities.

3.5.4 Vulnerability Summary

Most of the major climate change-driven vulnerabilities to emergency management are related to capacity, facilities, and equipment. Emergency management personnel in Bellevue already respond to extreme weather events that are comparable to future conditions. More severe weather events will strain existing resources, but in many cases would not require different resources for emergency response. Minor impacts to emergency management primarily relate to mitigation and preparedness. Training and resources that

support personnel enables success in their job performance; much of these trainings and resources are already provided, but may be insufficient for future needs. Emergency management personnel are often charged with responding to public behaviors that create risk or worsen emergencies. Under a more extreme climate, these behaviors may present greater vulnerabilities. Building adaptive capacity and preparedness to respond to them will be a critical component of reducing vulnerability.

Table 15 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Emergency Management sector in Bellevue.

TABLE 15 Emergency Management: Potential Impacts, Adaptive Capacity, and Vulnerability Scores

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Air Temperature/Extreme Heat	High	Moderate	High
Extreme Precipitation/Flooding	High	Moderate	High
Stream Temperature	N/A	N/A	N/A
Drought	Low	Low-Moderate	Low
Wildfire/smoke	Moderate-High	Low-Moderate	High

SOURCE: ESA 2023

3.6 Human Health

3.6.1 Sector Overview

Human health is influenced by countless environmental, social, and economic factors. The City of Bellevue supports healthy living and communities through regulation of the environment, provision of community resources and facilities, management of utilities and services, and engagement with the population. Climate change will impact people and the systems in place to maintain public health through harmful weather conditions, disruption of services, increasing the potential for exposure to hazardous materials, and increasing the exposure of vulnerable populations.

Climate change events can exacerbate pre-existing health conditions. Additionally, persons with less economic resources and BIPOC populations or those speaking English less than very well can have difficulty preparing for and recovering from climate change events. The City of Bellevue supports human health through its human services programs, parks and recreation, and emergency medical services, and this section identifies potential hazards and strategies to promote community health and well-being including building on Bellevue’s current programs and policies.

Local resources reviewed for this section include the following:

- Bellevue Comprehensive Plan – Human Services Element (City of Bellevue Community Development 2015)

- Bellevue Parks & Open Space System Plan (City of Bellevue Parks & Community Services 2022)
- Sustainable Bellevue: Environmental Stewardship Plan (City of Bellevue Community Development 2020a)
- Blueprint for Addressing Climate Change and Health (Seattle-King County Public Health Department n.d.)

Bellevue’s human health assets include its:

- Residential Population: The Washington Office of Financial Management estimates Bellevue’s 2022 population at 153,900 people, making it the second-largest city in King County.
- Human Services Resources: The City of Bellevue convenes human service providers and manages a human services fund meant to meet basic human needs for: Survival, finding and retaining gainful employment, support in times of personal and family crisis, assistance in overcoming family or individual problems, and help in gaining access to available, appropriate services.
- Recreation Facilities: City park assets include over 2,700 acres of land, 98 miles of multi-use trails, 30 sport fields, 63 sport courts, 47 playgrounds, 13 picnic shelters, four community centers, three community farms, and 100 community garden plots.
- Fire Department Emergency Response Resources: The Bellevue Fire Department has 179 Firefighter-EMTs and 34 Firefighter-Paramedics. Nine fire stations (plus a paramedic unit stationed at Overlake Hospital) are located throughout the city to minimize response times. There are three aid cars equipped with basic life support and four paramedic units with advanced life support equipment. In addition to the city, the Bellevue Fire Department provides services to the communities of Newcastle, Medina, Clyde Hill, Hunts Point, Yarrow Point and Village of Beaux Arts. In 2021, there were 22,545 incidents provided a response, and most are emergency medical related. Of 15,951 emergency medical incidents most required basic life services (two thirds) (Table 16).

TABLE 16 Bellevue Fire Department Emergency Medical Incidents

Service	2017	2018	2019	2020	2021
BLS	9,337	10,555	10,405	9,115	10,693
ALS	5,982	5,121	5,217	4,676	5,258
Total	15,319	15,346	15,622	13,791	15,951

Legend: BLS: basic life support ALS: advanced life support
SOURCE: Bellevue Fire Department 2022a

3.6.2 Potential Impacts

- Increased temperatures in Lake Washington will improve growing conditions for cyanobacteria (blue-green algae), which can cause irritation from skin contact and severe illness if ingested. Pets may experience organ damage or death if consuming water with cyanobacteria. Limited English speaking and low-income populations may be most vulnerable to cyanobacteria exposure, as they may be more likely to rely on public facilities for recreation, may not have appropriate technology access to receive

alerts, and warning signage at beaches may not be translated. However, private waterfront exposure could be much more significant, as water quality would not be monitored at private properties.

- Increased temperatures will worsen the urban heat island effect, where built environments absorb and retain heat. Urban heat island effects are worse in areas with limited tree canopy or natural ground cover, which provide shade and cool the air. The average urban tree canopy coverage in Bellevue neighborhoods is 36%, but the following neighborhoods have notably lower urban tree canopy: BelRed (14%), Downtown (9%), Crossroads (31%), and Factoria (20%). King County’s heat island mapping study demonstrates that many of these areas, as well as Lake Hills, retain high levels of heat into the evening, while much of the city cools. Senior and disabled populations are especially vulnerable to heat-related illness. BelRed and Northeast Bellevue both have high numbers of senior residents, while Lake Hills and Northeast Bellevue have high numbers of disabled residents. These neighborhoods could have more significant health impacts during extreme heat.
- Extreme heat and prolonged periods of high temperatures can strain the electric grid, with power outages presenting a significant risk to human health, due to the need for electricity to provide critical services and maintain safe conditions at home. Extreme heat can damage key grid infrastructure by causing transformers or other equipment to overheat, with the risk of overheating increasing when there is prolonged periods of high energy demand. Electric lines may also overheat from high energy demand, which can cause wires to expand and sag or break through their insulation, causing short circuits.
- Droughts resulting from increased temperatures further threaten the reliability of the electric grid in Washington because more than 60% of energy in the state is generated from hydropower.
- Increases in average annual temperature and frequency of extreme heat events have increased the demand for air conditioning. Higher levels of air conditioning usage result in significant increases in energy demand during warm months, in addition to the demand increases from fans, refrigerators, and people spending more time inside. High energy demand threatens power outages, which put the public at increased risk of extreme heat exposure. In 2013, 16% of households in the Seattle-Tacoma-Bellevue Metropolitan Statistical Area had air conditioning, which had increased to 53% of households by 2021. In 2013, 9% of households up to 150% of the poverty line had air conditioners, which had only increased to 11% by 2021, while the overall proportion of households in poverty increased. As such, low-income populations are at a high-risk of exposure to extreme heat, with limited adaptive capacity at home. Households without air conditioning would already have elevated temperatures at the start of a power outage, creating increased sensitivity to the power outage for these households, which would also experience exposure to extreme heat indoors sooner than a house that was running air conditioning at the start of an outage. Buildings with greater mass tend to retain heat more effectively, increasing the risks to low-income and other vulnerable populations, who are more likely to live in multifamily or congregate housing situations. Seniors and people with disabilities would have heightened sensitivities to these conditions, especially if they are low-income or living in multifamily or congregate housing.
- Increased wildfire risks will worsen air quality, as wildfire smoke contains particulate matter that can irritate the lungs and is carcinogenic. Exposure to wildfire smoke would have negative health impacts for anyone, but it would be particularly harmful for people with respiratory diseases, such as asthma, seniors, and young children. Bellevue has a fairly average asthma rate for King County, with little variation across Census Tracts. The highest asthma rates are in Lake Hills, but they are not particularly

elevated. People living or working near the highways in Bellevue can have heightened levels of exposure to a variety of harmful pollutants, which can impair lung development, reduce lung function, and increase risks of lung disease, in addition to non-respiratory impacts. Approximately, 8,500 Bellevue residents live within 500 feet of a highway. People living in these areas, even if they do not have a respiratory disease, will have a heightened sensitivity to poor air quality. Extended periods of poor air quality due to wildfire smoke could increase development of respiratory disease and drive increased hospitalizations. The large senior population in BelRed and somewhat high percentage of children living in Eastgate may be at increased risk of impacts from wildfire smoke due to their proximity to highway pollution.

- Wildfire smoke may indirectly impact mental health. The Washington Department of Health has warned of psychological stress as a symptom of exposure to smoke. The presence of wildfire smoke has been described in research as causing “solastalgia,” which is place-based distress related to environmental change. The direct impacts of wildfire smoke on mental health have not been extensively studied (Eisenman et al. 2021). However, spending extended periods of time inside, which is frequently encouraged to avoid poor air quality, has been studied extensively and been found to cause heightened stress levels and depression. As such, people who follow best practices and avoid wildfire smoke are still at risk of health impacts.
- Increased stormwater flooding and extreme weather conditions in general can increase risks of systems failures and illicit discharges of hazardous waste at sites that handle or store hazardous materials. Release of hazardous materials can have negative health consequences or necessitate evacuation of the area. The EPA’s Environmental Justice Index places the Bel Red neighborhood above the 90th percentile in the state for hazardous waste proximity. The Environmental Justice Index weights metrics based on the vulnerability of the population in the area. While hazardous waste proximity in the neighborhood ranges from the 72nd to the 81st percentile in the state, the socioeconomic demographics of the population in Bel-Red reflect a higher sensitivity to hazards.
- Increases in extreme precipitation events and flood extents will produce waterlogged soil, which can be unstable and hinder drainage into the soil. Waterlogged soil or flooded areas can lead to sewer backups from septic systems. Most of Bellevue is connected to the King County wastewater system, but a few neighborhoods have high concentrations of septic systems, including the Bridle Trails neighborhood and a section of the Newport neighborhood between 118th Avenue SE and I-405. The Newport area may be especially impacted by waterlogged soil, as much of the area between 118th Ave SE and the Lake Washington waterfront is in the 1% annual chance floodplain. Inundation of these lower areas could slow drainage out of the neighborhood and backup septic systems.
- Extreme precipitation and flooding can create unsafe living conditions through damage to structures and introduction of harmful materials in floodwaters. Buildings exposed to wet conditions through inundation, roof leaks, or damage to utilities risk growing mold, if not dried or cleaned sufficiently. Mold exposure can create serious health conditions and worsen existing conditions, especially respiratory diseases. The risk of exposure to mold or harmful materials is higher for those living in older houses, which are more likely to have been built prior to floodplain development regulations. Older homes may also be in worse states of deterioration and may be more likely to utilize organic materials such as wood that mold grow on. Low-income residents may lack adaptive capacity to professionally repair or clean flood damage, while senior and disabled residents are less likely to be able to perform needed cleaning or repairs after their homes are damaged.

- Heavy rains can produce dangerous travel conditions that result in higher numbers of accidents. Large numbers of injuries in a concentrated time period may overwhelm the Overlake Medical Center, especially if other regional hospitals are experiencing similar service demand or road conditions make other hospitals inaccessible. Flooded roadways are a serious hazard, with a majority of flood-related drownings occurring when vehicles are driven into floodwaters. However, the few locations where roads are at risk of flooding in Bellevue indicate that a more common hazard would be injuries from slippery road conditions. Rain events in general can create hazardous travel conditions, but high-volume winter rain events have produced icy conditions in recent history that resulted in significant increases in injury. Ice from large precipitation events is harder to remove from streets and is present for longer periods of time, exposing more people to the hazard. During a December 2022 ice storm, the Seattle Fire Department had its highest call volume on record, which included over 300 calls for falls on the ice, approximately one-third of which required hospitalization. During the same storm, Washington State Patrol responded to hundreds of vehicle collisions in King County. People who cannot work from home, especially those in service industries, would be most exposed to risks of fall and collisions.
- The link between demographic factors and climate stressors is also described in more detail in Table 17. Generally age, health, income, race, immigration/language, and other factors are factors that can increase vulnerability to extreme heat, flooding, and wildfire smoke.

TABLE 17 Demographics and Link to Climate Stressors

Demographics	Vulnerability	Heat	Flood	Smoke
Children, <5 years old	Breathe more air and drink more water per body weight than adults Developing organs and low immunity Dependent on adults More time spent outdoors	X	X	X
Older Adults, > 64 years old	Low immunity Pre-existing conditions Limited mobility	X	X	X
Communities of Color	Structural racism Inadequate infrastructure Health disparities Lack of social capital	X	X	X
Low-Income Communities	Less resources and means to evacuate Inadequate infrastructure	X	X	
Living Alone	May be less connected to information or community.	X	X	
Immigrants (inc. limited English)	Lesser English language abilities and cultural differences during evacuation Access to post-disaster funding		X	
Disabled	Limited access to knowledge, resources, and services to effectively respond to environmental change Compromised health makes people with disabilities more vulnerable to extreme climate events or infectious diseases More likely to have difficulties during required evacuations	X	X	X

Demographics	Vulnerability	Heat	Flood	Smoke
Unemployment	The potential loss of employment following a disaster exacerbates the number of unemployed workers in a community, contributing to a slower recovery from the disaster.	X	X	
Outdoor workers	Exposure to high temperatures, air pollution, extreme weather and natural disasters, and biological hazards	X		X
Persons with pre-existing or chronic medical conditions	Climate stressors can increase respiratory and cardiovascular disease, injuries and premature deaths related to extreme weather events, increased exposure to food- and water-borne illnesses and other infectious diseases, and threats to mental health	X	X	X
Pregnancy	Exposure to high temperatures or air pollution could increase the potential for babies to be premature, underweight or stillborn.	X		
Education – less than high school degree	Lower education constrains the ability to understand warning information and access to recovery information.	X	X	X

Note: * The CVI addresses outdoor workers in the heat index based on a review of literature and example climate index models.
SOURCES: APHA 2021; Cutter, 2003; EPA 2021; Lundgren and Jonsson 2012; Reid et al. 2009; Yu et al. 2021

Bellevue has a high share of non-White population and persons speaking English less than very well (Table 18). Older adults and adults living alone are also notable at above 10%.

TABLE 18 City of Bellevue Demographic Risks Associated with Neighborhoods

Demographics	Citywide Statistics	Neighborhoods with Greater Share
Children, <5 years old	4.4%	BelRed, Crossroads, Eastgate, Newport, West Bellevue, West Lake Sammamish
Older Adults, > 65 years old	15.0%	Crossroads, Northeast Bellevue
Communities of Color (non-White including Hispanic)	56.5%	BelRed, Bridle Trails, Cougar Mountain, Crossroads, Lake Hills, Somerset, West Bellevue
Low-Income Communities (Poverty Rate)	7.4%	BelRed, Crossroads, Lake Hills, Factoria, Newport
Living Alone	14.6%	BelRed, Downtown
Immigrants (inc. limited English) Foreign Born	42.0%	
Speak English less than “very well”	16.5%	Linguistic Isolation: Downtown
Disabled	9.5%	Unmapped
Unemployment	3.8%	Crossroads, Newport, Northeast Bellevue, Northwest Bellevue, Woodridge
Outdoor workers	4.1%	Eastgate, Newport, Northeast Bellevue, West Lake Sammamish, Woodridge

Demographics	Citywide Statistics	Neighborhoods with Greater Share
Persons with pre-existing or chronic medical conditions Fair or poor health%	8.5%	Crossroads, Eastgate, Factoria, Lake Hills, Newport, Somerset, West Lake Sammamish
Education – less than high school degree	10%	Northwest Bellevue

SOURCES: ACS 2022; Seattle-King County Public Health Department n.d.

Although Bellevue is an affluent community, some demographic risk factors include a high share of non-White residents including those that are foreign born and speak English less than very well, and older adults and those living alone. A lack of quality affordable housing is also a risk. The potential impacts to vulnerable populations include:

- An increase in heat-related deaths and illnesses, particularly among the elderly, poor, and other vulnerable populations. A study in King County showed an increase in basic life services (BLS) and advanced life services (ALS) with extreme heat events (DeVine et al. 2017).
- Rising temperatures and wildfires and decreasing summer precipitation will lead to increases in ozone and particulate matter, elevating the risk of cardiovascular and respiratory illnesses and death (Yu et al. 2021).
- Increased vulnerability of residents, particularly those who live in poverty and polluted and/or high-risk hazard areas. Bellevue has identified about 13 percent of the city’s land area is within an Air Pollution Exposure Zone (APEZ; 500 feet of a major road such as I-405) and about 18 percent of that area is zoned for multifamily or mixed-use residential use.

3.6.3 Adaptive Capacity

- The City of Bellevue incorporates public health considerations into strategic planning efforts, such as its Urban Tree Canopy Assessment. Consistently assessing public health risks and how to alleviate them in planning efforts will help to build capacity and competencies for managing health impacts of climate extremes.
- The city, via the Utilities Department and in coordination with the Seattle-King County Health Department, regulates septic systems that pose a threat to public health. Septic systems are at risk of failing under flood and extreme precipitation conditions, which will make maintaining these systems more difficult for property owners as climate change worsens. State and County regulations establish when there is a need for a property with a septic system to connect to a public sewer, but the city has the capacity for outreach to septic owners and to financially support property owners in connecting to public sewer systems.
- The City of Bellevue provides supplemental public transportation options and collaborates with partners to improve existing public transportation resources. Most community centers, libraries, and major medical centers are accessible through multiple public transportation options, some are underserved, such as the Highland Community Center in BelRed, which can be directly accessed through only one bus route. Providing public transit information when utilizing public facilities for

emergency services can improve access. Additionally, the City of Bellevue could implement expanded paratransit services during emergencies or work with King County Metro to expand access to these services that are crucial for senior and disabled populations.

- The City of Bellevue has established community centers and libraries as cooling centers during heat waves in recent years. Excessive heat warnings and cooling center announcements on the city's website have historically identified four community centers as cooling centers (e.g., Crossroads, Highland, North Bellevue, and South Bellevue), which are all located on the east side of the city. King County operates four libraries in Bellevue, all of which are air conditioned and most of which have operated as cooling centers during heat waves.
- The adaptive capacity of low-income households to extreme heat and wildfire smoke can be supported by the city through connecting households with existing energy assistance and weatherization programs. The federally-funded [Low-Income Home Energy Assistance Program](#) can provide low-income households with assistance on utility bills, as well as pay for air conditioners and air purifiers. [PSE's Home Energy Lifeline Program](#) also provides assistance with bill payment for low-income households. [Home Weatherization Assistance](#) provided through state and federal funding funds improvements for low-income households, such as air sealing, energy conservation, and improving indoor air quality, which reduces the financial burden of maintaining cool and healthy indoor spaces.
- BelRed and the Downtown district have the two lowest percentages for possible planting area for new trees and the two lowest percentages of existing tree canopy. The City of Bellevue has limited capacity to directly plant new trees in these areas to adapt to climate change. The ability to increase tree canopy in these areas would mainly be through regulation or partnership with private property owners in these areas. This could be performed through land use standards in the Bellevue Land Use Code, such as 20.20.900 Tree Retention and Replacement or 20.25A.120 Green and Sustainability Factor.
- Low-income populations may have limited adaptive capacity that could increase their vulnerability, such as needing going to work during a climate emergency, being unable to afford air conditioning, or lacking the funds to make repairs after a flood. People in the eastern part of the Crossroad neighborhood and the northeast corner of Lake Hills may especially lack adaptive capacity, as the two Census Tracts in this area have high concentrations of low-income populations and have the highest ratios of housing cost to income in Bellevue.
- Limited English-speaking populations may have reduced adaptive capacity due to reduced accessibility of information and reduced ability to communicate needs. The area bounded by 64th Ave SE and NE 8th Street that consists of the Landmark Apartments, Bellepark East Apartments, and Woodside East Apartments is above the 90th percentile in Washington for limited English speaking and low-income. The City of Bellevue has the capacity to translate weather emergency information and perform outreach to vulnerable populations during weather emergencies to ensure they are aware of available resources.

3.6.4 Vulnerability Summary

Human health vulnerabilities to climate change in Bellevue are largely the outcomes of increased exposure of people and infrastructure that have existing sensitivities (e.g., respiratory diseases, aging or outdated buildings). Inclusive planning efforts that work to reach vulnerable populations will help the City of Bellevue identify sensitivities and plan for appropriate adaptations. Many of the populations most vulnerable to

climate change are concentrated in particular neighborhoods, which can simplify outreach, needs assessments, and building community-based adaptive capacity. Vulnerabilities based in infrastructure are already regulated by the City of Bellevue or King County. Monitoring outcomes of existing policies and identifying opportunities to improve those policies to meet the needs of the future will allow Bellevue to effectively respond to impacts to human health in the built environment.

Table 19 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Human Health sector in Bellevue.

TABLE 19 Human Health: Potential Impacts, Adaptive Capacity, and Vulnerability Scores

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Air Temperature/Extreme Heat	High	Moderate	High
Extreme Precipitation/Flooding	Moderate-High	Moderate	Moderate-High
Stream Temperature	Low-Moderate	Moderate	Low-Moderate
Drought	Low	Moderate	Low
Wildfire/smoke	High	Low-Moderate	High

SOURCE: ESA 2023

3.7 Transportation

3.7.1 Sector Overview

Bellevue has grown rapidly over the past decade and relies on a robust transportation system comprised of infrastructure that supports walking, bicycling, transit, driving, and other mobility services including Rapid Ride buses and East Link Light Rail. Transportation in Bellevue is guided by the Transportation Plan; the goal of this plan is “to improve all mobility options so that everyone in Bellevue has a safe, comfortable, and efficient experience on their preferred mode while encouraging and transitioning to more environmentally and fiscally sustainable modes.”

Bellevue is connected to the region by Interstate-90, Interstate-405, and State Route-520 highway systems, which are all operated by the Washington State Department of Transportation. Additionally, the city is also served by regional trails including the Interstate-90 Trail and the State Route-520 Trail, which are also operated by the Washington State Department of Transportation. King County Metro and Sound Transit jointly operate 42 bus routes that include at least one stop in Bellevue, which connect the city to Seattle, other cities on the Eastside, and all parts of King County.

In 2019, the vehicle miles traveled per capita in Bellevue was 8,715 miles and an average of 51,000 individuals boarded transit services each day. From 2016 to 2020, the drive-alone rate in the city was 71% for workers and 58% for residents. As of 2021, there were 5,044 electric vehicles registered in the city; a five-fold increase from 2016. Of all transportation-related emissions measured by the city, 74% were from passenger cars.

The City of Bellevue estimates that by 2035, the highest average daily person trips per acre will occur in downtown Bellevue adjacent to Interstate-405 and range from 401 daily person trips per acre to over 1,400. Additionally, the city predicts a 43% increase in the total number of daily person trips to or from, or internal to, Bellevue between 2010 and 2030.

Local resources reviewed for this section include the following:

- City of Bellevue Comprehensive Plan – Transportation Chapter (City of Bellevue Community Development 2015)
- 2022–2023 Transportation Facilities Plan (City of Bellevue Transportation Department 2022)
- Eastgate Transportation Study (City of Bellevue Transportation Department 2019)
- Downtown Transportation Plan (City of Bellevue Transportation Department 2013)
- City of Bellevue Bike Map:
https://apps.bellevuewa.gov/gisdownload/PDF/Transportation/BikeMapUpdate_24x34.pdf
- Environmental Stewardship Plan (City of Bellevue Community Development 2020a)

3.7.2 Potential Impacts

As climate change accelerates, its impacts are anticipated to present an array of challenges to Bellevue. Of the projected climate change impacts facing the city, the transportation sector is most vulnerable to increasing air temperature variability and extreme temperature events, increasing heavy rainfall and extreme precipitation, and increased flood events.

- Extreme winter weather and cold temperatures pose a variety of threats to the transportation sector in the city.
 - In February 2019, a major winter storm resulted in 2-3 inches of snow in lower elevation portions of the city and between 6-8 inches in areas of higher elevation. This snow, combined with below-freezing temperatures, made travel throughout the city very difficult. Snow clearing was prioritized for major arterial streets leaving residential streets and less traveled routes impassable. Additionally, transit services were reduced and operated on designated snow routes, which substantially reduced the number of stops serviced (City of Bellevue 2019a).
 - In December 2022, freezing rain led to substantial disruptions to transportation corridors throughout Bellevue. Untreated roadway surfaces became nearly impassable, particularly in areas with steep terrain. Additionally, all transit services were cancelled for several hours due to roadway conditions (Westside Seattle 2022).
 - Extreme heat events, such as the heatwave of June 2021, can also impact transportation services in Bellevue. While personal vehicles are minimally impacted, individuals who rely on alternative forms of transportation such as a bicycle or transit are disadvantaged during such events when the heat poses risks to health and safety. Additionally, extreme heat in 2021 led Sound Transit to slow its trains to maintain safe operating conditions as the heat caused rails to expand and overhead power lines to lose tension. Elsewhere in the region the extreme heat caused sections of roadways to buckle resulting in road closures and delays (Crowe 2021).

- A recently completed King County project to map heat impacts across the county revealed that downtown Bellevue experiences high heat impacts due to limited vegetation and high density of buildings and infrastructure. This area is also home to the Bellevue Transit Center; during extreme heat events, transportation users in the Bellevue area would be susceptible to higher temperatures in this area (King County 2022).
- Overall, the challenges presented by increasing air temperature variability and extreme temperature events present moderate challenges to the transportation sector in Bellevue. While snow, ice, and extreme heat threaten public safety and transportation delays, the impacts of these events is typically short-lived. However, as these events become more common in the future, they will pose more frequent challenges to the city.
- Increased rainfall and extreme precipitation events will present challenges to transportation infrastructure throughout Bellevue. One such impact may be an increase in sinkholes causing road closures and the disruption of transit service. In September 2022, segments of Interstate-405 were closed to repair the freeway’s drainage system after a 15-foot-deep sinkhole was discovered adjacent to the freeway. Stormwater drainage pipes had failed, preventing the flow of rainwater to Lake Washington and instead it seeped under the roadway resulting in the formation of a sinkhole. This repair required the closure of the freeway for 23 hours in both directions, resulting in significant delays and disruptions for those traveling through Bellevue. The impacts of sinkholes caused by heavy rainfall are significant, and depending on their location, have the potential to alter transportation options for a large number of individuals (Sullivan 2022).
- Increased rainfall and precipitation may also lead to increased mudslide events throughout the city, particularly in areas with steep slopes.
 - In mid-January 2022, a landslide occurred in the Somerset neighborhood, which pushed a home off of its foundation and led to significant amounts of water, debris, and mud to flow into the road and cul-de-sac adjacent to the property. Six weeks after the initial landslide, heavy rainfall led mud and debris to flow through the vicinity again, which resulted in the closure of roads and limited access to the area (Bellevue Fire Department 2022b).
 - In 2012, heavy rainfall resulted in a landslide that closed a section of West Lake Sammamish Parkway for nearly nine weeks (Levy 2012).
 - Bellevue is highly susceptible to landslide events given the significant amount of rainfall the city receives and its hilly terrain. During prolonged periods of precipitation, steep sloped areas may become unstable and result in landslides, which damage properties, but also block roads and other transportation corridors.
- High winds associated with winter storm events have impacted roads throughout the city. In 2019, several arterial streets were closed due to downed trees, power lines, and other debris (City of Bellevue 2019b).
- Overall, increased rainfall and heavy precipitation events present significant challenges to the transportation sector in the city. The response time, repairs, and recovery efforts to deal with sinkholes, mudslides, and related events is substantial and inhibits the ability of individuals to use transportation resources in the city. The location of these events is particularly important when evaluating potential impacts. As noted above, disruptions on Interstate-405 resulted in significant impacts throughout

Bellevue and the region. And while the landslide events observed in Somerset were certainly consequential, their impacts were felt on a more local level. Accordingly, the City of Bellevue should prioritize maintenance and reinforcement efforts on major roadways and arterials in the city.

- Increased precipitation and heavy rainfall events also leads to localized urban flooding, which can result in significant impacts to roads and other transportation corridors.
- In December 2019, extreme rainfall flooded many roadways in Bellevue including Southeast Seventh Place, which experienced four feet of standing water. Apart from closures and alternate routes, flooding and standing water also pose safety concerns for transportation as cars become susceptible to hydroplaning. Roadway flooding, especially on a large scale, can limit the movement of emergency services and first responders hindering their ability to respond to accidents and other emergencies (MyNorthwest 2019).
- Overall, flood events pose a moderate risk to the transportation sector in Bellevue. Similar to extreme temperature events, the impacts associated with floods are typically short lived. However, like the impacts associated with increased precipitation and landslides, the location of flood events is important in evaluating their impacts on transportation resources. Additionally, existing resources such as FEMA Flood Maps and other geospatial analyses have provided managers with information about areas most susceptible to flooding, which can be used to help guide planning efforts.

3.7.3 Adaptive Capacity

There are several policies, programs, and other measures currently in place to help Bellevue adapt to the challenges presented by climate change on the transportation sector. Broadly speaking, however, the adaptive capacity of transportation infrastructure is limited given the need for large capital investments, which require funding, design, stakeholder engagement, and construction over long periods of time. This makes planning for future climate scenarios more viable for transportation infrastructure, however, responding to and recovering from severe climate-related events and damages is more challenging.

- In 2022, the City of Bellevue began development of a web-based mapping tool for residents and those who work in the city to see which streets have been plowed and the location of snowplows in near real time during winter weather events (<https://bellevuewa.gov/winter-response-map>). This map can be used by individuals to help identify recently treated roads before they travel through the city. Currently, the map displays data for primary and secondary arterial streets but will be developed to include all routes serviced during winter weather events.
- In 2022, several King County departments began working together to develop an Extreme Heat Mitigation Strategy to help coordinate a response by the county to extreme heat events. As part of the development of this strategy, King County Metro Transit is using information from heat mapping exercises to inform the design of bus stop structures and amenities to provide relief for transit users during extreme heat events, particularly at stops serving disadvantaged communities. Similarly, the county has initiated a 3 Million Trees initiative to grow the urban tree canopy, which will provide relief to transit users, bicyclists, and pedestrians during heat events (King County 2022).

- King County Metro Transit also encourages users to download apps that track the locations of buses and other transit vehicles so that individuals can limit time outdoors during extreme heat and cold events (King County 2022).
- King County Metro Transit also provides service to cooling and heating centers during extreme temperature events. During previous extreme heat events, King County Metro Transit did not collect fares for individuals travelling to cooling centers.
- The City of Bellevue has several policies intended to prevent landslides. The land-use code limits construction and the clearing of vegetation in geological hazard areas identified throughout the city. The City of Bellevue also limits development in areas of steep slopes and in areas with identified drainage routes that are susceptible to erosion. Individuals that own property near or on steep slope areas are encouraged to work with licensed engineers to evaluate slope conditions and mitigate slide hazards. Other efforts include maintaining vegetation on sloped areas to stabilize soil and connect all storm drains to channel runoff to approved areas outside of slopes and hillsides.
- The City of Bellevue is in the early stages of building electric vehicle charging capacity for its electric emergency vehicles. This includes adding Level 2 electric vehicle charging stations and establishing fast chargers on backup generators in case of emergency events.
- In its 2022-2023 Transportation Facilities Plan, the City of Bellevue has outlined several road projects intended to help manage stormwater, drainage, and flow diversion to minimize impacts from urban flooding. Additionally, the City of Bellevue has taken steps to plant greenspaces and gardens in areas of the city to help mitigate the impacts from increased stormwater during heavy precipitation events.

3.7.4 Vulnerability Summary

Overall, climate change poses a variety of threats to the transportation sector in Bellevue. The primary impacts that present the greatest risks to transportation include increasing air temperature variability and extreme temperature events, increasing heavy rainfall and extreme precipitation, and increased flood events. The consequences of these impacts on the transportation sector varies by time (e.g., extreme heat impacts can be disruptive but typically short lived) and space (e.g., disruption or damage to major freeways and arterial routes are more impactful to the transportation needs of city residents and commuters). Table 20 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Transportation sector in Bellevue.

TABLE 20 Transportation: Potential Impacts, Adaptive Capacity, and Vulnerability Scores

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Air Temperature/Extreme Heat	Moderate-High	Low-Moderate	High
Extreme Cold/Winter Storms	Low-Moderate	Low-Moderate	Moderate
Extreme Precipitation/Flooding	High	Moderate	High
Stream Temperature	N/A	N/A	N/A

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Drought	Low	Low-Moderate	Low
Wildfire/smoke	Low	Low-Moderate	Low

SOURCE: ESA 2023

3.8 Waste Management

3.8.1 Sector Overview

As Bellevue has grown over the past decades, it relies on a complex waste management system to provide residents and businesses with materials recycling and disposal as well as wastewater and stormwater management:

- The City of Bellevue contracts with Republic Services for garbage, recycling, and compost services. The Utilities Department administers programs and other initiatives to educate residents and business owners about environmentally friendly waste management practices.
- The Utilities Department manages a stormwater system that consists of streams, lakes, wetlands, pipes, catch basins, and flood control sites all of which drain into either Lake Washington or Lake Sammamish. The Utilities Department leads initiatives and projects that provide flood control, protect water quality, and enhance and protect natural habitats.
- Wastewater is managed by the Wastewater Division, which oversees the city’s wastewater collection system that connects to the King County regional sewage system where it is treated according to state and federal water quality standards. The City of Bellevue’s wastewater service area covers over 37 square miles and includes maintenance holes, mainline pipes, and pump and flush stations.

This section provides an overview of potential impacts expected as a result of climate change and their connection to waste management infrastructure in Bellevue.

Local resources reviewed for this section include the following:

- Wastewater System Plan (Bellevue Utilities 2015)
- Storm and Surface Water System Plan (Bellevue Utilities 2016)
- Business Profile (Bellevue Utilities 2021)
- City of Bellevue Environmental Stewardship Plan (City of Bellevue Community Development 2020a)

3.8.2 Potential Impacts

- Of the projected climate change impacts facing Bellevue, the waste management sector is most vulnerable to increasing air temperature variability and extreme temperature events, increasing heavy rainfall events, increasing flood events, increasing stream temperatures, and prolonged periods of drought.
- Cold temperatures and winter weather conditions can impede garbage, recycling, and compost collection, resulting in cancellation or delay of services. During the freezing rain event of December 2022, service was suspended for two days (KOMO News 2022). Areas accessed by roadways with steep slopes are most at risk of service disruption. Overall, impacts from such events present a minimal risk to waste management operations since they are usually short-lived.
- Increasing precipitation events will present many challenges to flood control initiatives led by the Utilities Department. The majority of precipitation that falls in Bellevue occurs during the winter months. While water can be absorbed by soils, there is little plant uptake that occurs during winter.
- With increasing winter precipitation, the capacity for soil uptake will be limited, resulting in more stormwater and increased flood risk, requiring the Utilities Department to increase its capacity for stormwater management.
- Uncertainty surrounding the specifics of changes to future rainfall amounts is a primary obstacle for future planning. Potential changes in the intensity and timing of rain events will have dramatic implications for stormwater management as well as potential changes to the biology and chemistry of receiving waterways.
- Aging and/or undersized infrastructure also poses significant challenges to stormwater management in the face of climate change. The average age of drainage assets in Bellevue is 45 years and with increased rainfall, this infrastructure may be unable to adequately handle increased flows. This system was built to handle typical light rainfall expected in Western Washington, however, as more intense rainstorms occur, the stormwater system in Bellevue may become overwhelmed (Buranen 2017).
- Increasing precipitation will heighten the risk of flooding, limit the ability of existing stormwater management features to abate flood risk, and increase the capacity demands put on aging infrastructure.
- Specific areas of Bellevue are more at risk from flood events than others. For example, a portion of stormwater flows into Lake Washington at Lower Coal Creek, however, the creek is restricted to a narrow channel that flows through a residential neighborhood. The creek's levees do not protect against 100-year flows and adjacent homes are at risk from even moderate flood events. As greater amounts of precipitation fall during winter months, homes such as these will be at an increased risk of flooding.
- Between 1986 and 2006, Bellevue lost 20% of its tree canopy cover. This loss of trees presents significant obstacles to flood management as less mature forests and trees absorb less water during and before flood events.
- Similar to increased precipitation events, increased flood events will present a significant risk to the waste management sector. Increased flooding will present risks to homeowners and demand larger and more comprehensive flood management systems. Fortunately, extensive flood mapping data exists for

the city, which will help resource managers identify and prioritize areas in need of infrastructure upgrades and other initiatives.

- Septic systems in Bellevue are at risk of failure or reduced capacity from flood events. Floodwater can damage septic systems and fully saturate soils in the system's drain field.
- The Wilburton Pump Station, part of the King County Wastewater Treatment System, is located within the Regulatory Floodway as identified by the Federal Emergency Management Agency. Pump station infrastructure could become damaged during flood events. Flood events also pose risks for sanitary sewer overflows, which occur when sewage from city-owned assets reaches storm drains or waterways and poses public health and environmental threats. The City of Bellevue has an established goal of 4 or fewer overflows per 100 miles of pipe each year.
- In late summer 2015, Bellevue and the greater Puget Sound Region experienced drought due to historically low precipitation and high temperatures. The cities of Seattle, Everett, and Tacoma created a regional agreement with a goal of reducing water use by 10%. As part of this effort, Bellevue Utilities limited routine maintenance activities that require the use of water, instead postponing them until October and November of that year. This included flushing of water mains and other work. Additionally, Bellevue Fire limited their training drills that required water.
- In general, Bellevue is somewhat drought-resilient given that its water supply comes from Seattle Public Utilities reservoirs, which are less impacted by drought events and declarations. However, as summers continue to warm and periods of drought are more frequent, the city will face challenges related to regular maintenance and other activities that require the use of water.

3.8.3 Adaptive Capacity

- In 2022, the City of Bellevue began the development of a web-based mapping tool for residents and those who work in the city to see which streets have been plowed and the location of snowplows in near real-time during winter weather events. This tool could be used by waste management collectors to help prioritize areas in which to collect garbage, recycling, and compost during winter weather events.
- The City of Bellevue is piloting Salmon Safe Certification for the construction of Fire Station 10. This includes the design of landscape features that capture excess stormwater to mitigate flood risk and remove pollutants from stormwater.
- In 2016, the City of Bellevue updated its critical areas codes to prioritize strategies for stormwater runoff reduction during and after heavy rainfall events.
- The Bellevue stormwater system includes regional detention ponds that can hold water during periods of heavy rainfall and slowly release it. These systems are designed to hold a week's worth of water under normal precipitation intensities, which can provide a buffer to the system during heavy rainfall events (Buranen 2017).
- The City of Bellevue's permit under the National Pollutant Discharge Elimination System requires low-impact development be considered as the preferred method of stormwater management. Low-impact development includes features such as downspouts that flow into planters, or raingardens and swales that help slow the speed of runoff to promote groundwater infiltration (Buranen 2017).

- In its Environmental Stewardship Plan, the City of Bellevue aims to increase tree canopy to 40% of the city's total area. This would equate to roughly 670 acres of tree canopy, or over 75,000 trees. Increasing the city's tree canopy will increase the amount of water uptake by plants. During extreme precipitation events, this will provide a buffer to excess stormwater amounts and help to limit flood risk.
- The City of Bellevue has a goal of open space preservation throughout the city. Not only will this action allow access to parks and open spaces for residents, but open space areas, particularly when situated in floodplains and low-lying areas, can help to alleviate the damages associated with flood events. These initiatives are further detailed in the Watershed Management Plan and the Parks and Open Space System Plan.
- The City of Bellevue is enrolled in FEMA's Community Rating System, which means Bellevue residents receive a 25% discount on National Flood Insurance Program policies. This provides adaptive capacity for Bellevue residents to respond to and recover from flood events.
- The City of Bellevue has established a goal of no more than five occurrences of structural flooding in the public stormwater system after heavy rainfall events. From 2015 through 2020, Bellevue recorded only 12 such events, all of which took place in 2019.
- The City of Bellevue is currently conducting a stream health assessment to inform the development of its Watershed Management Plan and has advanced several stream restoration projects including the acquisition of eight acres in BelRed for future restoration efforts.
- The Watershed Management Plan will guide its efforts to improve stream health by prioritizing investments in high-impact areas that will lead to measurable benefits over short time horizons.
- The City of Bellevue has also identified several green stormwater infrastructure projects in its Capital Improvement Plan to expand pervious surfaces, facilitated rainwater catchment, and reduce the flow of stormwater runoff to limit water pollution. Reducing impervious surfaces and increasing tree canopy and infiltration sites for runoff could reduce temperatures in some areas.
- The Bellevue Parks and Community Services Department has developed best management practices and design standards to guide the conservation of natural resources. This includes information related to native tree and vegetation plantings in city rights-of-way to limit the need for water during periods of drought. Additionally, the document includes information about upgrading irrigation systems to more efficient models.
- The Bellevue Utilities is also upgrading water meters to improve leak detection and updating building standards to specify water-efficient plumbing fixtures to optimize indoor and outdoor consumptive use.
- The Storm and Surface Water System Plan and Wastewater System Plan outline the approach to stormwater and wastewater management through a series of stated policies. These plans also include adaptive management to identify how environmental and operations monitoring data can be used to adjust and reframe policies of the programs.
- The City of Bellevue regulates runoff that can load nutrients and pollutants into water bodies, but is limited in its ability to regulate runoff from developments that pre-date current stormwater regulations.

3.8.4 Vulnerability Summary

Overall, climate change poses moderate risk to Bellevue’s waste management sector. Many of the direct services provided by the City of Bellevue (e.g., garbage, recycling, and compost collection) will be minimally impacted by climate change. However, large-scale elements of the waste management sector such as stormwater management and flood control will likely experience significant impacts. These effects will be felt throughout the city, and building capacity will be critical to help managers identify and prioritize adaptation efforts. Table 21 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Waste Management sector in Bellevue.

TABLE 21 Waste Management: Potential Impacts, Adaptive Capacity, and Vulnerability Scores

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Air Temperature/Extreme Heat	Moderate-High	Moderate	Moderate-High
Extreme Cold/Winter Storms	Low-Moderate	Low	Low-Moderate
Extreme Precipitation/Flooding	Moderate-High	Moderate	Moderate-High
Stream Temperature	N/A	N/A	N/A
Drought	Low	Low-Moderate	Low
Wildfire/smoke	N/A	N/A	N/A

SOURCE: ESA 2023

3.9 Water Resources

3.9.1 Sector Overview

Water resources play a vital and diverse role in Bellevue, including as drinking water, recreational resources, habitat, and a critical utility for emergency functions such as medicine and firefighting. The city, as well as other incorporated and unincorporated areas in the Bellevue Water District, receives water through the Cascade Water Alliance, who contract with Seattle Public Utilities. Bellevue receives its water via two supply lines: one from a reservoir on the South Fork Tolt River and one from a reservoir on the Cedar River. The city operates and maintains the water distribution system, including its pipes, reservoirs, pump stations, and hydrants. Climate change may have direct impacts on water resources and/or cause changes to the environment that drive impacts to water resources, all of which can affect water quality, quantity, natural drainage systems, and aquatic resources. Climate change may also impact the functionality of drinking water system infrastructure, potentially affecting utility service.

Local resources reviewed for this section include the following:

- City of Bellevue Habitat and Watershed Assessment Reports (e.g., Vasa Creek, Kelsey Creek, Lake Sammamish)
- Water Shortage Contingency Plan (Seattle Public Utilities 2018)

3.9.2 Potential Impacts

- Potential for more algae blooms because of increased water temperatures and eutrophication. Algae blooms can kill aquatic life by severely reducing dissolved oxygen in water. Waterborne pathogens, such as *Legionella* and *E. coli*, also pose a threat to water quality and health, as these pathogens may thrive in warmer water temperatures or due to high levels of nutrients from runoff.
- Bellevue’s water is sourced from protected forested watersheds on the Tolt and Cedar River, which limits the potential for severe impacts to the water. However, climate change will increase the risk of algae blooms, which can pose a risk to the water supply. Algae blooms have occurred in the Cedar River water supply, which is unfiltered, but can be treated. The protected watershed prevents significant nutrient loading that drives algae blooms; as such, historic occurrences of algae blooms in the water supply have had limited impacts.
- Increased stream temperatures deter salmon from upstream spawning habitats; runoff in Bellevue will increase temperatures in tributaries and lakes to the east and west of the city.
- Increased temperatures may be harmful to native vegetation in riparian areas, as well as aquatic vegetation, which could enable growth of invasive species that are harmful for riparian and aquatic habitat.
- Elevated energy demand may result in power outages that impact the water distribution system. Most pump stations either have a backup generator onsite or inputs for portable generators, which have enabled uninterrupted service throughout the longest power outages in Bellevue. However, many historical power outages have occurred during winter storms when demand is lower. Heightened water demand during heat waves could strain the backup power system for pump stations or require more frequent maintenance to keep it running.
- Increases in wildfires increase the risk of ash and dissolved organic matter entering drinking water, which increases treatment costs. Dissolved organic matter produced from fire has different chemical characteristics than dissolved organic matter under natural conditions and can require different approaches to water treatment. Burned dissolved organic matter can be flushed into water supplies in large quantity from post-fire rain events. This increases turbidity of water and total suspended solids, which can reduce dissolved oxygen and kill aquatic resources that help to maintain clean water. The most likely impact would be increased costs to Bellevue for water treatment.
- Water shortages can occur from climate change through decreased snowpack that feeds Bellevue’s primary drinking water supply and extended periods of hot temperatures and dry weather. Preliminary scenario assessments by Seattle Public Utilities found that climate change impacts to water supply could vary significantly, with projections for 2050 ranging from a zero to 50% reduction in supply. Water levels in the drinking water supply reservoirs are kept low in the winter for flood storage, but dry springs and summers will result in higher water levels not being restored. A multi-year drought is unlikely, but early stages of the Seattle Public Utilities Water Shortage Plan have been implemented during single-year droughts, the worst being in 2015.
- Droughts, as well as changing precipitation patterns, could reduce Bellevue’s emergency groundwater supplies from wells. Pumping from the wells during water supply emergencies impacts surface water availability. If emergency water supplies were needed for 100 days, the surface water in Kelsey Creek

could be depleted, which would impact salmon and aquatic species and habitat. Restoration of streamflow would be especially hindered during a drought.

- Droughts could deplete water availability in tributaries, especially in basins with high amounts of impervious surface and streams that are piped for long extents. Dry streambeds would reduce availability of fish spawning habitat.
- Extreme precipitation can increase the risk of landslides. Landslides can deposit sediment and debris into water bodies, which may disrupt habitat or other critical areas. The Factoria, Forest Hills, and Parksite Reservoirs could be vulnerable to structural damage or impacts to water quality due to their locations in relation to landslide hazard areas. Landslides may also damage supply lines from drinking water resources, but these areas are outside of Bellevue's jurisdiction and are the responsibility of Seattle Public Utilities.
- Increased precipitation will result in more polluted runoff entering water bodies. In addition to degrading water quality, heavy metals and other pollutants in runoff can kill aquatic species. Stormwater runoff provides a more frequent and consistent input of pollutants into water bodies, but flood events can inundate areas with hazardous materials or debris that would otherwise be kept out of water bodies, which can severely impact aquatic and riparian habitat.
- Extreme precipitation events, especially back-to-back events can overwhelm the capacity of water resource infrastructure, such as culverts, which can lead to overtopping of roads or inundating adjacent properties.

3.9.3 Adaptive Capacity

- The City of Bellevue assesses water resource conditions on a recurring basis to monitor the effects of implementing various watershed management, habitat improvement, and stormwater management initiatives. The city has done this with basin-specific habitat assessments, the Storm and Surface Water System Plan, and Stormwater Management Plan, in addition to annual reports on water quality, municipal stormwater permit compliance, and performance from relevant departments.
- The City of Bellevue protects and restores water resources, riparian areas, and surrounding natural resource buffers, in order to preserve water quality, habitat, and ecological functions.
- While the City of Bellevue can directly enforce critical area ordinances and regulate activities that are impacting the environment, it has limited ability to monitor critical areas on private land or direct property owners on how to manage their land beyond regulated activities.
- The City of Bellevue has built hazard-resilient drinking water facilities, such as the Horizon View 2 Reservoir and Pike Peak Reservoir Replacement, which can reduce risks of exposure to landslides.
- The City of Bellevue has added backup power equipment at pump stations and other utility facilities to ensure service through power outages. Improvements that included adding backup power have been pursued at multiple Horizon View and Cougar Mountain pump stations.

3.9.4 Vulnerability Summary

Many of the water resources that could be potentially impacted by climate change are outside of or only partially within the City of Bellevue’s jurisdiction, which limits its capacity to minimize some of these impacts on its own. Coordinating with other municipalities and entities will play a large role in addressing regional and local impacts, especially to drinking water supply sources, Lake Washington, and Lake Sammamish. However, local impacts from stormwater runoff and degraded natural resources can be addressed by the City of Bellevue. Table 22 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Water Resources sector in Bellevue.

TABLE 22 Water Resources: Potential Impacts, Adaptive Capacity, and Vulnerability Scores

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Air Temperature/Extreme Heat	Moderate	Low-Moderate	Moderate
Extreme Precipitation/Flooding	Moderate-High	Low-Moderate	Moderate-High
Stream Temperature	Moderate	Low-Moderate	Moderate
Drought	Moderate	Low-Moderate	Moderate
Wildfire/smoke	N/A	N/A	N/A

SOURCE: ESA 2023

3.10 Zoning & Development

3.10.1 Sector Overview

Bellevue is a metropolitan city with a wide range of economic and retail centers, residential neighborhoods, parks and trails, and civic facilities, governed by the Comprehensive Plan and Land Use Code. The city also has a network of high rank order wetlands and bogs, streams, and slopes protected by critical areas regulations. Bellevue fronts on two major lakes, Lake Washington and Lake Sammamish and implements a Shoreline Master Program. With new job and housing growth, and new high-capacity transit stations, the City of Bellevue is planning for additional transit oriented development focused on the stations. This section addresses how climate change affects the current land use pattern and planned growth for Bellevue.

Local resources reviewed for this section include the following:

- City of Bellevue Land Use Code: <https://bellevue.municipal.codes/LUC>
- Environmental Stewardship Plan (City of Bellevue Community Development 2020a)
- Vision 2050 (PSRC 2023)

PHYSICAL AND SOCIAL ASSETS

As Bellevue has transitioned to a major employment center over the past decades, several strategies have been implemented to focus development near transit and increase mobility options and the essential components of livability for people who live and work in Bellevue.

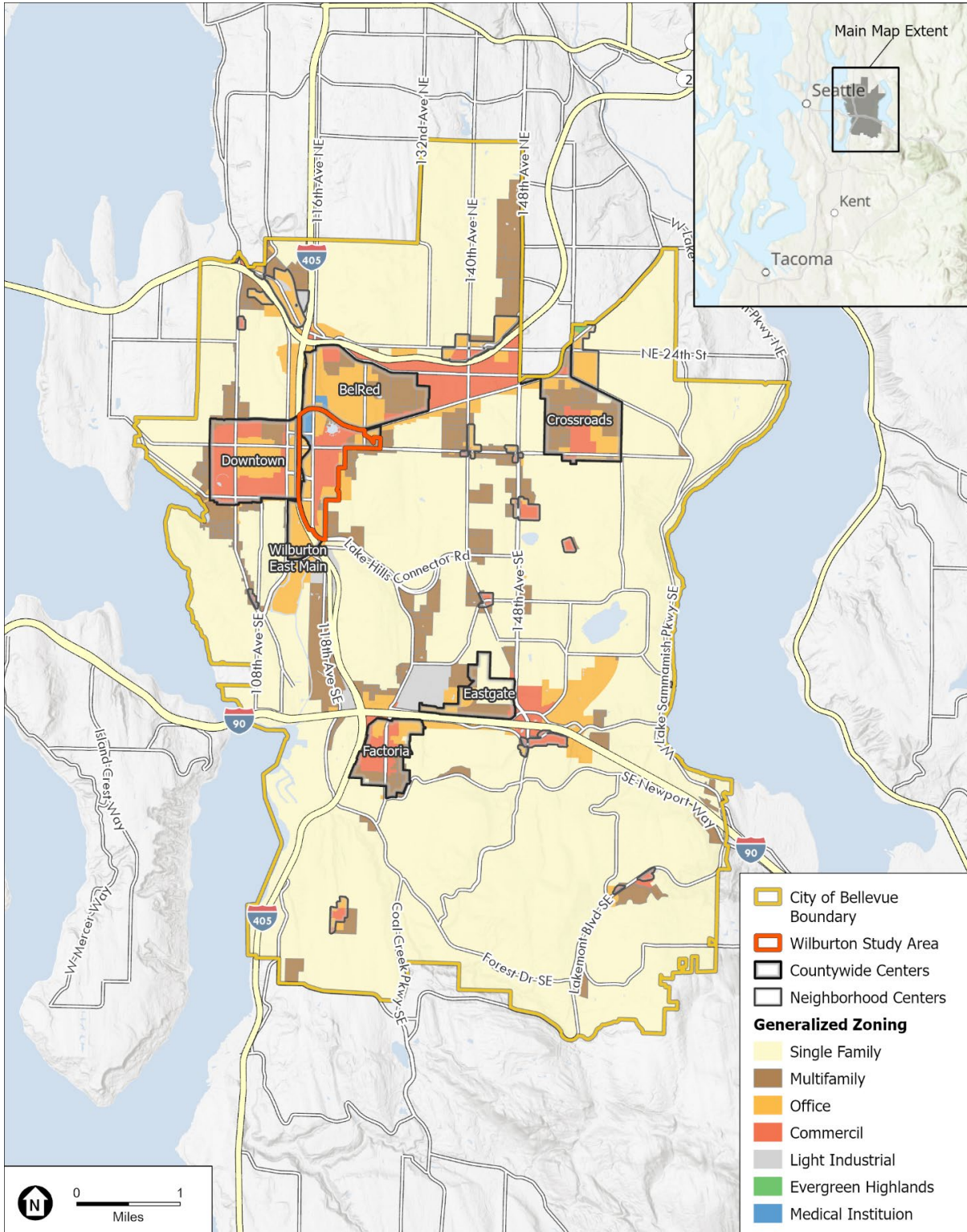
The vast majority of Bellevue is zoned for single-family development, though recent growth has been occurring in mixed use centers and corridors (Figure 20). Job and population growth is projected to continue, and the City of Bellevue is updating its Comprehensive Plan and Land Use Code to direct growth where it will provide the most benefit and produce the least harm. Climate resilience should be a key consideration when updating the land use plan and be integrated into policies and development standards.

When setting development patterns Bellevue can foster redundancy in the provision of essential goods and services by creating land use plans that allowing commercial uses within neighborhood centers distributed throughout the city so that essential goods and services can be accessed in multiple ways safely and conveniently by everyone. At a more specific scale, Bellevue can use site design to build adaptive capacity for stormwater infiltration by creating design standards and guidelines that require soil enhancement and landscaping on building sites and streetscapes.

TABLE 23 **Current Zoning**

Generalized Zoning	Acres
Single-family	16,309
Multi-family	2,020
Office	1,826
Commercial	1,157
Light Industrial	215
Evergreen Highlands	7
Medical Institution	29
Total	21,562

SOURCE: City of Bellevue, BERK 2023



SOURCE: City of Bellevue, BERK 2023

FIGURE 20 Bellevue Generalized Zoning

3.10.2 Potential Impacts

Bellevue's current and future neighborhoods could be impacted by:

- Need for new or upgraded flood-control and, erosion-control structures in hazard areas. In addition to flooding (described in Buildings & Energy), extreme precipitation could affect geologic hazard areas such as erosion and landslides. Neighborhoods with more risk of erosion include Bridle Trails, Northeast Bellevue, West Lake Sammamish, West Bellevue, and Northwest Bellevue, particularly lands along shorelines. Steep slopes are more extensive throughout Bellevue and particularly in West Lake Sammamish and Cougar Mountain.
- Risk to infrastructure damage due to extreme weather events. Bridges and roads, stormwater facilities, and water and wastewater systems among other infrastructure could be affected by extreme weather. This in turn could affect growth and development in the city.
- Urban heat island effects at parking lots and other high impervious areas could increase risks to people's health and comfort, and drought is likely to damage urban landscaping.
- Increased climate-induced displacement and migration and changes in housing stock availability due to hazard events such as flooding, or lack of resources to address cooling and clean air. Displacement of households with housing security challenges could be exacerbated by climate stressors (see additional information below).
- Impact of wildfire public health (e.g., smoke) but not likely to the development pattern since risk of wildfire is low to the largely urban landscape in Bellevue.

Displacement Risk for Housing

Households across Bellevue are at risk of displacement due to high housing costs and potential for redevelopment (see Table 24). Climate change stressors that increase costs have the potential to exacerbate the risk of displacement further. Costs associated with damage to structures from flooding, increased energy use for cooling, healthcare costs to treat illness from extreme heat or smoke are some examples. Due to the presence of floodplains, low tree canopy coverage, and relatively higher proportions of people with adverse health and/or lower incomes, the neighborhood areas of West Bellevue, Wilburton, Lake Hills, and West Lake Sammamish have relatively higher proportions of households at risk of experiencing displacement than other parts of the city.

In terms of combined vulnerability and population density, the residents in Crossroads, Lake Hills, Downtown and West Bellevue appear more vulnerable than other areas. This can be due to urban heat islands and adverse health conditions and in some locations exposure to flooding and drainage concerns. The combination of greater exposure to extreme heat, extreme precipitation, sensitivity, and adaptive capacity indicates more potential vulnerability compared to other neighborhoods of Bellevue.

TABLE 24 Housing Unit Displacement Risk, Bellevue Neighborhoods

Neighborhoods	Lower		Moderate		Higher	
	SF	MF	SF	MF	SF	MF
BelRed	36	1,702	61	36	-	-
Bridle Trails	957	31	1,001	2,955	-	-
Cougar Mountain / Lakemont	3,744	440	-	-	-	-
Crossroads	-	-	840	3,878	392	1,541
Downtown	-	-	79	9,884	-	-
Eastgate	1,145	48	1,404	125	-	-
Factoria	-	-	396	1,009	-	-
Lake Hills	196	-	4,359	1,935	330	91
Newport	2,347	171	1,086	207	-	-
Northeast Bellevue	3,890	163	-	-	-	-
Northwest Bellevue	220	474	2,231	1,489	-	-
Somerset	2,896	-	10	-	-	-
West Bellevue	1,536	859	650	917	-	-
West Lake Sammamish	1,683	322	419	-	-	-
Wilburton	-	-	900	1,048	-	-
Woodridge	1,176	395	97	571	-	-
Total	19,826	4,605	13,533	24,054	722	1,632

SF = Single Family, MF = Multifamily

SOURCE: PSRC 2023

3.10.3 Adaptive Capacity

Bellevue plans for its long-term growth in its Comprehensive Plan. The periodic update due in 2024 is an opportunity to integrate climate change resilience more fully into regulations related to zoning and development. For example, critical area regulations in Bellevue addressing wetlands, streams, aquifers, floodplains, and geologic hazards, include buffers and standards that do not currently reflect climate changes such as extreme precipitation, snowpack and low flows, and decreases in soil moisture that can affect critical areas and buffers meant to protect them.

A climate-exacerbated risk is the potential for housing stock damage and loss, and resulting displacement of households, especially those with preexisting health conditions and limited resources. A key area of focus for the Comprehensive Plan Update is the Housing Element, which must be amended to meet recent State requirements to supply housing for all income levels, and to remove racially disparate impacts that impede access to housing including ownership housing. This could help increase housing supply and improve housing quality such as ensuring design incorporates resilience. Bellevue has planned for

Downtown and BelRed as mixed use centers. The Comprehensive Plan Update and associated Land Use Code changes give the City of Bellevue opportunities to create more centers focused around new high-capacity transit.

The City of Bellevue also runs programs such as [Carbon Yeti](#) to help residents think about their contribution to carbon emissions and community sustainability. Programs targeted at businesses and residents to implement strategies that reduce greenhouse gas and increase resilience should be continued to build adaptive capacity in the city.

3.10.4 Vulnerability Summary

Neighborhoods in Bellevue largely experience similar exposure to climate-driven changes such as extreme heat and rainfall. However, historic and current land use patterns have created conditions in which these impacts will be felt more strongly in some areas compared to others within the city such as areas with greater pavement and lesser trees. Shorelines, greenbelts, and recreation areas could be damaged by flooding, landslides, erosion, or drought. Bellevue can proactively respond through its Comprehensive Plan, Shoreline Master Program, and critical areas regulations updates and other initiatives. Table 25 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Zoning & Development sector in Bellevue.

TABLE 25 Zoning and Development: Potential Impacts, Adaptive Capacity, and Vulnerability Scores

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Air Temperature/Extreme Heat	High	Moderate	High
Extreme Precipitation/Flooding	Moderate-High	Moderate	Moderate
Stream Temperature	Moderate	Moderate	Moderate
Drought	High	Moderate-High	High
Wildfire/smoke	Low-Moderate	Moderate	Low-Moderate

SOURCE: BERK 2023

SECTION 4 Climate Adaptation Strategies

Climate adaptation refers to strategies and actions taken to better prepare for and respond to the impacts of climate change. These strategies aim to address vulnerability by reducing climate change impacts and building adaptive capacity. While the focus of this report is on evaluating climate-related vulnerabilities posed to sectors of concern in the city, the consultant team also identified potential adaptation measures. These strategies include existing Comprehensive Plan policies that are responsive to climate change, modifications to those policies to better address climate change, and additional strategies that can be considered in departmental programs and projects. This section presents high-level adaptation measures organized by associated sectors (i.e. those with similar vulnerabilities and needed responses):

- Buildings & Energy, Economic Development, Zoning & Development
- Cultural Resources & Practices, Ecosystems
- Water Resources, Waste Management
- Emergency Management, Human Health
- Transportation

Strategies are sourced from the Commerce Menu of Measures, the K4C Climate Action Toolkit, and other regional climate change plans.

4.1 Buildings & Energy, Economic Development, Zoning & Development

COMPREHENSIVE PLAN POLICIES AND POTENTIAL MODIFICATIONS

Comprehensive Plan policies are listed below with suggested additions or modifications in ~~strikeout~~ or underline to better address climate change. Suggested additions could be appended to current policies or written as new standalone policies.

- UN-37. Use site design, water efficient landscaping and stormwater management practices to reduce the environmental impact of impervious surfaces.
 - No change.
- ED-11. Provide city leadership and direction to maximize the business retention and recruitment efforts of Bellevue’s economic development partners.

- Add: Implement Bellevue's Economic Development Plan and Sustainable Bellevue: Environmental Stewardship Plan to invest in a resilient economy and promote green jobs.
- Add: Promote green jobs and invest in a resilient economy as directed by Bellevue's Economic Development Plan and Sustainable Bellevue: Environmental Stewardship Plan.
- ED-22. Support efforts that promote tourism, hotel, retail and arts businesses.
 - Add: Encourage provision of indoor and outdoor spaces that are adapted to climate stressors such as extreme heat (e.g., awnings, tree canopy, green infrastructure) and promote energy conservation measures (e.g., passive cooling design, energy conservation retrofits, etc.).
- ED-24. Cultivate development of diverse, distinctive, well-defined places that invite community activity and gathering. Specifically facilitate the redevelopment and re-invigoration of older neighborhood shopping centers. Work with stakeholders to transform such centers into high quality and dynamic retail/mixed use commercial areas that also provide a gathering place and sense of community for the neighborhood. Allow for flexibility to repurpose and re-use a variety of building types to accommodate new uses.
 - Add: When redeveloping, require shopping centers to become more resilient to climate stressors such as extreme heat and extreme precipitation through installations of green infrastructure and tree canopy.
 - Add: Develop or modify design standards to integrate exterior building features (e.g., awnings, cool roofs, solar panels) that reduce the impacts of climate change including extreme heat.
- ED-25. Where commercial areas are in decline, work with businesses and other stakeholders to identify corrective actions, which may include:
 - Targeting investments in public infrastructure that may help catalyze new private sector investment, including investments that would increase resilience to climate change.
- ED-30. Facilitate efforts of businesses and institutions to train workers for today's and tomorrow's jobs, including green jobs, and support continuing education in the community.
 - Add: Invest in workforce training that promotes green jobs.
- HS-17. Encourage services that support Bellevue's workforce in maintaining or advancing their employment opportunities.
 - Add: Support job opportunities and workforce education that create a more climate-resilient Bellevue economy.
- LU-20. Support Downtown's development as a regional growth center, with the density, mix of uses and amenities, and infrastructure that maintain it as the financial, retail, transportation, and business hub of the Eastside.

- Add: Adapt Downtown’s streets and buildings to be resilient to climate stressors and reduce vulnerability of Downtown residents, such as with tree canopy, green infrastructure, and building designs promoting alternative energy.
- LU-21. Support development of compact, livable and walkable mixed use centers in BelRed, Eastgate, Factoria, Wilburton and Crossroads.
 - Add: Adapt Center streets, parking areas, and buildings to reduce vulnerability to extreme heat and extreme precipitation such as with tree canopy, green infrastructure, and building and site designs promoting alternative heat and cooling for energy efficiency and resilience.
- LU-28.4. Consider a land use incentive system that offers additional floor area in exchange for infrastructure and amenities that contribute to the public good, including climate mitigation and adaptation strategies effective for Bellevue’s economic centers.
- UT-70. Facilitate the conversion to cost-effective and environmentally sensitive alternative technologies and energy sources.
 - Add: Support local businesses’ efforts to generate and store renewable electricity on-site, which can provide back-up power during emergencies and help ensure continuity of operations.
- LU-6. Encourage new residential development to achieve a substantial portion of the maximum density allowed on the net buildable acreage.
 - Add: Prioritize middle housing and infill development in residential communities to offer new housing choices and supply and add mixed use development in high-capacity transit areas.
- LU-20. Support Downtown’s development as a regional growth center, with the density, mix of uses and amenities, and infrastructure that maintain it as the financial, retail, transportation, and business hub of the Eastside.
 - Add: Increase urban tree canopy and green infrastructure and landscape and building design that reduce heat islands throughout all mix use centers.
- LU-33. Preserve open space and key natural features through a variety of techniques, such as sensitive site planning, conservation easements, critical area buffers, green infrastructure practices, transferring density, land use incentives and open space taxation.
- EN-4. Promote and invest in energy efficiency and renewable energy resources as an alternative to non-renewable resources.
 - Add: Work with PSE to improve the safety and reliability of power infrastructure vulnerable to climate change.

- Add: Support distributed renewable energy generation, and design of buildings for passive survivability. Require electric heat pumps and restrict natural gas in new commercial and residential construction.
- EN-5. Protect air, water, land, and energy resources and build climate resilience consistent with Bellevue's role in the regional growth strategy.
- EN-6. Establish an achievable citywide target and take corrective actions to reduce greenhouse gas emissions such as reducing energy consumption and vehicle emissions, and enhancing land use patterns to reduce vehicle dependency.
 - Add: Increase tree canopy and green infrastructure to improve resilience to climate change.
- EN-7. Develop and implement climate change adaptation strategies that create a more resilient community by addressing the impacts of climate change to public health and safety, the economy, public and private infrastructure, water resources, and habitat.
 - No change.
- EN-24. Reduce runoff from streets, parking lots and other impervious surfaces and improve surface water quality by utilizing low impact development techniques in new development.
 - Add: Consider modifying stormwater design standards to address extreme precipitation and changes in summer soil moisture including sizing of facilities and types of plantings including those that are native and drought resilient.
- EN-41. Provide information to the public about potential geologic hazards, increased risk from climate change, including site development and building techniques and disaster preparedness.
- EN-45. Implement the citywide use of low impact development techniques and green building practices to protect and improve water and air quality and energy resilience.
- EN-47. Construct and operate new city facilities to exceed required development standards to conserve energy, water, and environmental resources.
 - Add: Incentivize new private development for commercial and residential to exceed minimum standards and optimally conserve these resources.
- EN-48. Support the use of emerging best practices in green building and site design including climate resilience measures through the use of pilot programs and model ordinances.
- EN-49. Provide education and incentives to support the implementation of low impact and green development practices (LEED Standards, etc.), integrated site planning, and green building, with a focus on early consideration of these in the site development process.
- EN-62. Preserve and maintain the 100-year floodplain in a natural and undeveloped state, and restore conditions that have become degraded.

- Add: Update floodplain regulations applicability and standards to address increasing frequency and extent of flooding and resilience measures in new development.
- EN-86. Facilitate the transfer of development potential away from critical areas and the with ways such as clustering of development on the least sensitive portion of a site.
 - Add: Encourage restoring and maintaining critical areas and open space areas to maximize the climate resilience benefits they provide consistent with best available science.

ADDITIONAL ADAPTATION STRATEGIES

Additional strategies that can be considered in climate-informed efforts by departmental programs and projects include:

- Discourage development in flood hazard areas.
- Minimize power outages from the local electric utility during extreme weather events by identifying and protecting critical energy facilities.
- Encourage facility owners to develop decentralized power generation and fuel flexibility capabilities.
- Increase energy efficiency across all sectors through education, efficiency retrofits, and building management systems.
- Increase solar readiness for new residential and commercial buildings.
- Ensure backup power generation for critical facilities and identified key infrastructure during power outages
- Support retrofits to public facilities and housing to improve indoor air quality.
- Develop an ordinance incorporating reflective surfaces (“cool paving” or “cool roofs”) into all municipal projects (e.g., parking lots and streets) and new private parking lot projects.
- Encourage the development of integrated flood protection systems that use structural (engineering) and non-structural (wetlands) measures.
- Install energy-efficient and low-water-use equipment during renovations in all buildings owned by the City of Bellevue.
- Invest in backup power systems and energy storage at emergency centers and cooling centers.
- Encourage sustainability certification for public infrastructure projects (e.g., Envision) to increase resilience of infrastructure.
- Support local businesses’ efforts to generate and store renewable electricity on-site, which can provide back-up power during emergencies and help ensure continuity of operations.
- Strengthen building, site, and landscape design standards and guidelines for cooling and promote energy redundancy. Examples include connected awnings along sidewalks, cool roofs, green roofs, distributed renewable energy, and battery infrastructure.

- Require the design and construction of commercial and residential buildings and their surrounding sites to reduce water consumption, reuse wastewater, and reduce stormwater runoff.
- Encourage building materials that are more resilient to increased extreme weather. Examples include allowing for natural ventilation and airflow to reduce cooling costs and vegetation/tree shade reducing heat gain; design and materials that facilitate rapid water drainage, avoiding accumulation and damage; and others (The Constructor n.d.).
- Prioritize infrastructure resilience efforts in economic centers more vulnerable to climate exacerbated events including setting similar equity priorities noted in the Sustainable Bellevue Plan.

4.2 Cultural Resources & Practices, Ecosystems

COMPREHENSIVE PLAN POLICIES AND POTENTIAL MODIFICATIONS

Comprehensive Plan policies are listed below with suggested additions or modifications in ~~strikeout~~ or underline to better address climate change. Suggested additions could be appended to current policies or written as new standalone policies.

- UD-37. Use site design, water efficient landscaping and stormwater management practices to reduce the environmental impact of impervious surfaces.
 - No change.
- UD-84. Designate historic landmark sites and structures and review proposed changes to ensure that these sites and structures will continue to be a part of the community and explore incentives for rehabilitation.
 - Add: Identify and protect historic and cultural sites that may be acutely sensitive to climate hazards such as flooding (e.g., raising, retrofitting, relocating structures).
- PA-8. Develop partnerships with other public agencies and the private sector to provide parks, open space, and cultural and recreation facilities in the city.
 - No change.
- PA-32. Provide environmental stewardship and nature education programs to increase the community's awareness, understanding, and appreciation of Bellevue's natural environment.
 - Add: Create and implement culturally contextualized outreach and education initiatives and materials that will inform the community about near-term and longer-term climate change threats and ways that the community can prepare and build resilience to these changes.
- PA-21. Use parks to celebrate, promote and preserve Bellevue's history, cultural arts and local heritage when consistent with the park's design and programming.
 - No change.

- EN-7. Develop and implement climate change adaptation strategies that create a more resilient community by addressing the impacts of climate change to public health and safety, the economy, public and private infrastructure, water resources, and habitat.
 - No change.
- EN-12. Work toward a citywide tree canopy target of at least 40% canopy coverage that reflects our “City in a Park” character and maintain an action plan for meeting the target across multiple land use types including right-of-way, public lands, and residential and commercial uses.
 - Add: Increase tree canopy cover to boost carbon sequestration, reduce heat islands, and improve air quality, prioritizing overburdened communities.
 - Add: Ensure that tree species selection and planting guidance are updated to be resilient to climate change.
 - Add: Choose native drought- and pest-resistant trees, shrubs, and grasses in restoration efforts to support climate resilience.
- EN-62. Preserve and maintain the 100-year floodplain in a natural and undeveloped state, and restore conditions that have become degraded.
 - Add: Restore floodplains and connectivity to improve the resilience of streams and rivers and reduce flood risk.
 - Add: Protect and restore riparian vegetation to reduce erosion, provide shade, and support other functions that improve the resilience of streams to climate change.
- EN-75. Protect wildlife corridors to minimize habitat fragmentation, especially along existing linkages and in patches of native habitat.
 - Add: Identify opportunities to expand habitat protection and improve habitat quality and connectivity to foster climate resilience using conservation area designations, buffers, and open space corridors.
- EN-76. Develop programs and regulations acknowledging that designated critical areas such as wetlands, shorelines, riparian corridors, floodplains, and steep slopes provide multiple functions including fish and wildlife habitat.
 - Add: Ensure no net loss of ecosystem composition, structure, and functions, especially in Priority Habitats and Critical Areas, and strive for net ecological gain to enhance climate resilience.

ADDITIONAL ADAPTATION STRATEGIES

Additional strategies that can be considered in climate-informed efforts by departmental programs and projects include:

- Identify and protect historic and cultural sites that may be acutely sensitive to climate hazards such as flooding (e.g., raising, retrofitting, relocating structures).

- Create and implement culturally contextualized outreach and education initiatives and materials that will inform the community about near-term and longer-term climate change threats and ways that the community can prepare and build resilience to these changes.
- Enhance urban tree canopy initiatives and use shade trees (e.g., canopy-forming trees) in all projects.
- Develop a comprehensive list of plant and tree species known to have a broad range of environmental tolerances (e.g., heat, drought, pest, and disease resilient species).
- Manage local forest density to reduce susceptibility to drought stress, pests, and diseases and plant trees that are compatible with future climate conditions.
- Preserve and enhance critical areas, considering the long-term impacts of climate change.
- Work with private property owners to build resilience of critical areas to the impacts of climate change.
- Reduce water use in parks and streetscapes to conserve water during droughts.

4.3 Water Resources, Waste Management

COMPREHENSIVE PLAN POLICIES AND POTENTIAL MODIFICATIONS

Comprehensive Plan policies are listed below with suggested additions or modifications in ~~strikeout~~ or underline to better address climate change. Suggested additions could be appended to current policies or written as new standalone policies.

- UT-20. Coordinate emergency preparedness and response with local and regional utility partners.
 - No change.
- UT-34. Provide a storm and surface water system that controls damage from storms, protects surface water quality, provides for the safety and enjoyment of citizens, supports fish and wildlife habitat, and protects the environment.
 - Add: Require the use of green infrastructure and low-impact development to address increased storm intensities and stormwater runoff.
- UT-38. Encourage the use of low impact development and stormwater best management practices to manage stormwater runoff, which may result in smaller facilities constructed on- and off-site for flow control, conveyance, and water quality.
 - Add: Develop a fund to build green infrastructure projects that help capture, filter, store, and reuse stormwater runoff.
- UT-39. Provide a reliable, cost-effective supply of safe, secure, high quality drinking water that meets the community's water needs in an environmentally responsible manner.
 - Add: Manage water resources sustainably in the face of climate change through smart irrigation, stormwater management, preventative maintenance, water conservation and wastewater reuse, plant selection, and landscape management.
- UT-41. Provide reliable water service for domestic use, fire flow protection, and emergencies.

- Add: Construct new water storage systems (e.g., large cisterns, water towers, and reservoirs) to provide back-up water supplies during droughts and support climate resilience.
- UT-42. Promote conservation and the wise and efficient use of the public water supply and discourage the waste of this valuable resource.
 - Add: Manage water resources sustainably in the face of climate change through smart irrigation, stormwater management, preventative maintenance, water conservation and wastewater reuse, plant selection, and landscape management.
- SH-48. Work with public health agencies to require repair or replacement of failing onsite septic systems within the shoreline area or require direct connection to the city's sewer system in accordance with the city's wastewater development regulations.
 - No change.
- SH-49. Encourage, natural drainage practices and associated low impact development techniques, where technically feasible, to minimize impervious surfaces, reduce surface water runoff, and prevent water quality degradation.
 - Add: Require the use of green infrastructure and low-impact development to address increased storm intensities and stormwater runoff.

ADDITIONAL ADAPTATION STRATEGIES

Additional strategies that can be considered in climate-informed efforts by departmental programs and projects include:

- Increase capacity of stormwater systems to manage increases in precipitation and higher peak flows.
- Educate residents and businesses about the benefits and appropriate uses of local water supplies (including recycled water and onsite water reuse systems) and further integrate recycled water (if available) and onsite water reuse systems into new development and redevelopment plans.
- Encourage projects that capture and reuse stormwater onsite.
- Encourage use of permeable pavement in non-critical areas—low-use roadways, sidewalks, parking lots and alleys where soils permit proper drainage.
- Ensure all water and wastewater pumping stations have off-grid, onsite energy sources and/or reliable backup power sources by increasing the number of backups and pulling electricity from different grids.
- Improve stormwater quality management to help keep lakes clean and free of algae.
- Implement preventative water conservation efforts to reduce the risk of water supply shortages
- Conduct outreach to residents with properties that abut water resources in order to educate them about low-impact development methods, riparian buffer management, landscaping regulations, and their role in buffering climate change impacts.
- Increase storage and treatment capacity of stormwater management infrastructure and increase capacity of culverts that may be too small for future streamflow volumes.

4.4 Emergency Management, Human Health

COMPREHENSIVE PLAN POLICIES AND POTENTIAL MODIFICATIONS

Comprehensive Plan policies are listed below with suggested additions or modifications in ~~strikeout~~ or underline to better address climate change. Suggested additions could be appended to current policies or written as new standalone policies.

- N-3. Equip residents, businesses, and community service providers through education and training to be active participants in public safety (including, but not limited to, emergency preparedness, crime prevention, first aid and fire prevention, and climate-related hazards).
 - Add: Create templates for neighborhood-based evacuation plans and outreach materials to help residents plan and practice actions that make evacuation quicker and safer.
- N-4. Plan and prepare for the response, recovery, and mitigation of potential disasters and hazards.
 - Add: Develop and maintain local government staff members' technical expertise and skills related to climate change so as to improve communitywide policy implementation and resilience.
 - Add: Factor climate impacts into the planning of operations and coordination of preparedness, response, and recovery activities among first responders and partners, including public health, law enforcement, fire, school, and emergency medical services (EMS) personnel.
 - Add: Prioritize at-risk community members for actions that mitigate wildfire smoke, including providing filter fans or incentivizing infrastructure updates that protect against wildfire smoke (e.g., HVAC updates and MERV 13 filters for air intake) for facilities that serve high-risk populations.
 - Add: Develop and implement an urban heat resilience strategy that includes land use, urban design, urban greening, and waste heat reduction actions.
- HO-41. Collaborate with other jurisdictions and social service organizations to assure availability of emergency shelters and day centers that address homelessness.
 - Add: Develop resilience hubs — community-serving facilities augmented to support residents and coordinate resource distribution and services before, during, and after a hazard event (Urban Sustainability Directors Network [USDN] 2023).
- EN-51. Work with the private sector to reduce growth in vehicle trips as a key strategy for reducing automobile-related air pollution.
 - Add: Design new development and retrofit existing development to reduce resident exposure to air pollution, and to be more climate resilient such as providing indoor clean air during smoke events.
 - Add: Avoid increasing development capacity for sensitive uses (e.g., day care, elder care) within 500 feet of a freeway where concentrations of air pollutants are already high and harmful to health.

- HS-8. Make Bellevue a welcoming, safe and just community marked by fairness and equity provided to those disproportionately affected by poverty, discrimination, ~~and~~ victimization, and vulnerable to climate stressors.
- HS-15. Support a network of service points that are easily accessible by Bellevue residents and workers, geographically distributed within the city and proximate to public transit.
 - Add: Develop resilience hubs — community-serving facilities augmented to support residents and coordinate resource distribution and services before, during, and after a hazard event.
- PA-18. Provide a variety of services and programs accessible to all throughout the city with special emphasis on serving those with limited opportunities including low-income households, youth, individuals with disabilities, ~~and~~ older adults, and those vulnerable to climate stressors.

ADDITIONAL ADAPTATION STRATEGIES

Additional strategies that can be considered in climate-informed efforts by city departmental programs and projects include:

- Increase local access to healthy and affordable foods, including community gardens, to reduce stress and capacity constraints during extreme events.
- Provide training and equipment that improve the safety of emergency management personnel and their ability to respond to climate change-driven emergencies. This could involve education about safety risks in particular weather emergencies, technical training for responding under extreme conditions, or providing uniforms and gear that accommodate extreme weather conditions.
- Provide incentives to property owners to ensure buildings are retrofitted or built to filter air and provide for cooling/heating.
- Ensure that emergency response plans incorporate possible climate changes that could impact the protection of staff, infrastructure, and facilities during emergencies and extreme weather events.
- Incorporate climate risks into staff safety plans and procedures to provide a safe and healthy work environment for city staff.
- Evaluate and ensure backup power generation is available to healthcare facilities (nursing homes, critical care facilities, hospitals, etc.).
- Promote existing hazard alert and warning system for workers.
- Support retrofits to public facilities and housing to improve indoor air quality.
- Evaluate, improve, and build redundancy into all public and inter-agency warning and communication systems.
- Identify additional alternative routes and modes for effective transport and evacuation efforts during emergency situations.
- Ensure access to cooling centers, parks, and shorelines through transit and pedestrian/bicycle infrastructure.

- Seek funding for energy improvements for low-income households.
- Build and foster community connections and resilience through neighborhood programming and outreach. Explore the creation and implementation of community-based resilience hubs to provide support during and after extreme events.
- Support vulnerable populations during smoke events.
- Develop strategies to support the homeless population during climate events.

4.5 Transportation

COMPREHENSIVE PLAN POLICIES AND POTENTIAL MODIFICATIONS

Comprehensive Plan policies are listed below with suggested additions or modifications in ~~strikeout~~ or underline to better address climate change. Suggested additions could be appended to current policies or written as new standalone policies.

- EN-52. Implement transportation projects that provide significant air quality improvements to areas with existing air quality problems, even where the project does not bring all locations up to adopted standards, provided that the project is the best feasible solution and it significantly improves the air quality at each substandard location.
 - No change.
- TR-2. To aggressively plan, manage, and expand transportation investments to reduce congestion and expand opportunities in a multimodal and comprehensive manner and improve the quality of the travel experience for all users.
 - Add: Consider system redundancy in planning for a climate-resilient transportation system.
 - Add: Promote government telework options wherever practicable to reduce exposure to extreme events. Transition any staff professional development and training programs to online to reduce need for travel.
- TR-35. Design, maintain, and protect the transportation system—including infrastructure, routes, and travel modes—to be resilient to disaster and climate change impacts.
 - Add: Promote diverse transportation options (e.g., car, bus, bike, sidewalk). Integrate climate change into asset design, maintenance, and management.

ADDITIONAL ADAPTATION STRATEGIES

Additional strategies that can be considered in climate-informed efforts by city departmental programs and projects include:

- Prioritize infrastructure upgrades for roads at risk of flooding.

- Raise streets in identified flood-prone areas as they are redeveloped.
- Implement a repaving strategy that reduces heat-related damage to asphalt and incorporates maintenance and operations that extend the life of the road surface.
- Develop deicing strategies and materials that are effective in extreme cold temperatures and prolonged events to stabilize roadway and bridge surfaces.
- Ensure vulnerable populations are served by transit during climate events or emergencies.
- Provide reliable infrastructure for walking and biking.
- Provide backup power for electric vehicle charging for fleets and critical facilities and publicly accessible charging stations.
- Adopt mandates for vans, work trucks, and heavy-duty vehicles (includes waste collection trucks) to convert to electric owned and operated by the City of Bellevue.
- Partner with hospitals and fire departments to transition all first responder fleet vehicles to electric.
- Support accessible and efficient public transit for all communities, especially frontline communities.

SECTION 5 References

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