

Appendix E

Action Risk Report

Action-Risk Report

General

ACTION A-01

Update the regional climate adaptation plan periodically with new information, evaluate implementation efforts and effectiveness, amend strategies and actions as necessary, and enhance community climate literacy (e.g., by working with schools, libraries, and other partners to enhance the public's understanding of climate change causes, impacts, and responses).

TRPC should update the plan every five years with new climate data (observed and projected) and community input to ensure the plan remains a relevant reference tool for local policymakers, residents, and other stakeholders. As part of its adaptive management process, TRPC should track where, when, and how the community implements actions, as well as consider new actions to address unforeseen impacts and overcome implementation barriers.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Intensifying precipitation increases the frequency and intensity of the heaviest 24-hour rain events and the overall volume of winter streamflow, which could degrade sensitive riparian areas.
- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Increasing drought raises the risk of wildfires and elevated levels of PM10 (coarse particulate matter) from smoke.

General

ACTION G-01

Direct government staff members to develop their technical expertise and skills to prepare for and respond to climate change impacts.

With clear policy direction from local and tribal government policymakers, staff members could invest in professional development that enhances their understanding of projected changes in the region's climate (e.g., air temperature and precipitation) and their impacts on municipal services and infrastructure. Staff members could use the skills and knowledge to protect human health and welfare, as well as adequately plan, design, build and maintain roads, culverts, and other assets.

- Intensifying precipitation increases the frequency and intensity of the heaviest 24-hour rain events and the overall volume of winter streamflow, which could degrade sensitive riparian areas.
- Warmer winters degrade critical habitat (rivers and streams) due to greater winter runoff.
- Warmer winters increase the range and survival of invasive species, pests, and diseases that threaten native flora and fauna.
- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Intensifying precipitation necessitates retrofitting stormwater and wastewater infrastructure to mitigate flooding and backups that threaten water quality and human health and welfare.
- Population change puts more strain on transportation (roads, transit, etc.).
- Warmer winters increase the range and survival of pests and diseases that affect crops.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.

ACTION G-02

Create hazard recovery plans and prioritize the restoration of vital public safety facilities and other essential community assets (e.g., hospitals and major bridges).

As part of this action, ensure that all appropriate personnel — including municipal public works, planning, and public health workers — have adequate training and gear (e.g., reflective vests, hard hats, and agency vehicles) to respond to emergencies.

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- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise increases coastal flooding of downtown Olympia and LOTT wastewater treatment plant assets, which could threaten the ability to treat and discharge water and increase the energy consumed to operate pumps.
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Warmer summers increase extreme temperatures that could cause heat-related illnesses (e.g., hyperthermia) -- a major risk for elderly, homeless, and other vulnerable populations.
- Sea-level rise pushes saltwater farther into estuaries, which may inundate near-coastal farms and ranches.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.

General

ACTION G-03

Pursue funding to implement highest-priority actions identified in the adopted Hazards Mitigation Plan for the Thurston Region.

This action would improve the region's resilience, its ability to recover more quickly and fully from hazards. Visit trpc.org/hazards to view a list of countywide and local partner actions.

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- Warmer summers introduce or exacerbate disease vectors (carriers), which could harm human health (warmer, wetter winters also exacerbate exposure to pathogens and other health threats).
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Warmer summers increase extreme temperatures that could cause heat-related illnesses (e.g., hyperthermia) -- a major risk for elderly, homeless, and other vulnerable populations.
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.
- Increasing drought raises the risk of wildfires, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.
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ACTION G-04

Factor climate impacts into the planning of operations and the coordination of disaster response and recovery activities among first-responders, including public health, law enforcement, fire, and emergency medical services personnel.

Examples of activities include: updating emergency services communications equipment; enhancing training of emergency personnel and other responders; taking regular inventory of emergency facility needs (e.g., cooling centers and temporary shelters); assessing and improving the adaptive capacity of people who are most vulnerable to climate change-exacerbated hazards (e.g., people who are homeless, elderly, socially isolated, and/or live in high-risk areas).

- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
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- Warmer summers increase extreme temperatures that could cause heat-related illnesses (e.g., hyperthermia) -- a major risk for elderly, homeless, and other vulnerable populations.
- Warmer summers cause urban heat islands, which could affect livability/health in heavily developed centers and corridors.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.
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ACTION G-05

Assess potential climate change-induced population migration within and to the Thurston Region, and evaluate response strategies.

This action could entail assessing who in the region is most vulnerable to temporary or permanent displacement (e.g., low-income or socially isolated residents who may be forced to move because of climate-exacerbated hazards) and what resources they might need. This action also could entail assessing who is most likely to move to the region and how to accommodate them in ways consistent with community values. For example, this could be done by studying “chain migration” (the tendency of migrants to follow those of similar ethnicity, language or job skillset), as well as by evaluating such migrants' needs and where/how much growth should occur so that it's consistent with local comprehensive plans. TRPC could integrate such analysis into its periodic population and employment forecasts. For more information, visit: <http://www.trpc.org/236/Population-Employment-Forecasting>.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Population change increases transportation-related energy consumption, CO2 emissions, and other pollutants related to buildings and transportation.
- Population change increases strain on social and emergency services.
- Population change increases pressure on existing parks and open space.
- Population change puts more strain on transportation (roads, transit, etc.).
- Population change increases pollution related to development (e.g., more septic systems and impervious surfaces).
- Population change puts more strain on schools (e.g., unplanned influx or loss of students).
- Population change increases solid waste generation.
- Population change increases pressure to develop rural areas, which could reduce, fragment and/or degrade farms, forests, and prairies.

ACTION G-06

Create a household preparedness plan and store of food, water, and other supplies (lanterns, bicycles, etc.) to use in case a flood or other hazard cuts off access to goods, services, and emergency responders.

Municipalities, neighborhood associations, and their partners (e.g., the American Red Cross) can encourage these household preparedness practices by enhancing outreach and incentives. See TRPC's online Resilience Toolkit (trpc.org/climate/resiliencetoolkit) for links to preparedness resources.

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General

ACTION G-07

Identify a neighborhood site (e.g., a school, house of worship, or other location that's safe, accessible, and well-known) to serve as a temporary coordination center for local hazard response and recovery efforts, and publicize the hub's location widely.

This action could help increase household and neighborhood resilience, in the event that police and fire personnel cannot provide immediate assistance. Households and their broader neighborhoods could work with municipal agencies (e.g., through neighborhood and sub-area plans) and nonprofits (e.g., the American Red Cross) to plan, select, and publicize emergency coordination sites.

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ACTION G-08

Encourage neighborhoods to become familiar with residents who have skills and tools to assist others with special needs (e.g., elderly or disabled), should residents need to provide emergency response in the event that police and fire personnel cannot provide immediate assistance.

Programs such as “Map Your Neighborhood” are effective ways to develop maps and inventories/directories of neighborhood assets. [Thurston County Emergency Management Map Your Neighborhood: <http://www.co.thurston.wa.us/em/MYN/MYN.htm>]

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ACTION G-09

Encourage residents to organize or participate in regular emergency preparedness, response, and recovery planning and training events.

Such events could include neighborhood potlucks with disaster drills, skills sharing, and discussions about hazards (extreme heat, wildfires, etc.) with local emergency responders.

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- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Population change increases strain on social and emergency services.
- Warmer summers increase extreme temperatures that could cause heat-related illnesses (e.g., hyperthermia) -- a major risk for elderly, homeless, and other vulnerable populations.

General

ACTION G-10

Increase the number of residents who receive Community Emergency Response Team (CERT) training to improve local hazard preparedness, response, and recovery efforts. Ensure such efforts are ongoing.

This action would help increase household and neighborhood resilience, in the event that police and fire personnel cannot provide immediate assistance.

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- Increasing drought raises the risk of wildfires, which could damage utility infrastructure.
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ACTION G-11

Factor climate impacts into the full life-cycle costs of roads, buildings, parks, and other assets — from their initial siting and design to their ongoing operations and maintenance.

The Thurston Climate Adaptation Plan, which should be updated periodically by TRPC [See Action A-01], will serve as a regional reference guide for understanding local climate impacts and asset risks. By considering such impacts (e.g., projected sea levels), public- and private-sector property owners will be better able to protect their assets and reduce operations and maintenance costs.

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- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Intensifying precipitation necessitates retrofitting stormwater and wastewater infrastructure to mitigate flooding and backups that threaten water quality and human health and welfare.
- Population change puts more strain on transportation (roads, transit, etc.).
- Intensifying precipitation raises the cost of development (flooding and runoff mitigation measures).
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).

General

ACTION G-12

Increase incentives to make urban infill and redevelopment projects more viable financially.

Incentives could include, but are not limited to, tax credits and fee waivers for infill and redevelopment projects, as well as stormwater control transfer programs (e.g., Redmond, Washington's stormwater mitigation banking program).

Infill and redevelopment projects within urban centers and corridors inside of the urban growth areas enhance residents' resilience by providing better access to transportation options and services (e.g., food stores, hospitals, and emergency responders). Such projects also have potential climate mitigation benefits, enabling residents to drive fewer miles and reduce their transportation-related greenhouse gas emissions.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Intensifying precipitation contaminates water (nutrients) from septic systems due to high groundwater flooding.
- Population change increases transportation-related energy consumption, CO2 emissions, and other pollutants related to buildings and transportation.
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Population change increases strain on social and emergency services.
- Population change puts more strain on transportation (roads, transit, etc.).
- Population change increases pollution related to development (e.g., more septic systems and impervious surfaces).
- Increasing drought raises the risk of wildfires, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.
- Population change increases pressure to develop rural areas, which could reduce, fragment and/or degrade farms, forests, and prairies.

ACTION G-13

Align land use, hazard mitigation, transportation, capital improvement, and other plans so that they take into account climate change and work toward the same goals.

This action, in which TRPC could take the lead as a coordinating body, would help ensure consistent interjurisdictional and interagency planning and policymaking with regard to climate change mitigation and adaptation.

- Warmer winters degrade critical habitat (rivers and streams) due to greater winter runoff.
- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
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- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Intensifying precipitation necessitates retrofitting stormwater and wastewater infrastructure to mitigate flooding and backups that threaten water quality and human health and welfare.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.

ACTION G-14

Expand ability to predict drought and flood events by tracking soil moisture, streamflow, precipitation, groundwater levels, tide levels, well levels, reservoir levels, and weather forecasts.

The City of Olympia proposes working with the Port of Olympia and the U.S. Geological Survey (USGS) to establish a tide gauge in Olympia. Additionally, the National Oceanic & Atmospheric Administration (NOAA) hosts the online Water Resources Dashboard — which includes maps and data that can help local resource managers monitor for the potential for extreme precipitation and drought events: <https://toolkit.climate.gov/topics/water-resources/water-resources-dashboard>.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Warmer winters degrade critical habitat (rivers and streams) due to greater winter runoff.
- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Warmer winters reduce snowpack and alter stream volume and temperature, impacting long-term productivity of anadromous fish populations and fisheries.
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought raises the risk of lower crop yield or failure.
- Sea-level rise pushes saltwater farther into estuaries, which may inundate near-coastal farms and ranches.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.
- Warmer summers increase the heat stress risk for dairy cows and other large livestock.
- Increasing drought parches farm fields and other open spaces, which could erode and release windblown dust (e.g., PM10) that degrades air quality.

General

ACTION G-15

Create a website that details health risks exacerbated by climate change and provides information that helps residents prepare for and respond to drought, poor air quality, extreme heat, disease vectors, and other threats.

This action would improve the region's climate literacy and resilience.

- Warmer water increases the growth and reach of pathogens (e.g., cyanobacteria and algal blooms) harmful to humans, fish, and other water users.
- Sea-level rise increases coastal flooding of downtown Olympia and LOTT wastewater treatment plant assets, which could threaten the ability to treat and discharge water and increase the energy consumed to operate pumps.
- Intensifying precipitation contaminates water (nutrients) from septic systems due to high groundwater flooding.
- Sea-level rise inundates former industrial sites, which could mobilize pollutants in the soil and degrade water quality.
- Warmer summers introduce or exacerbate disease vectors (carriers), which could harm human health (warmer, wetter winters also exacerbate exposure to pathogens and other health threats).
- Increasing drought raises the risk of wildfires and elevated levels of PM10 (coarse particulate matter) from smoke.
- Warmer summers increase extreme temperatures that could cause heat-related illnesses (e.g., hyperthermia) -- a major risk for elderly, homeless, and other vulnerable populations.
- Increasing drought raises pollutant concentrations in shallow wells and surface waters.
- Warmer summers increase production of surface ozone (VOCs interacting with NOx) and accumulation of fine particulate matter (PM2.5).
- Warmer summers cause urban heat islands, which could affect livability/health in heavily developed centers and corridors.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.
- Increasing drought parches farm fields and other open spaces, which could erode and release windblown dust (e.g., PM10) that degrades air quality.

ACTION G-16

Develop a countywide disaster debris management plan with actions to dispose of or recycle materials (organic and artificial) efficiently after a disaster.

This action would improve the region's resilience, its ability to recovery quickly and fully from hazards.

- Warmer summers stress sensitive plants and habitat (including urban landscaping), which could leave them vulnerable to extreme heat, pests, or pathogens.
- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.
- Population change increases solid waste generation.
- Increasing drought raises the risk of wildfires, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

General

ACTION G-17

Advocate for expanding the eligibility of federal disaster-assistance funding to allow for the replacement or relocation of aging or vulnerable infrastructure before it fails.

This includes facilities such as water infrastructure, fire stations, transportation infrastructure, emergency coordination shelters, and buildings that are used as emergency shelters.

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- Sea-level rise increases coastal flooding of downtown Olympia and LOTT wastewater treatment plant assets, which could threaten the ability to treat and discharge water and increase the energy consumed to operate pumps.
- Warmer summers increase extreme temperatures that could cause heat-related illnesses (e.g., hyperthermia) -- a major risk for elderly, homeless, and other vulnerable populations.
- Sea-level rise makes coastal groundwater more vulnerable to saltwater intrusion and inundation.
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.
- Increasing drought raises the risk of wildfires, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

ACTION G-18

Limit access to parks, lakes, and other outdoor recreation areas when natural hazards (e.g., algal blooms, wildfires, floods) pose risks to public safety.

This action would help protect public health and welfare.

- Warmer winters increase the range and survival of invasive species, pests, and diseases that threaten native flora and fauna.
- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Warmer water increases the growth and reach of pathogens (e.g., cyanobacteria and algal blooms) harmful to humans, fish, and other water users.
- Sea-level rise increases coastal flooding of downtown Olympia and LOTT wastewater treatment plant assets, which could threaten the ability to treat and discharge water and increase the energy consumed to operate pumps.
- Sea-level rise inundates former industrial sites, which could mobilize pollutants in the soil and degrade water quality.
- Intensifying precipitation contaminates water (bacteria, pathogens) due to a greater incidence of combined stormwater/sewer system overflows.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.



ACTION D-01

Develop and implement a comprehensive drought-response strategy that sets action levels for different drought stages.

Thurston County experienced moderate or more extreme drought conditions in the summer months nine out of the last sixteen years, including the last three consecutive years. Climate change and population growth will exacerbate these water shortages.

A possible funding source for this action is the Washington Department of Ecology's Watershed Planning Implementation and Flow Achievement grant; the next funding cycle is 2019-2021.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought stresses sensitive plants and habitat, which could reduce long-term viability of preserved and restored areas.
- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Increasing drought reduces summer hydropower production, a comparatively clean and inexpensive electricity source for commercial and residential customers.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Increasing drought increases the concentration of pollutants in first-flush runoff.
- Increasing drought raises the risk of wildfires and elevated levels of PM10 (coarse particulate matter) from smoke.
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought raises the risk of lower crop yield or failure.
- Increasing drought raises pollutant concentrations in shallow wells and surface waters.
- Increasing drought raises the risk of wildfires, which could destroy forests that serve as a net carbon sink.
- Increasing drought raises the risk of wildfires, which could contaminate water (turbidity and sedimentation).
- Increasing drought raises the risk of wildfires, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.
- Increasing drought raises the risk of wildfires, which could damage utility infrastructure.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.
- Increasing drought lowers reservoir levels, which exposes organic materials and causes them to decay and emit greenhouse gases.
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).
- Increasing drought parches farm fields and other open spaces, which could erode and release windblown dust (e.g., PM10) that degrades air quality.

ACTION D-02

Evaluate and secure sustained funding to support enhanced long-term monitoring of ground and surface water quality and quantity.

This action includes enhancing monitoring of water volume, temperature, and pollution in streams, lakes, and Puget Sound. Existing resources include:

The state Department of Ecology measures changes in the Puget Sound lowland streams and urban shoreline areas as a result of stormwater management: <http://www.ecy.wa.gov/programs/wq/stormwater/municipal/rsmp/status.html>.

Thurston County conducts data analysis and regular monitoring of specific lakes, rivers, and streams: <http://www.co.thurston.wa.us/health/ehswat/swater.html>.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Intensifying precipitation increases the frequency and intensity of the heaviest 24-hour rain events and the overall volume of winter streamflow, which could degrade sensitive riparian areas.
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Warmer winters degrade critical habitat (rivers and streams) due to greater winter runoff.
- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Warmer water increases the growth and reach of pathogens (e.g., cyanobacteria and algal blooms) harmful to humans, fish, and other water users.
- Increasing drought increases the concentration of pollutants in first-flush runoff.
- Intensifying precipitation contaminates water (turbidity and sedimentation) due to landslides.
- Sea-level rise increases coastal flooding of downtown Olympia and LOTT wastewater treatment plant assets, which could threaten the ability to treat and discharge water and increase the energy consumed to operate pumps.
- Ocean acidification decreases marine pH and -- when coupled with increases in ocean temperature and land-borne pollution -- threatens marine water quality.
- Intensifying precipitation contaminates water (nutrients) from septic systems due to high groundwater flooding.
- Sea-level rise inundates former industrial sites, which could mobilize pollutants in the soil and degrade water quality.
- Intensifying precipitation contaminates water (bacteria, pathogens) due to a greater incidence of combined stormwater/sewer system overflows.
- Warmer summers introduce or exacerbate disease vectors (carriers), which could harm human health (warmer, wetter winters also exacerbate exposure to pathogens and other health threats).
- Sea-level rise makes coastal groundwater more vulnerable to saltwater intrusion and inundation.
- Warmer water increases periods of low dissolved oxygen and hypoxic conditions in lakes and other freshwater areas.
- Warmer water increases the risk of marine water stratification and hypoxia, which could alter the timing of spring plankton blooms that support the marine food web (including salmon and other economically important fish).
- Increasing drought raises the risk of wildfires, which could contaminate water (turbidity and sedimentation).
- Warmer summers increase recreational activity in waterbodies and the risk of boat fuel spills.



Drought & Water Quality

ACTION D-03

Increase reuse of reclaimed water for irrigating plants, supplementing low streamflow, and other purposes.

In the north Thurston County area, the LOTT Clean Water Alliance produces reclaimed water. LOTT's partner cities — Lacey, Olympia, and Tumwater — operate reclaimed water utilities and purvey the water to customers for reuse. LOTT develops reclaimed water production capacity based primarily on the need for additional treatment capacity in the wastewater system. Other community needs, such as climate resilience, can influence planning for additional reclaimed water. Because reclaimed water must be conveyed in a separate purple pipe network, distribution and reuse is generally limited to areas within close proximity to existing reclaimed water pipelines. Decisions about the expansion of the distribution line network are generally made by the partner cities' utilities. Significant cost is involved in adding reclaimed water production capacity and expanding the distribution system. Local and outside funding commitments may be necessary.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought stresses sensitive plants and habitat, which could reduce long-term viability of preserved and restored areas.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).
- Increasing drought parches farm fields and other open spaces, which could erode and release windblown dust (e.g., PM10) that degrades air quality.

ACTION D-04

Conduct benefit-cost analyses (BCAs) of adaptation actions that conserve water resources.

Benefit-cost analyses, also commonly called cost-benefit analyses, would provide Thurston Region policymakers an important economic tool for evaluating water-conservation actions, including those in this plan [See Drought & Water Quality actions].

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).

ACTION D-05

Increase the number of water rights that are transferred to a trust, temporarily or permanently.

This action would be measurable and could involve a variety of leads and partners. Washington's Trust Water Rights Program provides a way for the State to legally hold water rights for future uses without the water right relinquishing. Water rights holders may sell, lease, or donate their unused capacity to the program. The Department of Ecology, guided by RCW 90.42.40, holds the water rights in a trust to support instream flows and other beneficial uses. Water rights that are donated or leased temporarily to Ecology retain their original priority date while held in the trust. Water rights that are sold permanently to Ecology are retired. For more information, visit ecy.wa.gov/programs/wr/market/waterbank.html.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).

ACTION D-06

Set up a water bank in Thurston County's watersheds to enable water rights trading that supports conservation.

Thurston County does not currently have an active water bank for its watersheds. Under RCW 90.42.40, however, communities in the Yakima River, Columbia River, Dungeness River, and Walla Walla River watersheds have set up water banks for buying and selling water rights. In Walla Walla's water bank, for example, the Walla Walla Watershed Management Partnership buys water rights and then divides them into exempt well mitigation credits for sale to prospective water users. Thurston County could explore creating a similar partnership.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).

Drought & Water Quality

ACTION D-07

Implement tiered water pricing.

This action, in which municipal water customers pay more per gallon as they use more, would provide a clear price signal and support conservation.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).

ACTION D-08

Increase incentives for water conservation during dry months.

This action would investigate and implement additional incentives that could be offered, including for outdoor use and for properties on private water systems or wells.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought raises the risk of lower crop yield or failure.
- Increasing drought raises pollutant concentrations in shallow wells and surface waters.
- Increasing drought lowers reservoir levels, which exposes organic materials and causes them to decay and emit greenhouse gases.
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).
- Increasing drought parches farm fields and other open spaces, which could erode and release windblown dust (e.g., PM10) that degrades air quality.

ACTION D-09

Incentivize new commercial construction to include on-site rainwater harvesting facilities.

This action would reduce runoff and provide a source of water for irrigating plants and flushing toilets.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Intensifying precipitation contaminates water (bacteria, pathogens) due to a greater incidence of combined stormwater/sewer system overflows.
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Intensifying precipitation necessitates retrofitting stormwater and wastewater infrastructure to mitigate flooding and backups that threaten water quality and human health and welfare.
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Intensifying precipitation increases volume of urban runoff and flooding, which decrease groundwater recharge.

ACTION D-10

Install efficient plumbing fixtures and equipment in buildings so as to conserve water.

The Uniform Plumbing Code, part of the Washington State Building Code, sets maximum water consumption levels for new faucets, toilets, showerheads, and other plumbing fixtures in buildings.

The LOTT Clean Water Alliance provides free water-saving kits (showerheads, leak-detection kits, etc.) to rate-payers within its Lacey, Olympia and Tumwater service area. LOTT also provides rebates to residential, commercial, industrial, and institutional rate-payers who install water-saving toilets, appliances, and other equipment. For more information, visit <http://lottcleanwater.org/programs>.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).

Drought & Water Quality

ACTION D-11

Evaluate and offer new incentives for residents to install rain gardens on well-draining soils and plant drought-tolerant landscaping (e.g. xeriscaping) to adapt to changes in seasonal precipitation.

Incentives could include utility rebates or credits.

[U.S. EPA has published a handbook with "Water-Smart" landscaping tips for rain gardens and other parts of the yard: https://www3.epa.gov/watersense/docs/water-efficient_landscaping_508.pdf]

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Warmer summers stress sensitive plants and habitat (including urban landscaping), which could leave them vulnerable to extreme heat, pests, or pathogens.
- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Intensifying precipitation contaminates water (bacteria, pathogens) due to a greater incidence of combined stormwater/sewer system overflows.
- Intensifying precipitation increases volume of urban runoff and flooding, which decrease groundwater recharge.

ACTION D-12

Construct new water-storage systems (e.g., large cisterns, water towers, and reservoirs) to provide back-up water supplies during droughts.

Per state law (RCW Title 90), a municipality or other party would need state approval to store and withdraw water that exceeds its allocated water rights.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).

ACTION D-13

Expand Thurston County's septic system operation and maintenance education and outreach programs.

Climate models project more frequent and intense rain storms, which could oversaturate drain fields around septic tanks and cause them to flood, overflow, and release pollutants into surface waters. A 2016 report by Thurston County and TRPC — Deschutes Watershed Land Use Analysis: Scenario Development Report — estimated that it would cost about \$43,000 annually to administer a voluntary septic system operation and maintenance program in the Deschutes Watershed alone.

- Warmer water increases the growth and reach of pathogens (e.g., cyanobacteria and algal blooms) harmful to humans, fish, and other water users.
- Intensifying precipitation contaminates water (nutrients) from septic systems due to high groundwater flooding.
- Population change increases pollution related to development (e.g., more septic systems and impervious surfaces).

ACTION D-14

Reduce zoning density for parcels (i.e., "downzone") and lower limits for impervious surfaces near streams and lakes with nutrient-loading problems.

When considering whether to take this action, which would mitigate the combined impacts of water pollution and warming, government agencies should consider whether it would result in more impervious surfaces elsewhere.

- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Warmer winters degrade critical habitat (rivers and streams) due to greater winter runoff.
- Warmer water increases the growth and reach of pathogens (e.g., cyanobacteria and algal blooms) harmful to humans, fish, and other water users.
- Increasing drought increases the concentration of pollutants in first-flush runoff.
- Intensifying precipitation contaminates water (nutrients) from septic systems due to high groundwater flooding.
- Population change increases pollution related to development (e.g., more septic systems and impervious surfaces).

ACTION D-15

Facilitate new residential water and sewer connections to municipal sources, where feasible.

This action would help protect water quality and quantity.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).

ACTION D-16

Incentivize water metering for all wells.

Metering all wells, either through voluntary or regulatory means, would help fill water usage data gaps and provide water managers with information they can use to ensure there is sufficient supply to meet demand (water for people, fish, and other users).

Every municipal water supplier in Washington — i.e., Group A water systems with at least 15 service connections — must install a source meter that shows total system production, as well as install service meters that show authorized consumption for each connection (e.g., a single-family home). All new Group B water systems — those with multiple, but fewer than 15 connections, often in less-urbanized areas — must install a source meter as well.

Most of Thurston County's Group B systems have source meters, in compliance with state law, but such systems are not required to report their production data to state and local governments. Few of Thurston County's Group B systems have individual service meters, which are not required by state law.

About a quarter of Thurston County's wells are considered "permit-exempt" and are not in a Group A or B water system. Washington's groundwater permit exemption (RCW 90.44.050) allows for single or group domestic well water use up to 5,000 gallons per day without first obtaining water right permits.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).



ACTION D-17

Establish a local non-regulatory entity to provide technical assistance to private well owners regarding conserving water and detecting leaks and pollution.

This action would help protect water quality and quantity.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Sea-level rise makes coastal groundwater more vulnerable to saltwater intrusion and inundation.
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought raises pollutant concentrations in shallow wells and surface waters.
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).

ACTION F-01

Evaluate and secure sustained funding to restore and protect riparian vegetation along freshwater and marine shorelines.

Plant buffers stabilize banks, provide shade and flood storage, slow and filter polluted runoff, store carbon emissions, and enhance air quality. A local government, for example, could add a vegetation surcharge to its stormwater utility rate to fund restoration of these riparian areas.

- Intensifying precipitation increases the frequency and intensity of the heaviest 24-hour rain events and the overall volume of winter streamflow, which could degrade sensitive riparian areas.
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Warmer winters degrade critical habitat (rivers and streams) due to greater winter runoff.
- Sea-level rise increases wave-action exposure, which could increase the erosion rate of coastal bluffs, degrade coastal wildlife habitat, and threaten the property and safety residents.
- Warmer water increases the growth and reach of pathogens (e.g., cyanobacteria and algal blooms) harmful to humans, fish, and other water users.
- Increasing drought increases the concentration of pollutants in first-flush runoff.
- Warmer water threatens the survival of salmon, which support cultural and economic practices and ecosystem services.
- Warmer water expands the range for invasive aquatic species.
- Warmer winters reduce snowpack and alter stream volume and temperature, impacting long-term productivity of anadromous fish populations and fisheries.
- Warmer water increases periods of low dissolved oxygen and hypoxic conditions in lakes and other freshwater areas.

ACTION F-02

Incorporate projected sea-level rise and flooding information into the designation of regulatory hazard areas.

Development and activities typically are required to be set back and/or buffered from regulated hazard areas, such as floodplains, marine shorelines, and high groundwater areas, which are determined by historic water level information. This action could involve updating regulations to better reflect projections about how water levels may change (e.g., the Ordinary High Water Mark [OHWM], the 100-year floodplain or channel migration area) in order to ensure new homes and other development are located and/or designed appropriately for future conditions.

- Sea-level rise increases wave-action exposure, which could increase the erosion rate of coastal bluffs, degrade coastal wildlife habitat, and threaten the property and safety residents.
- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

Flooding & Erosion

ACTION F-03

Design new and replacement stream culverts and other drainage infrastructure to accommodate projected higher peak flows associated with more frequent and intense heavy precipitation events.

This action would improve fish passage and reduce flooding that occurs when debris blocks culverts. Additional funding could help Thurston County address problematic culverts more quickly.

- Intensifying precipitation increases the frequency and intensity of the heaviest 24-hour rain events and the overall volume of winter streamflow, which could degrade sensitive riparian areas.
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Intensifying precipitation contaminates water (bacteria, pathogens) due to a greater incidence of combined stormwater/sewer system overflows.
- Intensifying precipitation necessitates retrofitting stormwater and wastewater infrastructure to mitigate flooding and backups that threaten water quality and human health and welfare.
- Intensifying precipitation raises the cost of development (flooding and runoff mitigation measures).

ACTION F-04

Install flood gates and pumps on stormwater outfalls connected to Puget Sound to mitigate back-ups during high tides and heavy rains exacerbated by rising seas.

This action, to be considered as part of the City of Olympia's sea-level rise response strategy for downtown (2018), would help reduce flooding and its impacts on public budgets and mobility.

- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation contaminates water (bacteria, pathogens) due to a greater incidence of combined stormwater/sewer system overflows.
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

ACTION F-05

Build floodwalls or other protective structures around critical facilities located in areas vulnerable to flooding as a result of sea-level rise and heavy precipitation.

This action will be considered as part of the City of Olympia's sea-level rise response strategy for downtown (2018). Local policymakers could utilize best available science to evaluate site-specific responses, which could include walls, berms, or other "hard" or "soft" structures. As a follow-up to this action, policymakers could identify and set aside areas to receive critical facilities that could be moved at the end of their useful lifespan.

- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise reduces shoreline recreation opportunities.
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

Flooding & Erosion

ACTION F-06

Require that new or renovated buildings utilize flood-protection measures (such as raised finished-floor levels and temporary flood barriers) to accommodate projected sea-level rise over the structures' lifespan.

Chapter 16.80 of the Olympia Municipal Code, which focuses on reducing damage from sea-level rise, requires that all new buildings have the lowest floor (including basement) protected from flooding or elevated to 16 feet or greater. Other parts of the county could replicate this requirement.

- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise raises the cost of new development and redevelopment.
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

ACTION F-07

Increase education and enforcement efforts to ensure that commercial and residential building owners properly maintain low-impact development (LID) facilities that treat stormwater runoff on site.

Washington's municipal stormwater permit directs recipients to make LID the "preferred and commonly used approach to site development," where feasible. Such facilities, even those on private property, must be maintained properly to reduce stormwater runoff, flooding, and water pollution.

- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Increasing drought increases the concentration of pollutants in first-flush runoff.
- Intensifying precipitation contaminates water (bacteria, pathogens) due to a greater incidence of combined stormwater/sewer system overflows.
- Population change increases pollution related to development (e.g., more septic systems and impervious surfaces).
- Intensifying precipitation raises the cost of development (flooding and runoff mitigation measures).
- Intensifying precipitation increases volume of urban runoff and flooding, which decrease groundwater recharge.

ACTION F-08

Assess drinking water wells' vulnerability to saltwater intrusion and inundation from rising sea levels, and develop adaptation measures (e.g., relocating wells).

This action would help ensure the protection of the region's drinking water supplies.

- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise raises the cost of new development and redevelopment.
- Sea-level rise makes coastal groundwater more vulnerable to saltwater intrusion and inundation.

Flooding & Erosion

ACTION F-09

For sites where elevating or relocating a building is not a viable option in response to flood risks, acquire the property, use the land for appropriate uses (e.g., flood storage or agriculture), and help the occupants resettle in the community.

This action would help protect public welfare and physical assets while mitigating flood risks.

- Sea-level rise increases wave-action exposure, which could increase the erosion rate of coastal bluffs, degrade coastal wildlife habitat, and threaten the property and safety residents.
- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).

ACTION F-10

Implement brownfield clean-up strategies/planned actions for low-lying sites that are most vulnerable to sea-level rise.

This action would reduce the risk of water contamination from polluted coastal sites that become inundated with seawater.

- Sea-level rise inundates former industrial sites, which could mobilize pollutants in the soil and degrade water quality.

ACTION F-11

Protect important historical or cultural sites that are at risk of coastal or inland flooding, erosion, and wildfires.

Options could include allowing inundation of the site, relocating the site to higher ground, or stabilizing the site's shoreline with vegetation, rip-rap or other materials.

- Sea-level rise increases the frequency, depth, and duration of inundation of low-lying coastal areas, which could turn marshes, estuaries, and other upland areas into mudflats (dams limit sedimentation and 1-5 berms limit vegetation adaptation in the Nisqually Estuary).
- Sea-level rise increases wave-action exposure, which could increase the erosion rate of coastal bluffs, degrade coastal wildlife habitat, and threaten the property and safety residents.
- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise reduces shoreline recreation opportunities.
- Increasing drought raises the risk of wildfires, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

Flooding & Erosion

ACTION F-12

Limit construction of buildings and roads in areas where flood and landslide risks are highest.

This action would reduce the risk of infrastructure damage from floods and landslides exacerbated by changes in precipitation timing, type, and volume.

- Sea-level rise increases wave-action exposure, which could increase the erosion rate of coastal bluffs, degrade coastal wildlife habitat, and threaten the property and safety residents.
- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise raises the cost of new development and redevelopment.
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

ACTION F-13

Identify where and how the region could support the natural inland transition of coastal lowlands to estuaries as sea levels rise.

Supportive actions could include modifying artificial barriers such as roads, as well as purchasing vulnerable properties (e.g., low-lying agricultural lands) that could transition to estuaries over time.

- Sea-level rise increases the frequency, depth, and duration of inundation of low-lying coastal areas, which could turn marshes, estuaries, and other upland areas into mudflats (dams limit sedimentation and 1-5 berms limit vegetation adaptation in the Nisqually Estuary).
- Sea-level rise increases wave-action exposure, which could increase the erosion rate of coastal bluffs, degrade coastal wildlife habitat, and threaten the property and safety residents.
- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise raises the cost of new development and redevelopment.
- Sea-level rise pushes saltwater farther into estuaries, which may inundate near-coastal farms and ranches.
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

ACTION F-14

Construct flood-storage facilities (e.g., wetlands or artificial ponds) upstream of concentrated development areas that are at risk of flooding.

This action would reduce the risk of flooding and protect downstream built and natural assets.

- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Intensifying precipitation raises the cost of development (flooding and runoff mitigation measures).

Flooding & Erosion

ACTION F-15

Minimize development, disturbance, and vegetation removal on or near steep slopes (>25% gradient) adjacent to waterbodies.

This action would reduce the risks of landslides and sediment runoff.

- Sea-level rise increases wave-action exposure, which could increase the erosion rate of coastal bluffs, degrade coastal wildlife habitat, and threaten the property and safety residents.
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation contaminates water (turbidity and sedimentation) due to landslides.
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

ACTION F-16

Retrofit or reroute pedestrian/bicycle trails and bridges in areas that are subject to repetitive flooding and/or landslides.

This action would help protect public welfare.

- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise reduces shoreline recreation opportunities.

ACTION F-17

Decouple remaining combined storm and sewer systems, where cost-effective, so as to add capacity and mitigate back-ups and water-borne disease outbreaks.

This action would help protect the LOTT Clean Water Alliance's downtown Olympia treatment plant from marine water inundation during coastal flood events exacerbated by rising seas and heavy rains. Marine water would kill the plant's biological water-treatment process.

- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Intensifying precipitation contaminates water (bacteria, pathogens) due to a greater incidence of combined stormwater/sewer system overflows.
- Intensifying precipitation raises the cost of development (flooding and runoff mitigation measures).

Plants & Animals

ACTION P-01

Increase funding, education, and incentives for private landowners to manage lands in ways that enhance ecological and economic resilience (e.g., protecting and restoring forests, prairies, and shoreline/riparian areas).

Incentives could include expanding Thurston County's Transfer of Development Rights (TDR) program, conservation easement funding, as well as expanding market-based approaches for ecosystem service payments or credits (e.g., for water quality, carbon sequestration, and flood management).

- Intensifying precipitation increases the frequency and intensity of the heaviest 24-hour rain events and the overall volume of winter streamflow, which could degrade sensitive riparian areas.
- Increasing drought stresses sensitive plants and habitat, which could reduce long-term viability of preserved and restored areas.
- Warmer winters degrade critical habitat (rivers and streams) due to greater winter runoff.
- Warmer winters increase the range and survival of invasive species, pests, and diseases that threaten native flora and fauna.
- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Ocean acidification decreases marine pH and -- when coupled with increases in ocean temperature and land-borne pollution -- threatens marine water quality.
- Warmer winters shift the life cycle of fish and wildlife, which could reduce populations that support subsistence and recreational hunting.
- Warmer summers decrease climatic suitability of areas that currently support Garry oak and prairie habitat.
- Warmer water expands the range for invasive aquatic species.
- Increasing drought raises the risk of wildfires, which could destroy forests that serve as a net carbon sink.
- Warmer summers decrease climatic suitability of areas that currently support Douglas fir.
- Population change increases pressure to develop rural areas, which could reduce, fragment and/or degrade farms, forests, and prairies.

ACTION P-02

Use best-management practices, such as installing large woody debris in rivers, to improve water temperature, streamflow, and channel conditions.

Placing large woody debris in rivers alters the flow of water, digs out cooler pools for fish to rest, and creates sediment-free riffles for fish to spawn. It will be necessary to choose proper sites and structures that do not cause flooding.

- Intensifying precipitation increases the frequency and intensity of the heaviest 24-hour rain events and the overall volume of winter streamflow, which could degrade sensitive riparian areas.
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought stresses sensitive plants and habitat, which could reduce long-term viability of preserved and restored areas.
- Warmer winters degrade critical habitat (rivers and streams) due to greater winter runoff.

Plants & Animals

ACTION P-03

Create/Update basin plans that integrate climate impacts, and include goals and targets for protecting natural resources and habitat.

This action would ensure that region continues to assess how climate change affects watersheds and takes measurable steps to protect the water, plants (e.g., riparian areas), and animals within.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Intensifying precipitation increases the frequency and intensity of the heaviest 24-hour rain events and the overall volume of winter streamflow, which could degrade sensitive riparian areas.
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought stresses sensitive plants and habitat, which could reduce long-term viability of preserved and restored areas.
- Warmer winters degrade critical habitat (rivers and streams) due to greater winter runoff.
- Warmer summers stress sensitive plants and habitat (including urban landscaping), which could leave them vulnerable to extreme heat, pests, or pathogens.
- Warmer winters cause salmon to remain active during winter and deplete their store of energy/health.
- Warmer winters increase the range and survival of invasive species, pests, and diseases that threaten native flora and fauna.
- Sea-level rise increases wave-action exposure, which could increase the erosion rate of coastal bluffs, degrade coastal wildlife habitat, and threaten the property and safety residents.
- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Warmer water threatens the survival of salmon, which support cultural and economic practices and ecosystem services.
- Ocean acidification makes it harder for calcifying organisms to form shells, and it ultimately harms commercial and recreational fisheries.
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Warmer summers decrease climatic suitability of areas that currently support Garry oak and prairie habitat.
- Warmer summers raise the risk of low crop yields or failure due to warmer temperature, reduced summer precipitation, and increased pest prevalence.
- Warmer winters reduce snowpack and alter stream volume and temperature, impacting long-term productivity of anadromous fish populations and fisheries.
- Increasing drought raises the risk of lower crop yield or failure.
- Warmer winters increase the range and survival of pests and diseases that affect crops.
- Sea-level rise pushes saltwater farther into estuaries, which may inundate near-coastal farms and ranches.
- Warmer summers decrease climatic suitability of areas that currently support Douglas fir.
- Warmer summers increase the heat stress risk for dairy cows and other large livestock.
- Population change increases pressure to develop rural areas, which could reduce, fragment and/or degrade farms, forests, and prairies.

ACTION P-04

Implement monitoring practices that provide early detection of invasive species on land and in water, and expand biological control and manual removal of such plants and insects.

This action would help halt the spread of invasive plant and insect species that thrive in a warmer climate.

- Increasing drought stresses sensitive plants and habitat, which could reduce long-term viability of preserved and restored areas.
- Warmer winters increase the range and survival of invasive species, pests, and diseases that threaten native flora and fauna.
- Warmer water expands the range for invasive aquatic species.
- Warmer winters increase the range and survival of pests and diseases that affect crops.

ACTION P-05

Evaluate additional assisted migration of vulnerable plant and animal species to suitable habitat.

This action would help ensure species survival as changes in temperature and precipitation shift the location of suitable habitat.

- Intensifying precipitation increases the frequency and intensity of the heaviest 24-hour rain events and the overall volume of winter streamflow, which could degrade sensitive riparian areas.
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Increasing drought stresses sensitive plants and habitat, which could reduce long-term viability of preserved and restored areas.
- Warmer winters degrade critical habitat (rivers and streams) due to greater winter runoff.
- Warmer summers stress sensitive plants and habitat (including urban landscaping), which could leave them vulnerable to extreme heat, pests, or pathogens.
- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Warmer summers decrease climatic suitability of areas that currently support Garry oak and prairie habitat.
- Warmer summers decrease climatic suitability of areas that currently support Douglas fir.

ACTION P-06

Expand efforts to monitor the cause and extent of changes in native and invasive plant distribution.

This action would help land managers select and implement effective actions to ensure the survival of native plants.

- Increasing drought stresses sensitive plants and habitat, which could reduce long-term viability of preserved and restored areas.
- Warmer summers stress sensitive plants and habitat (including urban landscaping), which could leave them vulnerable to extreme heat, pests, or pathogens.
- Warmer winters increase the range and survival of invasive species, pests, and diseases that threaten native flora and fauna.
- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Warmer summers decrease climatic suitability of areas that currently support Garry oak and prairie habitat.
- Warmer water expands the range for invasive aquatic species.
- Warmer summers decrease climatic suitability of areas that currently support Douglas fir.

ACTION P-07

Increase organic matter content and water retention in soils within urban and agricultural settings.

Integrating perennials into cropping systems such as grass forages, cover cropping, compost application and conservation tillage helps improve water infiltration and storage, as well as increases soil organic matter content and carbon sequestration.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought stresses sensitive plants and habitat, which could reduce long-term viability of preserved and restored areas.
- Warmer summers stress sensitive plants and habitat (including urban landscaping), which could leave them vulnerable to extreme heat, pests, or pathogens.
- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Increasing drought reduces groundwater recharge (drinking water and in-stream flows).
- Warmer summers raise the risk of low crop yields or failure due to warmer temperature, reduced summer precipitation, and increased pest prevalence.
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.

Plants & Animals

ACTION P-08

Increase urban agriculture and biointensive farming methods to maximize crop yields and ecosystem services.

Municipalities and their partners could encourage such practices by providing technical support and incentives.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Warmer summers stress sensitive plants and habitat (including urban landscaping), which could leave them vulnerable to extreme heat, pests, or pathogens.
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Warmer summers raise the risk of low crop yields or failure due to warmer temperature, reduced summer precipitation, and increased pest prevalence.
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought raises the risk of lower crop yield or failure.
- Warmer winters increase the range and survival of pests and diseases that affect crops.
- Warmer summers accelerate the risk of food spoilage before it reaches market.
- Population change increases pressure to develop rural areas, which could reduce, fragment and/or degrade farms, forests, and prairies.

ACTION P-09

Protect and enhance marine vegetation, such as eelgrass, so as to help clean water, sequester carbon dioxide, and improve fish habitat and survival.

The Nisqually Estuary has Thurston County's only significant eelgrass beds.

- Sea-level rise increases wave-action exposure, which could increase the erosion rate of coastal bluffs, degrade coastal wildlife habitat, and threaten the property and safety residents.
- Ocean acidification decreases marine pH and -- when coupled with increases in ocean temperature and land-borne pollution -- threatens marine water quality.
- Ocean acidification makes it harder for calcifying organisms to form shells, and it ultimately harms commercial and recreational fisheries.
- Ocean acidification reduces the food available for and survival of salmon and other marine life.
- Ocean acidification reduces food available for and survival of salmon and other marine life.

ACTION P-10

Educate waterfront property owners about the benefits of voluntary oyster seeding and other shellfish production, and encourage such practices.

This action would help improve water quality and sustain the region's shellfishery, which are threatened by ocean acidification and land-borne pollution.

- Increasing drought increases the concentration of pollutants in first-flush runoff.
- Sea-level rise increases coastal flooding of downtown Olympia and LOTT wastewater treatment plant assets, which could threaten the ability to treat and discharge water and increase the energy consumed to operate pumps.
- Ocean acidification decreases marine pH and -- when coupled with increases in ocean temperature and land-borne pollution -- threatens marine water quality.
- Ocean acidification makes it harder for calcifying organisms to form shells, and it ultimately harms commercial and recreational fisheries.
- Warmer water increases the risk of marine water stratification and hypoxia, which could alter the timing of spring plankton blooms that support the marine food web (including salmon and other economically important fish).

ACTION P-11

Support Voluntary Stewardship Program (VSP) implementation to encourage conservation of agricultural lands and critical areas (e.g., riparian stream buffers) that provide ecosystem services.

Under the VSP program, which was created via state law, Thurston County works with landowners to develop voluntary, site-specific plans to protect critical areas on agricultural lands.

- Intensifying precipitation increases the frequency and intensity of the heaviest 24-hour rain events and the overall volume of winter streamflow, which could degrade sensitive riparian areas.
- Increasing drought degrades critical habitat (lakes, rivers and streams) due to changes in water volume and temperature.
- Warmer winters reduce snowpack and alter stream volume and temperature, impacting long-term productivity of anadromous fish populations and fisheries.

ACTION P-12

Grow woody perennial crops that help conserve water, store carbon, and provide other ecosystem services.

This action, which includes planting fruit trees and other crops whose woody stems and branches don't die off each winter, has both climate adaptation and mitigation co-benefits.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Warmer summers raise the risk of low crop yields or failure due to warmer temperature, reduced summer precipitation, and increased pest prevalence.
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Increasing drought raises the risk of lower crop yield or failure.
- Warmer winters increase the range and survival of pests and diseases that affect crops.
- Warmer summers accelerate the risk of food spoilage before it reaches market.
- Warmer summers accelerate the release of carbon stored in soils.
- Increasing drought parches farm fields and other open spaces, which could erode and release windblown dust (e.g., PM10) that degrades air quality.

ACTION T-01

Expand and retrofit the region's energy distribution, monitoring, and storage infrastructure to support more on-site renewable energy generation.

Bolstering the region's electricity distribution, monitoring, and storage infrastructure to handle more on-site renewable energy generation (e.g., solar panels on residential rooftops) would provide a hedge against the risk of service disruptions as a result of storms and blackouts.

- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Increasing drought reduces summer hydropower production, a comparatively clean and inexpensive electricity source for commercial and residential customers.
- Warmer summers increase summer peak energy demand and costs for cooling residential and commercial buildings (e.g., buying and operating air conditioners), which could place more demand on the grid and reduce energy security.

ACTION T-02

Provide additional utility incentives to support energy efficiency and renewable energy investments in buildings.

Thurston County's electric utility, Puget Sound Energy, could offer new incentives to help building owners cover the cost of investing in energy efficiency (e.g., installing new windows and insulation) and installing solar panels, small-scale wind turbines, and other equipment that generates electricity on site from clean, renewable resources.

Washington state law allows "on-bill" financing, for example, in which an electric utility provides a loan to the owner of a commercial or residential building to invest in on-site renewable energy generation and efficiency upgrades. The borrower, which pays back the loan on its electric bill, saves money over time as it reduces its need for utility-provided electricity. This, in turn, reduces pressure on the utility to invest in generation from new sources (e.g., coal and natural gas power plants).

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces summer hydropower production, a comparatively clean and inexpensive electricity source for commercial and residential customers.
- Warmer summers increase summer peak energy demand and costs for cooling residential and commercial buildings (e.g., buying and operating air conditioners), which could place more demand on the grid and reduce energy security.

ACTION T-03

Offer additional utility rebates or bill credits to induce residents to buy and install energy-efficient appliances and other equipment.

Thurston County's electric utility, Puget Sound Energy, could provide residential rate-payers additional financial incentives to buy and install energy-efficient light bulbs, clothes dryers, air conditioners, and other equipment that saves energy and lowers bills. To enhance equity, PSE could increase incentives for low-income renters and homeowners.

- Increasing drought reduces summer hydropower production, a comparatively clean and inexpensive electricity source for commercial and residential customers.
- Warmer summers increase summer peak energy demand and costs for cooling residential and commercial buildings (e.g., buying and operating air conditioners), which could place more demand on the grid and reduce energy security.
- Warmer summers increase extreme temperatures that could cause heat-related illnesses (e.g., hyperthermia) -- a major risk for elderly, homeless, and other vulnerable populations.
- Warmer summers cause urban heat islands, which could affect livability/health in heavily developed centers and corridors.

ACTION T-04

Evaluate strategies to protect important electrical equipment that is within critical areas at risk of flooding and/or landslides.

Examples of such critical electrical equipment include underground power lines and low-elevation substations near the Puget Sound shoreline. Strategies could include elevating, reinforcing, or relocating such equipment.

- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).

ACTION T-05

Map transportation infrastructure that is vulnerable to repeated floods and/or landslides, and designate alternative travel routes for critical transportation corridors when roads must be closed because of natural hazards.

Integrate this lifeline transportation route map's data into the Thurston County Emergency Operations Plan and other local planning efforts.

- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).

ACTION T-06

Relocate or retrofit low-lying roads vulnerable to coastal or inland flooding.

This action, for example, could include relocating or raising Interstate 5 at the Nisqually Estuary and U.S. Highway 101 at Mud Bay (e.g., building taller, longer bridges). Such near-shore areas are vulnerable to coastal flooding exacerbated by sea-level rise and heavy precipitation.

- Sea-level rise increases the frequency, depth, and duration of inundation of low-lying coastal areas, which could turn marshes, estuaries, and other upland areas into mudflats (dams limit sedimentation and 1-5 berms limit vegetation adaptation in the Nisqually Estuary).
- Sea-level rise increases wave-action exposure, which could increase the erosion rate of coastal bluffs, degrade coastal wildlife habitat, and threaten the property and safety residents.
- Sea-level rise raises the risk of coastal inundation, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Sea-level rise raises the cost of new development and redevelopment.
- Sea-level rise raises the risk of coastal inundation and landslides, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.

ACTION T-07

Increase the energy efficiency of the region's water infrastructure.

This action includes replacing pumps and other drinking water, wastewater, and stormwater systems that consume large amounts of energy.

- Sea-level rise increases coastal flooding of downtown Olympia and LOTT wastewater treatment plant assets, which could threaten the ability to treat and discharge water and increase the energy consumed to operate pumps.
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Increasing drought necessitates moving water farther distances, which consumes more energy and may increase greenhouse gas emissions (depending on the energy fuel source).

ACTION T-08

Build additional large-scale renewable energy projects (e.g., utility-scale solar arrays and wind farms) in Thurston County.

Such clean-energy projects offset demand for electricity from polluting fossil fuels (coal and natural gas) and hydropower — which is vulnerable to less summer precipitation/lower streamflow.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces summer hydropower production, a comparatively clean and inexpensive electricity source for commercial and residential customers.
- Warmer summers increase summer peak energy demand and costs for cooling residential and commercial buildings (e.g., buying and operating air conditioners), which could place more demand on the grid and reduce energy security.

ACTION T-09

Establish energy goals/benchmarks (e.g., LEED) for new buildings, and adopt permitting practices and building code and/or design guidelines that support clean and efficient energy practices and technologies (e.g., passive design, rooftop solar panels, electric vehicle charging stations).

This action, which could be taken by tribal, state or local governments, would reduce building electricity consumption and demand/costs for utility-provided power.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces summer hydropower production, a comparatively clean and inexpensive electricity source for commercial and residential customers.
- Warmer summers increase summer peak energy demand and costs for cooling residential and commercial buildings (e.g., buying and operating air conditioners), which could place more demand on the grid and reduce energy security.
- Intensifying precipitation increases use of polluting generators following storm-induced power outages.

ACTION T-10

Expand utility outreach to and education of commercial and residential power customers about the benefits of clean and efficient energy technologies and practices.

Generating electricity from clean, renewable resources (e.g., the wind and sun) — and using electricity more efficiently — helps reduce the region's greenhouse gas emissions that contribute to global climate change. Such actions also offset demand for electricity Puget Sound Energy gets from polluting fossil fuels (coal and natural gas) and hydropower — which is vulnerable to less summer precipitation/lower streamflow.

- Increasing drought reduces summer hydropower production, a comparatively clean and inexpensive electricity source for commercial and residential customers.
- Warmer summers increase summer peak energy demand and costs for cooling residential and commercial buildings (e.g., buying and operating air conditioners), which could place more demand on the grid and reduce energy security.

Transportation & Energy

ACTION T-11

Develop and adopt policies that require residential and commercial properties to undertake an energy audit at the time of sale or during a substantial remodel.

Tribes or local governments could require such energy audits. If the energy audits identify deficiencies, regulators could recommend energy retrofits to upgrade properties to a specified level.

- Increasing drought reduces summer hydropower production, a comparatively clean and inexpensive electricity source for commercial and residential customers.
- Warmer summers increase summer peak energy demand and costs for cooling residential and commercial buildings (e.g., buying and operating air conditioners), which could place more demand on the grid and reduce energy security.

ACTION T-12

Generate additional energy from waste products (e.g., woody biomass and sewage) in Thurston County.

LOTT's wastewater-treatment plant, located in downtown Olympia, already captures methane to generate heat and electricity on site. Such projects offset demand for electricity from polluting fossil fuels (coal and natural gas) and hydropower — which is vulnerable to less summer precipitation/lower streamflow.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Increasing drought reduces summer hydropower production, a comparatively clean and inexpensive electricity source for commercial and residential customers.
- Warmer summers increase summer peak energy demand and costs for cooling residential and commercial buildings (e.g., buying and operating air conditioners), which could place more demand on the grid and reduce energy security.

ACTION T-13

Increase resources to monitor air quality, and enforce regulations to reduce the health risks of air pollution (e.g., surface ozone and particulate matter) exacerbated by warmer temperatures and automobile emissions.

This action would help reduce air pollution that threatens the region's residents.

- Population change increases transportation-related energy consumption, CO2 emissions, and other pollutants related to buildings and transportation.
- Increasing drought raises the risk of wildfires and elevated levels of PM10 (coarse particulate matter) from smoke.
- Warmer summers increase production of surface ozone (VOCs interacting with NOx) and accumulation of fine particulate matter (PM2.5).
- Warmer summers cause urban heat islands, which could affect livability/health in heavily developed centers and corridors.
- Increasing drought parches farm fields and other open spaces, which could erode and release windblown dust (e.g., PM10) that degrades air quality.

Wildfire & Extreme Heat

ACTION W-01

Create and maintain a map of the region's high-risk wildland urban interface communities and locations of wildfires.

Such a map would be used to regulate Firewise development practices (e.g., requiring building fire-suppression sprinklers and setbacks), as well as to educate property owners about wildfire risks.

- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Increasing drought raises the risk of wildfires and elevated levels of PM10 (coarse particulate matter) from smoke.
- Increasing drought raises the risk of wildfires, which could destroy forests that serve as a net carbon sink.
- Increasing drought raises the risk of wildfires, which could contaminate water (turbidity and sedimentation).
- Increasing drought raises the risk of wildfires, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.

ACTION W-02

Require new developments in high-risk wildfire areas to submit a fire-protection plan during site plan review.

This action would help reduce the risk of wildfire spreading to and damaging buildings.

- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Increasing drought raises the risk of wildfires and elevated levels of PM10 (coarse particulate matter) from smoke.
- Increasing drought raises the risk of wildfires, which could destroy forests that serve as a net carbon sink.
- Increasing drought raises the risk of wildfires, which could contaminate water (turbidity and sedimentation).
- Increasing drought raises the risk of wildfires, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.
- Increasing drought raises the risk of wildfires, which could damage utility infrastructure.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.

Wildfire & Extreme Heat

ACTION W-03

Provide private forestland owners and residents living in Wildland-Urban Interface (WUI) areas information about fire prevention/Firewise practices, and encourage the application of such practices.

Firewise is a program of the National Fire Protection Association (NFPA) and co-sponsored by the USDA Forest Service, the US Department of the Interior and the National Association of State Foresters. Firewise practices include limiting vegetation near homes and building such structures with flame-resistant materials.

- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Increasing drought raises the risk of wildfires and elevated levels of PM10 (coarse particulate matter) from smoke.
- Increasing drought raises the risk of wildfires, which could destroy forests that serve as a net carbon sink.
- Increasing drought raises the risk of wildfires, which could contaminate water (turbidity and sedimentation).
- Increasing drought raises the risk of wildfires, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.
- Increasing drought raises the risk of wildfires, which could damage utility infrastructure.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.

ACTION W-04

Plant drought- and pest-resistant trees, shrubs, and grasses in parks, landscaping strips, and other urban areas.

Such vegetation reduces the need for watering, provides cooling shade, improves air and water quality, and supports flood storage/infiltration.

- Increasing drought makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation increases the volume of urban runoff and flooding, which could render inadequate some stormwater/flood-control facilities.
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Population change increases strain on social and emergency services.
- Warmer summers increase extreme temperatures that could cause heat-related illnesses (e.g., hyperthermia) -- a major risk for elderly, homeless, and other vulnerable populations.
- Population change makes it harder to balance competing demands for water (for housing, industry, energy, agriculture, and the environment).
- Population change increases pressure on existing parks and open space.
- Increasing drought reduces aquifer recharge and could spur more groundwater pumping when surface water is scarce, all of which could lower well levels and raise the cost of pumping water from greater depths.
- Warmer summers increase production of surface ozone (VOCs interacting with NOx) and accumulation of fine particulate matter (PM2.5).
- Warmer summers cause urban heat islands, which could affect livability/health in heavily developed centers and corridors.
- Intensifying precipitation raises the cost of development (flooding and runoff mitigation measures).
- Warmer summers increase atmospheric CO₂, which decreases the nutritional quality of forage and pasture lands for livestock and wild animals.

Wildfire & Extreme Heat

ACTION W-05

Adopt wildfire hazard overlay districts with development regulations (for new structures) based on factors such as slope, structure, and fuel hazards.

This action would help reduce the risk of wildfire spreading to and damaging buildings.

- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Increasing drought raises the risk of wildfires and elevated levels of PM10 (coarse particulate matter) from smoke.
- Increasing drought raises the risk of wildfires, which could destroy forests that serve as a net carbon sink.
- Increasing drought raises the risk of wildfires, which could contaminate water (turbidity and sedimentation).
- Increasing drought raises the risk of wildfires, which could damage public- and private-sector infrastructure (homes, businesses, roads, etc.) and create waste that cannot be reused or recycled.
- Increasing drought raises the risk of wildfires, which could damage utility infrastructure.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.

ACTION W-06

Lower the density of development allowed in areas with the highest risk of wildfire.

Downzoning rural, unincorporated areas within the region's Wildland-Urban Interface (WUI), the zone where natural areas and development meet, would decrease the number of homes and businesses at risk of fire damage. Downzoning areas within city and town urban growth areas, however, may be in conflict with state Growth Management Act and local density goals.

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Wildfire & Extreme Heat

ACTION W-07

Extend and enforce the rural burn ban when wildfire risks are high.

This action would lower the risk of wildfires during periods of extreme heat and drought.

- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Increasing drought raises the risk of wildfires and elevated levels of PM10 (coarse particulate matter) from smoke.
- Increasing drought raises the risk of wildfires, which could destroy forests that serve as a net carbon sink.
- Increasing drought raises the risk of wildfires, which could contaminate water (turbidity and sedimentation).
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ACTION W-08

Modify local building codes, where necessary, to require fire sprinkler systems and enable emergency access/egress in all new residential and commercial construction.

This action would help mitigate the risks of wildfires spreading.

- Intensifying precipitation raises the risk of floods and landslides, which could damage private property and public infrastructure, endanger lives, and cut off access to goods and services (affects agriculture, buildings, roads, bridges, cultural sites, and other assets).
- Intensifying precipitation puts more strain on services (social, emergency, etc.).
- Population change increases strain on social and emergency services.
- Increasing drought raises the risk of wildfires, which could close roads and cut off access to vital goods and services.
- Increasing drought raises the risk of wildfires, which could result in personal injury or death.

ACTION W-09

Account for the inclusion of defensible spaces into future developments (e.g., designing roads, pathways, sidewalks, and landscaping to create firebreaks) in areas where there is high wildfire risk.

This action would reduce the risk of wildfires spreading to and damaging homes.

- Increasing drought raises the risk of wildfires, which could damage forests and other sensitive lands that provide wildlife habitat, economic resources (e.g., timber), and recreation opportunities.
- Increasing drought raises the risk of wildfires and elevated levels of PM10 (coarse particulate matter) from smoke.
- Increasing drought raises the risk of wildfires, which could destroy forests that serve as a net carbon sink.
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