

Chapter 6

Environmental Considerations

Consideration of the environmental impacts of the Regional Transportation Plan (RTP) expands well beyond the discussion in this chapter. Each project will undergo rigorous environmental analysis prior to building. This chapter highlights some of the central environmental issues raised during the RTP's development. It's helpful to consider our environmental impacts in three distinct layers: natural, built, and social.

The natural environment includes those aspects that come to mind upon hearing the word "environment" – air, water, earth, plants, animals, and energy resources. The built environment encompasses many of the physical aspects of human activity, such as noise, public health effects of toxic releases, land and shoreline use, historical and cultural preservation, transportation systems, and other public services and utilities. The social environment entails how we relate to one another through the natural and built environments. The RTP investigates issues of social justice in the location and building of facilities, as well as how changes in our society and the way we travel impact personal health.

The RTP's core concepts related to the natural, built, and social environment are consistent with those in Thurston Regional Planning Council's (TRPC) Sustainable Thurston Plan, *Creating Places – Preserving Spaces: A Sustainable Development Plan for the Thurston Region*. TRPC staff consulted with local policymakers, as well as integrated input from local residents, business owners, and other stakeholders, to craft the plan's regional sustainability vision for 2035. Many of the *Sustainable Thurston Plan's* goals, targets, and actions related to air quality, water quality, habitat, energy, land use, and transportation are consistent with the RTP's policies.

Natural Environment

This section summarizes the major natural environment issues addressed by the RTP, and how the RTP goals, policies, and recommendations accommodate those issues. Air quality, water quality, habitat, and energy use are the focus.

Population Growth versus Travel Growth

To meet air quality conformity requirements, TRPC must show a less than 6.3 percent annual per capita rate of growth in the vehicle miles traveled (VMT). How does growth in VMT compare to population growth? The tables below provide a comparison of growth in VMT and population in the region’s Maintenance Area (roughly the 1987 city limits of Lacey, Olympia, and Tumwater). The tables are based on regional forecast models for population growth and VMT.

Table 6-1: Air Quality Maintenance Area VMT and Population

	Maintenance Area Daily Average VMT	Maintenance Area Population
2010	2,244,800	86,900
2020	2,434,700	97,100
2030	2,767,200	110,200
2040	3,099,800	118,600

Annual Rate of Growth

	Maintenance Area VMT	Maintenance Area Population
2010-2020	0.82%	1.12%
2020-2030	1.29%	1.27%
2030-2040	1.14%	0.74%

Sources: Washington Department of Transportation Highway Performance Monitoring System (2010-2014); TRPC Population and Employment Forecast.

Air Quality

The RTP includes an assessment of air quality impacts attributed to vehicles, specifically an evaluation of PM10 – particulate matter less than 10 microns in size. Vehicle sources of particulates include tailpipe emissions, road dust, and tire and brake wear. These tiny airborne particles pose hazards to people with asthma and other respiratory problems, as well as the very young and very old. Significantly, wood burning also produces PM10.

In the 1980s, wood smoke caused a substantial PM10 air quality problem in the Lacey/Olympia/Tumwater area. The region’s clean air authority worked with homeowners to change from older wood burning stoves to more efficient models, and to control outdoor burning. As a result of these measures, the region experienced a steady decrease in PM10, falling below the national standard in 1990 and continuing well under the standard today. Other key pollutants, such as carbon monoxide, ozone, and PM2.5, continue to be at levels well below national standards.

While the region now enjoys good air quality, we continue to monitor the vehicle sources of PM10, modeling vehicle miles traveled and the potential generation of PM10 caused by that driving. This includes looking at the increase in drivers and vehicles from population growth, and how the projects listed in the RTP expand the transportation system’s capacity for more driving.

TRPC receives federal Congestion Mitigation and Air Quality (CMAQ) funds to award to projects that help reduce PM10 generated by on-road vehicles. Awards were made to traffic signal, transit, and trip reduction projects.

In the region's *Second Ten Year Limited Maintenance Plan for PM10*, regulators established that the vehicle miles we travel in the Lacey/Olympia/Tumwater area should not exceed a sustained annual growth rate over 6.3 percent to keep PM10 in check. The projected annual growth rate is well below that, nearer 1 percent.

The RTP sets forth several policies and features intended to support the reduction and control of air pollutants:

- The PM10 constraint. Modeling of projects in the RTP must show that the sustained annual growth rate in vehicle

miles traveled in the Lacey/Olympia/Tumwater area will not exceed 6.3 percent.

- The transportation demand management Goals and Policies in Chapter 3 promote mixed-use urban development to reduce the need for auto travel; improve access to public transportation, ridesharing, bicycling, and walking; encourage employers to help change commute patterns through telework, flex-time, and compressed work weeks; and promote park-and-ride lot use and development.
- The Thurston region actively promotes Commute Trip Reduction (CTR) – a transportation demand management strategy. In Thurston County, 190 worksites are affected by the state's CTR law or have voluntary programs. These are predominantly government worksites and a few private businesses or organizations. Statewide, between 2007 and 2012, CTR-affected employees reduced their annual greenhouse gas

Figure 6-1: Intercity Transit Hybrid Bus

Commute alternatives reduce the number of vehicle miles we travel each year, and thus the greenhouse gases we generate.



emissions by an estimated 72,000 metric tons. This is the amount of carbon in 310 railcars of coal or the amount of carbon sequestered annually by 59,000 acres of forest.

- The RTP emphasizes other Goals and Policies that materially contribute to the preservation and health of our environment and limit the impacts of air pollution. The RTP calls for consistency between land use and transportation, promoting development that supports bicycle, pedestrian, and transit travel.

The RTP envisions a multimodal transportation system, decreasing the need for drive-alone trips. It encourages the use of transportation technologies to improve the operation of the system, which often result in air quality improvements. The RTP also promotes appropriate levels of public transportation,

Figure 6-2: Permeable Sidewalk



This permeable sidewalk and swale, located on McPhee Road on Olympia's Westside, filters water run-off onsite.

and an increase in the share of all trips made by active transportation – like bicycling and walking.

The RTP supports minimizing transportation impacts on the natural environment and people in the Thurston region by:

- Creating mixed-use development.
- Promoting alternative fuels and technology developments that reduce motorized vehicle emissions.
- Encouraging active modes of transportation.
- Coordinating closely with the Olympic Region Clean Air Authority and the Washington State Department of Ecology in meeting federal Clean Air Act requirements.

Electric vehicle use is growing. Other alternative fuels for vehicles, like hydrogen, are being explored. Batteries are becoming longer-lived and more reliable for use in alternative fuel vehicles. These cleaner automobiles benefit local air quality, reducing auto-related particulate matter and greenhouse gasses.

In pursuing sustainability, however, we need to take into account other potentially related environmental impacts. Examples: Depending on how it is produced, electricity generation can be harmful to air quality (coal or diesel), or fish habitat (hydro power) near power plants. Batteries used in electric vehicles require special disposal, and their production can generate

hazardous waste. Electric and hydrogen power sources require new re-fueling systems for automobiles. Vehicles will continue to generate particulate matter related to brake and tire wear, and road dust.

Sustainability is about balance. That balance includes the more distant impacts of our choices. It also involves being responsive to rapidly changing technology, recognizing how benefits and consequences impact our region and our neighbors.

For a deeper dive into Climate Change see “Climate Change Impacts on Regional Transportation” on page 211.

Climate Change

Climate change is caused by air pollution from a group of greenhouse gases, including carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons. Gas- and diesel-powered engines from on-road vehicles are a substantial source of greenhouse gases.

The earth’s atmosphere acts as a greenhouse. The sun’s energy radiates into the atmosphere, where much of it is absorbed by “greenhouse” gases. The atmosphere then radiates most of this energy back to the earth’s surface, making the planet warmer than it would be absent those gases.

During the past century, the amount of greenhouse gases in the earth’s atmosphere increased substantially due to the burning of

Figure 6-3: Salmon in McLane Creek



Protecting wildlife and native plant species are important considerations in any construction project.

oil, coal, and other fossil fuels. According to scientific research, the added gases enhance the natural greenhouse effect and contribute to an increase in global average temperature and related climate changes.

On-road vehicles account for 43 percent of the greenhouse gas emissions in Thurston County. The same RTP policies that promote the reduction of PM10 also work to limit production of greenhouse gases from vehicles. Taking the bus, walking, or riding a bicycle, sharing the ride with a co-worker, using alternative fuels, and creating mixed use urban development – all aim to reduce the number of vehicle miles we travel each year, and the greenhouse gases we generate.

The RTP’s policies acknowledge that changing climate patterns will impact the region. Recommendations include developing a climate

action plan to address these impacts. RTP policies also call for reductions in per capita vehicle miles traveled to help limit production of greenhouse gases by gasoline- and diesel-powered vehicles.

Water Quality

Thurston County has a large number of surface water bodies. Glacial activity in the county's geologic past left the land dotted with lakes and ponds. Puget Sound's shoreline determines the northernmost boundary of the county. Budd, Henderson, and Eld Inlets are exclusive to the County. Totten Inlet divides Thurston and Mason Counties, and the Nisqually River separates Thurston from Pierce County.

In the county, four watersheds flow to the Pacific Ocean basin, and five watersheds flow into Puget Sound.

The RTP contains many policies that protect water quality:

- Limiting impervious surface area and avoiding, decreasing, and/or treating stormwater runoff.
- Minimizing road crossings through environmentally sensitive areas.
- During transportation planning, design, and construction, proactively address fish barrier removal, taking into consideration the habitat of fish-bearing streams and environmentally sensitive areas.

Thurston County and the cities of Lacey, Olympia, and Tumwater are updating their stormwater regulations to implement new state requirements, placing an emphasis on removing barriers to low impact development practices. Low impact development infiltrates rainwater into the ground near where it falls to mimic the natural hydrologic cycle. Such development may use green infrastructure such as bioswales, or vegetated channels, alongside streets to provide treatment and retention of stormwater runoff. Jurisdictions also continue to explore other techniques, such as permeable surfaces, to control stormwater from transportation infrastructure. These new facilities will have major implications on how streets are designed and maintained in the coming years.

Habitat

Protecting wildlife and native plant species are important considerations in any construction project. Federal, state, and local laws focus on endangered species, as well as wetlands, and other critical areas. Construction projects undergo environmental and land use review and permitting processes that specifically address these issues. Additionally, the RTP specifies policies regarding habitat:

- Discouraging road crossings through designated environmentally sensitive areas and habitat corridors.
- During transportation planning, design, and construction, proactively address fish barrier removal, taking into consideration the habitat of fish-bearing streams and environmentally sensitive areas.

Figure 6-4: Interstate 5 in Thurston County



I-5 runs through the center of Thurston County, from north to south. For many Thurston residents, I-5 is as much part of the local road system as it is an Interstate Highway.

In 2013, a Washington Federal Court ruled that by 2030, the state must significantly increase the effort to replace state-owned culverts that block habitat for salmon and steelhead. Culverts are typically large pipes that allow water to pass under roadways. They often block salmon and steelhead from reaching spawning grounds. The injunction does not apply to local governments, however Thurston jurisdictions are making strides in replacing culverts.

Endangered species also present unique challenges to the region. In 2014, four species found in Thurston County were added to the federal Endangered Species List:

- The Taylor checkerspot butterfly was once widespread throughout prairies in association with golden paintbrush, a

federally listed plant species. The butterfly is listed as an endangered species.

- The streaked horned lark is a small bird whose historic range once stretched from British Columbia to southern Oregon. It is listed as a threatened species.
- The Mazama pocket gopher is a native mammal found in prairie habitat. It is listed as a threatened species.
- The Oregon spotted frog lives in shallow waters among the wetlands in Canada, Washington, and Oregon. It is listed as a threatened species.

Local jurisdictions are working with federal and state partners to determine how the listing will affect future development. Once plans and procedures are in place, TRPC will update the land use forecast, and examine the implications to the transportation network.

Energy

Automobile transportation generally relies on combustion engines using gasoline and diesel. In our region, the market for biodiesel is growing. Biodiesel is a blended fuel made in part from clean-burning recycled vegetable oils. Additionally, some fleet cars use natural

gas, and many organizations have moved to hybrid gas-electric vehicles.

The RTP contains several policies that promote and support energy conservation, including language that specifically promotes the use of alternative fuels.

Transportation demand management goals and policies also support energy conservation.

Figure 6-5: Billy Frank Jr. Nisqually National Wildlife Refuge Barns



Promoting mixed-use urban development reduces the need for auto travel. Improving access to public transportation, ridesharing, bicycling, and walking decreases car trips. Encouraging employers to help change commute patterns through telework, flex-time, and compressed work week schedules, and promoting development and use of park-and-ride lots, also decrease the number or length of car trips. Statewide, the CTR program

participants save about 1.5 million gallons of gasoline a year – saving themselves about \$30 million a month.

Many of the goals and policies described in the air quality section also promote energy conservation. For example, consistency between land use and transportation, development of a multimodal transportation system, and support for active transportation and transit travel all promote situations where less fuel is used to make a trip. Transportation technologies can help us use the system more efficiently and reduce energy use.

Thurston County residents enjoy almost 50,000 acres of state and federal lands, including 2,900 acres of wildlife habitat at the Billy Frank Jr. Nisqually National Wildlife Refuge.

Built Environment

Man-made structures also form a component of our environment. Our homes, offices, shopping centers, roads, sidewalks, bicycle trails, water and sewer systems, fire stations, and community centers make up the environment we live in. How these relate to one another determines many of the choices we make in our daily lives. In particular for the RTP, how we use our land affects and is affected by transportation.

Land Use

Thurston County had approximately 264,000 residents in 2014 and 134,000 full- and part-time jobs. By 2040, we expect the population to increase to 394,000 with 200,000 jobs. We use these population and employment forecasts to predict where growth will occur in the region, based on the locally adopted land use plans that regulate where houses and businesses may be built. The RTP is developed using a transportation model that incorporates these land use forecasts. The Regional Projects recommended by the RTP support local land use plans, improving access to housing and jobs throughout the county.

The RTP policies encourage transportation-efficient mixed-use development, where appropriate, and transportation facilities that support the location of jobs, housing, industry, and other activities as called for in locally adopted land use plans.

Where we build transportation facilities and the types of transportation services we furnish can substantially affect the type of surrounding land use. Vice versa, where we build our homes and businesses can cause demand for additional roads and transportation services, sometimes where they are expensive and inefficient to deliver. This relationship between land use and transportation is important.

Rural roads in the south county, in particular, are forecasted to undergo significant changes in use, with large volumes of traffic headed north in the morning to work and returning south in the evening to home. This represents an important shift in how the regional transportation system performs, and indicates an underlying issue regarding land use in the urban and rural areas. Policy makers identified analysis of land use and transportation as a priority work item resulting from the RTP.

The transportation system plays other important roles beyond allowing us to travel to work and home. In Thurston County, residents have access to a number of public lands offering a variety of activities such as boating, fishing, bicycling, camping, hiking, and wildlife viewing. Thurston County residents enjoy almost 50,000 acres of state and federal lands, including 2,900 acres of wildlife habitat at the Billy Frank Jr. Nisqually National Wildlife Refuge, 842 acres at Millersylvania State Park, and approximately 40,000 acres in the Capital Forest. We also have several major trails,

numerous city and county parks, access to water sports on rivers, lakes, and Puget Sound, and hundreds of miles of bicycle lanes adjacent to local roadways.

The multimodal regional transportation system provides access to these recreational facilities. The RTP's goals and policies specifically address the many modes we use to access recreation. Facilities promoting active transportation, such as the Chehalis Western Trail, are supported by both transportation and recreation planning and funds. Like the roadways, trail connections to local paths, sidewalks, and streets are crucial. Many of our local jurisdictions have trail plans to improve recreational access.

Transportation

The number of trips we make and the average distances we travel are both projected to increase over the next 20 years. This creates additional demand for new transportation facilities and services, upkeep of the facilities and services we already have, and pressure to increase efficiency while improving safety throughout the system.

The RTP is based on a system of regional roadways that provide the main thoroughfares through our community, forming a significant element of our built environment. It assesses overall transit service and includes broad recommendations for changes in transit. The RTP also investigates parking policies available to jurisdictions that would support transportation demand management goals, but does not

make specific recommendations regarding the amount or location of parking.

Policies in the RTP aim to reduce and control the development impacts of and on transportation facilities. The RTP encourages facilities compatible with approved land use, multimodal, active transportation options that are barrier free, and facilities that are safer. It prioritizes the repair, maintenance, and preservation of existing infrastructure. It promotes increased use of transportation demand management to reduce peak period drive alone trips, transportation technology to improve the transportation system safety and efficiency; and public transportation, bicycling, and walking to increase system efficiency and options.

Land use drives the development of most regional transportation facilities. As a result, increased public services will usually be demanded, such as fire protection, police protection, schools, water, and sewer. Convenient and reliable access to these services depends on a well-functioning transportation system. How to supply and pay for these needs presents a challenge. The RTP recommends a more comprehensive look at growth patterns and the cost of providing these public services.

Noise

The transportation system can be a considerable source of noise. Local and state transportation agencies are working to address extreme transportation-related noise. For instance, the State uses sound walls and alternative types of paving materials on freeways to decrease transportation-related noise where it is severe. Many communities have regulations regarding the use of noisy truck brakes, or restrict trains on how they blow their whistles overnight.

Electric vehicles make far less noise than gasoline- and diesel-based vehicles. In this case, the lack of noise can be a problem. Pedestrians and bicyclists often use their hearing as part of determining if it's safe to cross a street. Electric vehicles can be quiet enough that they can't be heard until they are quite close.

Local and state agencies are expected to address potential noise impacts related to their transportation projects.

Historic and Cultural Preservation

Thurston County has a rich legacy of pre-historic and historical cultural resources extending back thousands of years to the earliest habitation of the Coastal Salish people. Beginning in the 1950s, historic preservation efforts began documenting the County's significant cultural resources. The Washington

State Department of Archaeology and Historic Preservation (DAHP) maintains a database of historic resources. This database provides a valuable resource in meeting requirements for protection of historic resources. In addition to considering 1,376 cultural resources currently identified in the database, jurisdictions must also consult tribal cultural resource staff regarding properties or sites that are unpublished or whose location and significance are a tribal matter, as well as DAHP's confidential record of known archaeological sites.

Potential transportation project-related impacts may include physical changes to historic transportation infrastructure, effects of road widening on historic settings or structures, effects on historic roadside elements, effects of air pollution on resources due to increased traffic, and disturbance or infringement on cultural landscapes. The nature of these impacts is highly site- and project-specific, and the information about historic and cultural resources is constantly evolving. It is important for each project to be evaluated in the specific context and timeframe in which it is designed.

Guiding Principles and Goals and Policies in the RTP support investments that contribute to a community's overall sense of place, including the preservation of historic and cultural resources. The RTP calls for road crossings to be minimized through designated sensitive areas, encourages a multimodal system that may lessen some transportation impacts on cultural

and archaeological resources, and promotes good coordination and communication among agencies, including cultural resources staff, in communities impacted by transportation projects.

State and federal regulations require careful and specific consideration of project impacts on cultural resources, and local jurisdictions have enacted their own policies for historic resources. The RTP works in concert with these regulations to address potential impacts on historic and cultural resources.

Social Environment

Location and access to transportation play key roles in how our society functions today. We became increasingly mobile during the twentieth century, fundamentally changing where most of us live and work. As a result, our social environment is shaped, impacted, and sometimes limited by our proximity to and use of the transportation systems available to us. Two areas to monitor in this social environment include environmental justice and personal health.

Environmental Justice

The federal Environmental Justice requirement directs that we identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of transportation programs, policies, and activities on minority and low-income

populations.

In the Thurston region, low-income and minority populations are generally more concentrated in the urban core areas of Lacey, Olympia, and Tumwater. However, the small rural communities of Bucoda, Yelm, and Rochester have pockets of poverty. Rates of poverty for members of the Nisqually Tribe and Confederated Tribes of the Chehalis Reservation are much higher than the county average. There is a fairly even distribution of minority populations across the region.

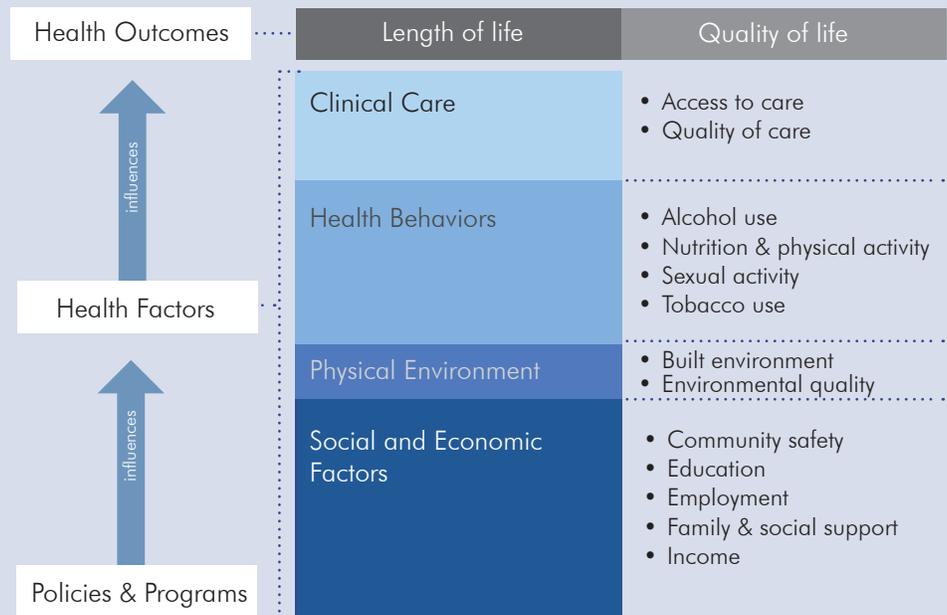
The region's policy makers strongly support transportation options serving all the system's users, especially those who face challenges due to language, income, age, or physical ability. The RTP's emphasis on a multimodal system, with appropriate levels of transit and safe bicycle and pedestrian facilities supplies choices for all residents – regardless of ethnicity or income. The benefits and impacts of the RTP's regional projects are spread equitably across the region. The continuing land use and transportation discussion will emphasize the economic impacts of decisions on where we live and how we travel.

Ongoing regional programs look beyond traditional fixed-route buses and coordinate the resources – vehicles and drivers – of non-profit, faith-based, and other social service providers to create an efficient network of transportation choices for residents of rural communities. The RTP also contains policies that focus on barrier-free transportation, and enhanced public involvement strategies that encourage

County Health Rankings Model

Transportation and land use patterns shape our health outcomes. Thurston County ranks 23th out of Washington’s 39 counties in terms of physical environment (2015). The County Health Rankings Model (see figure)

shows physical activity as an important part of healthy behaviors. Active transportation – like walking, bicycling, and riding the bus (which always involves walking) to get to work, school, and shopping – is a key source of physical activity, and one which has substantially declined



as we have become largely automobile dependent. Active transportation is also a key strategy to alleviate vehicle congestion. It’s a win-win – walking, bicycling, and bus riding improve our health, and improve traffic flow for longer trips we need to make by car.

innovative means to reach out to all residents.

Personal Health

Radical changes in where we live and the way we travel have impacted the personal health of most Americans. Over 60 percent of adults in Thurston County are overweight or obese. Physicians note a related increase in obesity-related diseases, including type 2 diabetes, heart disease, and stroke, the leading causes of death in Thurston County. While several factors

contribute to this epidemic, sedentary lifestyles are a prime contributor.

The marked increase in obesity in our society parallels a major shift in both diet and transportation over the last several decades. A number of factors – living farther from work and services, concerns about safety, more demands on our time, and increasing reliance on automobiles – have all contributed to a change in our transportation patterns. We have moved from more active transportation, using

foot or bicycle for all or part of our trips, to making most of our trips, even very short ones, by automobile. This has greatly impacted the amount of exercise performed by most adults and many children during a typical day.

Adolescent obesity quadrupled over the last 30 years. Programs like the International Walk to School Week each October and ongoing Walk N Roll programs hope to reverse the trend and reintegrate physical activity into our everyday lives.

The RTP includes a number of policies and projects to support greater reliance on walking and bicycling. Land use policies support mixed-

use development, making walking and bicycling trips convenient for shopping and running errands in city centers. Transportation demand management policies promote greater access to and flexibility for using alternatives to driving alone, such as transit, carpooling, bicycling, and walking. In addition, the RTP supports the development of regionally important, active transportation facilities which are also used for recreation. The RTP strongly promotes choice in transportation options, including driving, but also creating more convenient opportunities for walking, bicycling, and using transit.

Figure 6-6: Children Walking to School



The Walk N Roll program hopes to reverse the adolescent obesity trend and reintegrate physical activity into our everyday lives.

Climate Change Impacts on Regional Transportation

Our climate is changing, but how might such changes affect transportation in the Thurston region?

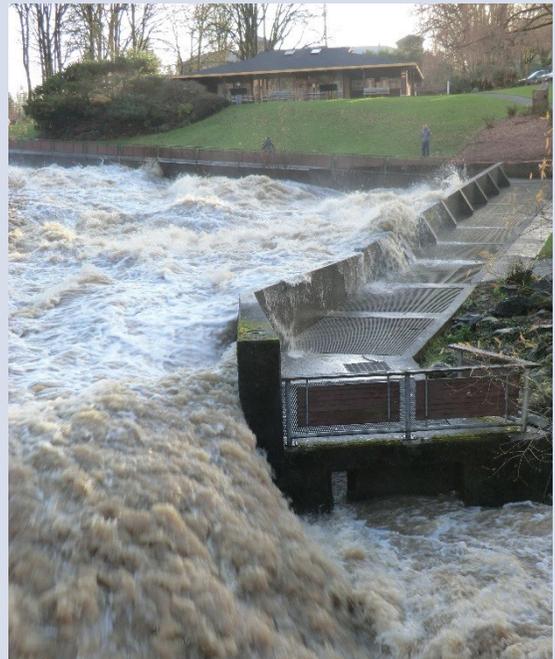
There's no crystal ball that shows what the future holds. So scientists run plausible greenhouse gas emissions scenarios through computer simulations of the global climate and then downscale such models. This produces regional projections for sea-level, temperature, precipitation, and other climate indicators that affect our human and natural systems. (Unless noted otherwise, the regional projections listed are from the University of Washington's Climate Impacts Group.)

Temperature:

Puget Sound's long-term climate changes are consistent with those observed globally, resulting from increasing levels of carbon dioxide and other heat-trapping gases. Our region experienced a warming trend during the 20th century, and all but six of the years from 1980 to 2014 were above the century average.¹ Changes we're seeing already include a longer frost-free season and more nights with warm temperatures. Additional warming is projected this century with the change in annual temperature projected to be at least double that experienced last century and possibly 10 times as large.

¹Mauger, G.S., J.H. Casola, H.A. Morgan, R.L. Strauch, B. Jones, B. Curry, T.M. Busch Isaksen, L. Whitely Binder, M.B. Krosby, A.K. Snover, 2015. *State of Knowledge: Climate Change in Puget Sound*. Report prepared for the Puget Sound Partnership and the National Oceanic and Atmospheric Administration. Climate Impacts Group, University of Washington, Seattle. doi: 10.7915/CIG93777D

Figure 6-7: Deschutes River, Thurston County



The Deschutes River surges over its banks at Tumwater Falls Park following a record-breaking rainstorm in December 2015. Puget Sound climate models project that future occurrences of heavy rainfall would be more frequent and intense, and exacerbate flood risks in many watersheds.

Precipitation:

There's no discernible long-term trend in regional precipitation over the past few decades. Looking ahead, our seasonal precipitation totals – and to a lesser extent, our annual precipitation totals – are projected to change. Generally, future Puget Sound summers are expected to be warmer and drier, with more extreme heat events; winters are likely to be warmer and wetter, with more intense heavy rain events.

Global models project that the heaviest 24-hour rain events west of the Cascade Range will intensify by 22 percent, on average, by the end of this century (2070-2099, relative to 1970-1999). Such “high-intensity” events would occur more frequently – about eight days per year by the 2080s, compared to two days per year historically.

Sea Level:

Sea level rose along many parts of the Puget Sound shoreline during the 20th century and is projected to rise 14 to 54 inches by 2100, relative to 2000. Sea levels could be higher or lower than this range, however, depending on the local rate of vertical land motion.

The City of Olympia is already taking steps to defend its low-lying downtown from flooding resulting from high precipitation runoff combined with a high tide that inundates the gravity-fed stormwater drainage system. A 2011 technical report prepared for the city identified areas at risk of flooding and projected depths corresponding to 10-, 50-, 100-, and 500-year return periods for increments of sea level rise up to 50 inches.² Based on the location, depth, and probability of flooding, the consultant report recommended strategies that include raising shoreline elevations, enhancing erosion protections, retrofitting stormwater outfalls, and installing flood barriers, tide gates and pump stations.

Transportation Impacts:

Consequences of coastal inundation, flooding, wildfires, and other hazards include increased safety risks, road closures, and infrastructure maintenance costs, according to a statewide climate risk assessment of transportation assets.³

²Coast & Harbor Engineering. (2011). *City of Olympia Engineered Response to Sea Level Rise*. Edmonds, WA: David P. Simpson.

³Washington State Department of Transportation. (2011). *Climate Impacts Vulnerability Assessment*. Olympia, WA: Maurer, M., C.L. Roalkvam, S. Salisbury, E. Goss, M. Gabel,

- **Airports:** Drier summers and extreme heat events could lead to more wildfires, and wind and dust storms that could close airports temporarily.
- **Rail Lines:** Extreme heat could increase the risk of fires on wooden trestle bridges and deform rail lines consisting of joined track.
- **Highways:** Climate change could exacerbate natural hazards — including flooding, landslides, dust storms, and fires — for state and federal highways (as well as local roads) that provide important transportation routes through Thurston County and surrounding areas.
- **Ferries:** There are more than a dozen ferry terminals along the Puget Sound shoreline, but none in Thurston County. Such terminals are generally resistant to rising sea levels. However, more extreme storm events, accompanied by larger waves, sediment, and debris, could pose safety and operational challenges.

Climate Action:

Our future is not yet written, fortunately, and we have time to mitigate and adapt. As a region, we're already taking steps to reduce our transportation-related emissions and prepare for a changing climate.

Thurston County's direct greenhouse gas emissions totaled roughly 2.71 million metric tons of carbon dioxide equivalent in 2012, according to analysis by the non-profit Thurston Climate Action Team. The emissions figure was up about 30 percent from 1990 — a widely used benchmark year for measuring and managing emissions — while population grew by about 59 percent over the same period. On-road vehicles accounted for about 43 percent of county emissions in 2012.

TRPC is using a National Estuarine Program (NEP) grant administered by the Washington Department of Commerce to draft a watershed-based climate adaptation plan. The project will wrap up in late 2017 with a menu of actions Thurston region stakeholders could take to prepare for or adjust to climate change.

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