

Chapter 18 Human Health

1 In what ways do changes in our environment affect human health?

Changes to the natural and built environment affect human health in many ways. The following topics and their effects on human health are described briefly in this chapter and in more detail elsewhere in this FEIS:

- Proximity and degree of risk of exposure to hazardous materials in Chapter 13: Environmental Health
- Noise, including potential noise increases from transportation, industry, and other sources in the urban environment, in Chapter 7: Noise
- Air quality in Chapter 6: Air Quality and Climate Change
- Water quality in Chapter 9: Water Quality and Hydrology
- Availability and access to recreation, parks, and green spaces in Chapter 15: Parks and Recreation
- Safety, including personal safety and accessibility-related safety (automobile, transit use, biking, and walking) in Chapter 4: Transportation
- Sidewalks, bikeways, and pedestrian-friendly development and their contribution to physical activity and the general well-being of the population in the emergency medical services, social connections, and mental well-being section of the Policy Analysis and Evaluation Criteria Report

Policy Analysis and Criteria Evaluation Report

Please refer to Appendix D for more information about emergency medical services, social connections, and mental well-being.

Which elements of Washington Administrative Code (WAC) 197-11- 444 are addressed in this chapter?

This chapter is not required by the State Environmental Policy Act (SEPA) and does not specifically address any elements of the environment listed in WAC 197-11-444. This chapter is included to provide information on an important topic of interest and to respond to requests made during the public scoping process.

2 How could exposure to hazardous materials affect human health?

For a risk to exist to human health and the environment, two components must be present:

- Toxicity or hazard, which creates the potential for a substance to cause an adverse health impact (e.g., cancer)
- Exposure, which creates the potential for humans or environmental receptors to come into contact with the hazardous materials

Construction and operation of the types of projects contained in the Transportation 2040 alternatives could result in human exposure to hazardous materials, as described below.

Long-term Effects

The development of new or improved transportation facilities could require property acquisition for rights of way. During project-level planning and design, most project owners research the potential for encountering contaminated materials as part of their project. This allows them to better understand the financial risks and potential environmental cleanup or management actions that may need to be taken. These issues can affect a project's cost or an existing property owner's costs, particularly for a major release that had not previously been identified. However, the environmental consequences are considered positive overall because contaminated sites would be managed to minimize exposure to people or the environment consistent with applicable regulations.

Operation and maintenance of the region's transportation system would involve materials that can affect environmental health and human health. Oil-based lubricants, vehicle batteries, parts-cleaning fluids, paints, solvents, and fuels are among the products typically used in the maintenance and operation of transportation vehicles. All vehicles are subject to fluid leaks. Because the region's transportation system includes aviation, surface, and marine transportation, releases to the

Environmental Health

For more information on environmental health and its effect on human health, refer to Chapter 13: Environmental Health.

How is a property researched?

The American Society of Testing and Materials establishes standards for identifying the presence or likely presence of hazardous materials in connection with a specific property.

For further information, go to www.astm.org/Standards/E1527.htm.

environment could affect a range of environmental media, including soils, groundwater, surface water, air, and sediments.

Construction Effects

For all construction projects identified in the alternatives, persons involved in construction excavating, trenching, or moving soil may be affected by hazardous waste release sites. People living or working near such sites may also be exposed through skin contact, ingestion, or inhalation of soil particles, dust, or vapors. If safe work practices are followed in site preparation and development, the impact risk would be low.

Construction activity that may cross or include railroad tracks, railroad yards, and other industrial and commercial sites could encounter sites contaminated with fuels, oils, and materials that have leaked from railroad cars. Contaminants are likely to have entered the soil and groundwater because rail beds are typically built with gravel, which promotes rapid vertical drainage.

Hazardous materials can travel in groundwater hundreds of feet from where they originated, thereby contaminating groundwater beneath properties purchased for rights of way. Similarly, groundwater pumped out during excavation or construction may be contaminated and require special treatment or disposal.

3 How could exposure to noise affect human health?

At high intensities, environmental noise directly affects human health by contributing to or causing hearing loss. Although the science is currently inconclusive, noise is also suspected of causing and aggravating other health problems. Environmental noise affects general human welfare by interfering with thought, sleep, and conversation. According to the U.S. Environmental Protection Agency (EPA), environmental sound levels below 55 dBA should protect human health and welfare with a margin of safety for areas with outdoor uses. However, this level is not a standard. Rather, it identifies a safe level of noise exposure without consideration of other factors, such as cost of mitigation (EPA, 1974). Environmental sound levels in

Noise

For more information on noise and its effect on human health, refer to Chapter 7: Noise.

What does the abbreviation dBA stand for?

The human ear can best perceive frequencies or pitches between 1,000 and 5,000 Hertz (Hz). Environmental sounds consist of many frequencies. Frequency weighting combines all of the frequencies into one sound level that simulates how an average person hears sounds. The commonly used frequency weighting for environmental sounds is A-weighted decibels (dBA).

most urban environments are greater than 55 dBA (refer to the sidebar).

All Transportation 2040 alternatives contain facilities that would generate noise. The following sections provide a sampling of possible effects.

Long-term Effects

Projects in the Transportation 2040 alternatives would likely affect traffic patterns in the Puget Sound region. For example, widening a highway would likely increase traffic and associated noise levels on the highway and on nearby feeder roads. The effect of transportation-generated noise depends on the proximity of noise-sensitive land uses to the noise source.

Construction Effects

Noise during construction could be bothersome to nearby residents and businesses. Construction workers also would be subject to construction noise while working on the site. Construction noise would vary widely both in its range and hours over the course of implementation of the program. Individual projects would generate disturbances in their general vicinity during construction. Specific impacts would be determined during future project-level planning and environmental review.

The most prevalent noise source at most construction sites would be internal combustion engines. Earth-moving equipment, material-handling equipment, and stationary equipment are all engine-powered. Because trucks would be present during most phases and would not be confined to the project site, noise from trucks could affect more receptors. Other noise sources could include impact equipment and tools such as pile drivers. Impact tools could be pneumatic, hydraulic, or electric.

Construction noise associated with any project element would be intermittent, occurring at different times during the construction and at various locations in the project area. Construction noise levels would depend on the type, amount,

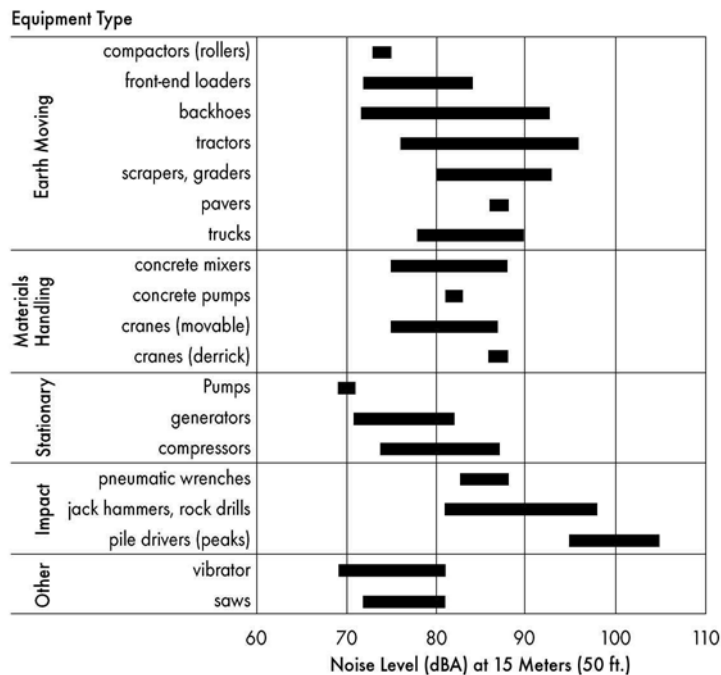


Construction noise can adversely affect human health.

Source: Wikipedia, 2005

and location of construction activities. The maximum noise levels of construction equipment for individual projects would be similar to the typical maximum construction equipment noise levels presented in Exhibit 18-1.

Exhibit 18-1
Typical Construction Equipment Noise Levels



Sources: EPA, 1971; WSDOT, 1991

The construction activities that would result in the highest levels of ground vibration are demolition, tunneling, and impact pile driving. The use of jackhammers and hoe rams would result in the highest levels of vibration during demolition activities. Analysis of construction vibration impacts would be determined in conjunction with future project-level environmental review for those projects where vibration damage would be likely.

4 How could air quality affect human health?

Particulate matter

Particulate matter is the term for small particles of dust, soot, and organic matter suspended in the atmosphere. Health effects

Air Quality

For more information on air quality and its effect on human health, refer to Chapter 6: Air Quality and Climate Change.

of particulate matter include respiratory illness such as aggravated asthma, chronic bronchitis, and decreased lung function. Fine particulates can pose more serious health risks because they are easily inhaled and have the ability to penetrate deeper into lung tissue. As with many pollutants, sensitive populations such as children and the elderly are more susceptible to these health risks. Particulate emissions from diesel exhaust are of particular concern due to their toxicity. EPA has concluded that diesel exhaust is a probable human carcinogen, and diesel particulate matter is the most likely portion of the exhaust to pose a risk (EPA, 2002).

Carbon Monoxide

Carbon monoxide reduces the blood's oxygen-carrying capability. Acute health effects include headaches, slowed reflexes, weakened judgment, and impaired perception. Chronic effects include aggravation of pre-existing cardiovascular disease and increased heart disease risk in healthy individuals. At very high levels, carbon monoxide is poisonous and can be fatal.

What is carbon monoxide?

Carbon monoxide (CO) is a colorless, odorless, poisonous gas produced when carbon-containing fuel is not burned completely.

Ozone

Ozone (O₃) is a molecule consisting of three oxygen atoms. Ozone is an eye and respiratory tract irritant and increases the risk of respiratory and heart diseases. Ozone can cause breathing difficulty for susceptible populations (e.g., asthmatics and the elderly), and may lead to impaired lung function and premature death.

Hazardous Air Pollutants/Air Toxics

Hazardous air pollutants, also referred to as air toxics, are chemicals emitted into the atmosphere that cause or are suspected to cause cancer or other severe health effects, such as birth defects or reproductive problems. These health effects include respiratory illness such as asthma and reduced lung function, damage to the immune system, neurological problems, and reproductive problems such as reduced fertility. Once deposited into the soil and waterways, air toxics can build up in the food chain, resulting in human consumption of

contaminated plants, fish, and other animals. Examples of air toxics include benzene, perchlorethylene, methylene chloride, formaldehyde, and asbestos, as well as diesel particulate matter and wood smoke.

Greenhouse Gases and Climate Change

Some greenhouse gases occur naturally in the atmosphere, trapping solar energy and warming the earth's surface. These gases include carbon dioxide (CO₂), nitrous oxide, and methane. However, more greenhouse gases are being added into the atmosphere, causing more heat to be trapped and the earth's surface to warm even further, which may affect human health. For example, deserts may expand into existing rangelands, and features of some national parks may be permanently altered. The Puget Sound region may experience warmer summers and longer, wetter winters. Such effects could reduce forests in the Cascade Mountains and reduce snow packs. Reduced snow packs could change water availability in the region, which in turn would require a change in the way current water demands are managed. Climate change is also likely to result in more winter floods and potentially increase heat-related pollution such as ozone (Climate Impacts Group, 2007).

5 How could water quality affect human health?

Clean water is critical for basic needs of human life, including safe drinking water and safe consumption of food grown in aquatic environments. The Puget Sound Partnership, in their review of water quality issues in the region, concluded that the primary transporter of pollution throughout the Puget Sound basin is surface water runoff. Past and current development and the resulting land use changes in the central Puget Sound region have resulted in degraded water quality and impairment to many water bodies.

Major categories of pollutants affecting the region's water quality include toxics, pathogens, and nutrients. In addition, other types of impairment, including high temperatures, low

What are greenhouse gases?

Climate-changing greenhouse gases come in several forms. These gases include carbon dioxide (CO₂), nitrous oxide, and methane. CO₂ makes up the bulk of the emissions from the transportation sector. Any process that burns fossil fuel releases CO₂ into the air. Vehicles are a significant source of greenhouse gas emissions and contribute to global warming primarily through the burning of gasoline and diesel fuels.

Water Quality

For more information on water quality and its effect on human health, please refer to Chapter 9: Water Quality and Hydrology.

levels of dissolved oxygen, suspended solids, and changes in acidity, are affecting water quality in the region.

Toxics include metals, oil and petroleum products, phthalates, pesticides, polychlorinated biphenyls (PCBs), endocrine disruptors, pharmaceuticals, and polybrominated diphenyl ether (PBDE) flame retardants. Air deposition of toxics from vehicles onto the water is potentially a major contributor to water pollution (PSCAA and Public Health, 2008). These pollutants can have acute or chronic toxicity for people. Also, the effects of contact or ingestion of contaminated water are much greater in vulnerable populations such as children, the elderly, and those with compromised immune systems (Frumkin and Gaffield, 2004).

Many of these substances can increase in concentration as they move up the food web. As a consequence, fish, such as salmon, which feed on invertebrates and other fish, often have very high concentrations of these substances in their tissues and can be a health risk for people consuming them. Human consumption of these fish can lead to chronic health problems, and children are at the greatest risk for developmental effects from such exposure. Tribes in the region and some immigrant populations are particularly at risk because they tend to consume more bottom fish than the general population. They may also experience serious health, social, and economic consequences if traditional marine food sources become scarce or unavailable because of contamination (PSCAA and Public Health, 2008).

6 How could access to parks and recreational areas affect human health?

Green spaces are essential to the health of communities as they connect residents with the natural world. Exposure to natural environments enhances the ability to cope with and recover from stress, and observing nature can restore concentration and improve productivity. The increase of landscaped and green public spaces can also lead to improved mental well-being and increased physical activity. Having nature nearby or just

Parks and Recreation

For more information on access to parks and recreation and its effect on human health, please refer to Chapter 15: Parks and Recreation.

knowing it exists is important to people regardless of whether they are regular users (Maller et al., 2005).

Studies also indicate that landscaping in urban living areas is positively correlated with greater use and more vital interactions in the space (Sullivan et al., 2004). Green spaces become centers that bring a diverse group of individuals of different ages, socioeconomic levels, and cultures together to enjoy an escape from everyday stresses. Research shows that residents of neighborhoods with access to greenery in common spaces are more likely to enjoy stronger social ties than those who live surrounded by barren concrete (Gies, 2007).

7 How could transportation safety affect human health?

Death and injuries on the transportation system represent a fundamental link between human health and transportation. Death and injuries also represent billions of dollars of losses to the regional economy and untold pain and suffering. According to data compiled in *Crashes vs. Congestion – What’s the Cost to Society?*, in the Seattle-Tacoma-Everett Metropolitan area, the cost of crashes is \$3.4 billion while the cost of congestion is \$1.4 billion (2005 dollars) (Cambridge Systematics, Inc., 2008). Driver behavior is the largest contributor to crashes.

Safety is emphasized in all of the alternatives included in the Transportation 2040 FEIS. For example, all alternatives include roadway crossing safety measures for bicycles and pedestrians, especially in areas of high bicycle/pedestrian activity near transit stations.

Coordination among Agencies

Successful safety programs at the metropolitan planning level require collaboration with many different partners including law enforcement agencies, local and state jurisdictions, transit agencies, emergency service responders, and advocacy organizations. While the Puget Sound region is making progress towards meeting traffic safety goals, efforts could potentially be even more effective if there were greater coordination among these organizations.

Transportation Safety

For more information on transportation safety and its effect on human health, please refer to Chapter 4: Transportation.

Transportation 2040 must be consistent with the goals and objectives of Target Zero—Washington state’s strategic highway safety plan—and must address safety issues unique to the region. Target Zero promotes safer roadways, safer walkways/pathways for pedestrians and bicyclists, improved response systems, and passenger and driver behavior improvements. The plan focuses on five key areas:

- Driver behavior
- Other users (pedestrians, bicyclists, motorcyclists, and freight)
- Roadway improvements
- Emergency medical services
- Traffic information systems

The highest-priority objectives and strategies include the following:

- Impaired driving
- Speed-related collisions
- Occupant protection
- Run-off-road collisions
- Intersection collisions
- Traffic data systems

PSRC will report annually on safety trends for all modes of travel to monitor regional progress toward meeting the goal of Target Zero.

8 How could the relationship between transportation and physical activity affect human health?

The link between transportation and health is an emerging national issue. Physical inactivity has become a growing health problem in the United States, contributing to obesity, chronic disease, osteoporosis, depression, and premature death. The Centers for Disease Control and Prevention cites direct medical

Human health and physical activity

For more information about human health and physical activity, please refer to the emergency medical services, social connections, and mental well-being section of the Policy Analysis and Evaluation Criteria Report (Appendix D).

expenses associated with physical inactivity totaling more than \$76 billion in 2000 (CDC, 2008). The number of children walking or biking to school has dropped from nearly half in 1960 to about 15 percent today (PSRC, 2006), while childhood obesity has more than doubled in three decades (CDC, 2008). A sedentary lifestyle increases the risk of cardiovascular disease three- to five-fold and overall mortality two- to three-fold. It also contributes to the risk of some types of cancer.

Public health professionals at the local, state, and national level are evaluating ways for the built environment to help people incorporate physical activity into their daily routine. A growing body of research has begun to document correlations between dispersed development patterns and health. The central Puget Sound area is one of the first urban regions in the United States where detailed research examining the linkage between health and the built environment has been conducted. Through a grant from the Federal Transit Administration, King County, along with the Cities of Kent and Redmond and other partners, including PSRC, engaged in a 2-year study of the relationship of land use, transportation, air quality, and health. The summary of this study states that low-density separated land uses and disconnected street networks are associated with the following conditions:

- Increased automobile use, per capita air pollution, greenhouse gas emissions, and energy consumption
- Reduced transit ridership, walking, and physical activity
- Increased obesity and likelihood of cardiovascular disease, type II diabetes, and colorectal cancer (King County, 2005)

In 1996 the U.S. Surgeon General issued a report titled *Physical Activity and Health*. The report states significant health benefits can be obtained through moderate activity, citing walking and bicycling as two types of physical activity that are the easiest to adopt and adhere to over the long term. Yet, a variety of barriers inhibit walking and bicycling; some are subjective (time and lack of motivation) while others



Walking to school could help children incorporate physical activity into their daily routine.

Source: www.saferoutesinfo.org

include safety issues and the lack of or poorly maintained biking and walking facilities (CDC, 1999).

Federal and State laws

Among the federal transportation requirements are planning factors to protect and enhance the environment, promote energy conservation and improve the quality of life, and improve transportation system safety for motorized and nonmotorized users. In 2000, the Federal Highway Administration adopted policy and guidance that calls for incorporating bicycling and walking facilities into all transportation projects unless exceptional circumstances exist. In Washington state, regional transportation planning guidelines and principles call for “development patterns that promote pedestrian and nonmotorized transportation.”

Design Guidelines

The VISION 2040 transportation policies, with which any final Transportation 2040 plan must comply, provide specific direction for development of an integrated bicycle and pedestrian network. The regional system is based on the concept of shifting shorter vehicle trips to biking and walking trips, and facilitating access to transit for longer trips. The regional network consists of facilities that create connections to and improve circulation within centers, and link bicyclists and pedestrians to regional transit services. To support the development of walkable, transit-oriented centers, VISION 2040 also establishes 10 physical design guidelines. These guidelines advance many of the concepts advocated for creating healthier, more active communities.

Current Programs

A number of practices support improved health and physical activity. With a focus on pedestrian and bicycle safety and providing children a safe, healthy alternative to riding the bus or being driven to school, Washington State Department of Transportation (WSDOT) “Pedestrian and Bicycle Safety” and “Safe Routes to School” grant programs fund engineering improvements, safety education curriculums, enforcement

What are the VISION 2040 physical design guidelines for transit-oriented centers?

1. Encourage a mix of complementary land uses, particularly uses that generate pedestrian activity and transit ridership.
 2. Encourage compact growth by addressing planned density.
 3. Link neighborhoods, and connect streets, sidewalks, and trails.
 4. Integrate activity areas with surrounding neighborhoods.
 5. Locate public and semi-public uses near high-capacity transit stations in designated urban centers and activity centers.
 6. Design networks for pedestrians and bicyclists.
 7. Provide usable open spaces for the public.
 8. Manage the supply of parking.
 9. Promote the benefits of on-street parking.
 10. Reduce and mitigate the effects of parking.
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programs, and community health and encouragement initiatives.

Approved in 2003, PSRC has a bicycle and pedestrian implementation strategy that was developed to advance regional plan objectives and support local planning efforts. The strategy offers guidance for how to implement any regional bicycle and pedestrian system that would be included in the new Transportation 2040 plan.

Under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), 10 percent of the Surface Transportation Program funds allocated to the state of Washington are in the form of a set-aside for the Statewide Transportation Enhancements Program that funds pedestrian and bicycle facilities. It is also the approved policy of the region to make at least 10 percent of the combined estimated Surface Transportation Program and Congestion Mitigation and Air Quality Program funds available for programming of bicycle and pedestrian projects in the four counties.

The 2005 legislative session addressed this health and active living issue by passing a Growth Management Act amendment (Revised Code of Washington [RCW] 36.70A.070). This amendment mandates that all local jurisdictions planning under this Act incorporate a pedestrian and bicycle element into local transportation plans and consider urban planning approaches to promote physical activity in local land use plans.

9 Which Transportation 2040 alternatives would have the greatest effect on human health?

As mentioned in the response to Question 1, human health is an amalgam of several topics covered elsewhere in this FEIS. Refer to those chapters for a comparison of long-term and cumulative effects among alternatives, and discussion of potential mitigation measures.

How would the Transportation 2040 alternatives affect walking and bicycling?

Refer to Chapter 4: Transportation for a discussion of the change in the number of walking and bicycling trips projected for each alternative.



Federal and local legislation supports planning and funding bicycle facilities.

Source: WSDOT, 2009