
CHAPTER 4

AFFECTED ENVIRONMENT

INTRODUCTION

This chapter provides an overview of the region's environmental resources likely to be affected by implementation of the RWSP. It first addresses the four elements of the environment most directly affected (water resources, biological resources, land and shoreline use, and environmental health), and then provides a briefer discussion of other elements of the environment.

WATER RESOURCES

Fresh Waters

The King County wastewater service area includes two major drainage basins: the Cedar River-Lake Washington basin and the Green River basin. The Cedar River-Lake Washington basin includes Swamp and North Creeks (both originating in Snohomish County) and the Sammamish River, the Cedar River, and numerous small drainages flowing directly into Lake Washington. The Green River basin occupies much of the southern and southwestern portions of King County. In addition, there are many small drainages located along the saltwater margins of Puget Sound in the westernmost portions of Snohomish and King counties.

The State of Washington classifies surface waters of the state based on existing water quality and beneficial uses of the individual water bodies (Chapter 173-201A WAC). All rivers and streams in the King County wastewater service area are classified either AA (extraordinary quality) or A (excellent quality), with the exception of the Duwamish River from the confluence of the Green and Black rivers to Elliott Bay, which is classified B (good quality). In general, the lower portions of rivers and streams in the western, more heavily developed half of both counties are Class A waters, while the upper portions of major rivers and the tributaries of these upper portions are classified AA. Water quality criteria applicable to Class AA, A, and B surface waters are shown in Appendix F.

Approximately nine lakes with a surface area of 20 acres or more exist within the King County wastewater service area, or in areas potentially affected by proposed wastewater treatment or conveyance facilities. The two largest lakes, Lake Washington and Lake Sammamish, are located in the Cedar River-Lake Washington basin. The State of Washington classifies all lakes as Lake Class in Chapter 173-201A WAC. Water quality criteria applicable to lakes are also shown in Appendix F.

Metro conducted an ongoing freshwater assessment program of streams and lakes in the Seattle-King County metropolitan area between 1979 and 1993. The program focused on the Cedar River-Lake Washington and Green River basins. The most recent reports from

that assessment (Metro, 1990, 1991; KCDMS 1994a) provide a current characterization of freshwater quality in those two basins. Overall, the assessment characterizes the quality of streams and rivers in the two basins as fairly good, although water quality in several sub-basins is characterized as fair to poor.

Marine Waters

Puget Sound is an estuary connected to the Pacific Ocean by the Strait of Juan de Fuca. The sound consists of several deep basins separated by shallow sills. The maximum water depth is 930 feet (in the central basin) with an average depth of 346 feet (KCDMS, 1994b). The depth of the shallow sills is approximately 150 feet (Metro, 1985). Circulation in the sound is driven by freshwater inputs, gravitational convection, tides, and wind. In general, seaward-flowing water of lower salinity and density remains on the surface, and landward-flowing ocean water with higher salinity and density occurs at depth. The relatively shallow underwater sills assist the tidal action in providing good vertical mixing throughout the water column. Puget Sound contains 26.5 cubic nautical miles of water, with a 12- to 14-foot tidal exchange in which 1.27 cubic nautical miles of water (on average) move in and out with each tidal cycle (KCDMS, 1994b).

The depth of Puget Sound and the extent of mixing and tidal exchange contribute to the good water quality found in offshore water samples. Near-shore waters and sediments, however, collect contaminants from a variety of sources including industrial and municipal discharges, rivers and streams, atmospheric deposition, and urban runoff. Generally, contaminants enter the sound either in a dissolved state or bound to particles. Some contaminants are concentrated in the surface layer; some remain in solution and are dispersed and diluted throughout the sound; some settle out into nearshore sediments; and some are transported far out into the sound before settling. The physical, chemical, biological, and hydraulic processes that affect the movement of pollutants within marine waters include solubility, sorption capacity, flocculation, resuspension and redissolution from sediments, bioaccumulation, biotransformation, current speed and direction, and mixing (Puget Sound Water Quality Authority, 1988b).

Embayments and deep areas of the sound are subject to lower current velocities and, therefore, act as depositional areas (i.e., sinks) in which particles tend to accumulate. Bottom sediment materials are generally silty and fine-grained. Narrower channels have strong currents and, consequently, are generally nondepositional areas with sand or gravel bottoms (Metro, 1985).

Most of Puget Sound is classified as Class AA (extraordinary quality) marine water by Ecology (Chapter 173-201A WAC). Certain embayments, such as inner Elliott Bay east of Pier 91 and Duwamish Head, are rated Class A (excellent quality). The water-quality standards set limits for fecal coliform bacteria, dissolved oxygen, temperature, pH, turbidity, radioactive substances, and a number of metals and organic compounds. Class AA and Class A waters differ in the specified temperature, pH, and dissolved oxygen levels to be maintained.

Another parameter used to gauge marine water quality is the frequency of depletion of dissolved inorganic nitrogen. Areas exhibiting periods of depletion of dissolved inorganic nitrogen are likely to be susceptible to phytoplankton blooms if influent nutrient loadings

increase. Phytoplankton blooms are associated with oxygen depletion, possibly leading to fish kills and the occurrence of paralytic shellfish poisoning. A study conducted by the U.S. EPA ranks various areas of Puget Sound according to the frequency of dissolved inorganic nitrogen depletion and low dissolved oxygen concentrations (Rensel and PTI, 1991). Elliott Bay, the main channel of central Puget Sound, and the East Passage are identified as areas not likely to be sensitive (in the near future) to nutrient inputs from human sources.

Offshore sediments within the King County wastewater service area have recently met regulatory threshold toxicity limits for organic pollutants and metals. The only marine sediments within the King County wastewater service area that exceed these levels are located near present and historical industrial sources, storm drains, combined sewer overflows (CSOs), and municipal outfalls on Harbor Island and the Seattle waterfront (KCDMS, 1994b).

Appendix F includes a table indicating state marine sediment quality standards (Table F-3).

Groundwater

The most recent comprehensive surveys of groundwater in King County occurred in the 1960s (Liesch, et al., 1963; Luzier, 1969). Snohomish County groundwater was more recently surveyed (EES, 1991). At the time of the King County surveys, groundwater accounted for nearly one-third of total water use in the county (King County, 1987a). Groundwater use continues to be significant because several cities (Auburn, Issaquah, Kent, Redmond, and Renton, as well as the Seattle system's Highline wellfield) and most of the rural areas in the county obtain water from subsurface supplies. In accordance with the Growth Management Act, King County is developing policies and regulations to protect critical groundwater recharge areas and groundwater supplies, including the identification of groundwater management areas.

Major supplies of groundwater in the area are typically found in deposits of porous sediments. These deposits are most commonly sands and gravels associated with glacial outwash deposits including stream-laid deposits in major valleys (King County, 1987b; EES, 1991). Surface recharge of groundwater is most significant in areas of porous soils, particularly large river and stream valley floors underlain by porous alluvial deposits. In addition, although most of the upland drift plains in the King County wastewater service area are underlain by relatively impermeable till, significant portions of the upland areas are underlain by more porous soils (e.g., Everett soils formed in outwash sands and gravels) that are significant recharge areas.

Although no major overdrafts (unacceptable reductions in groundwater quantity) or human-caused occurrences of groundwater pollution have been identified in the King County wastewater service area, groundwater quality data are limited. However, recent studies in Snohomish County have identified localized problems, including elevated levels of nitrate, naturally elevated levels of arsenic, and sea water intrusion (EES, 1991).

BIOLOGICAL RESOURCES

This section provides a discussion of vegetation, important wetlands, wildlife species and habitat, and fish species and habitat present in the service area. State and federally listed sensitive species that have been documented in the service area are also discussed.

Vegetation and Wetlands

The King County wastewater service area includes fully developed urbanized areas (e.g., Seattle and the lower Duwamish Valley; less densely developed urban / suburban areas north, east, and south of Seattle (e.g., Bothell, Redmond, Kirkland, Bellevue, Renton, Kent, and Auburn); and suburban/rural areas (e.g., East Sammamish Plateau, and Maple Valley). Vegetative habitats in these areas are a function of the level of development and the nature of land use patterns. In more urbanized areas, native vegetation tends to be concentrated in areas difficult to develop, such as steep slopes and floodplains, or areas that have been set aside as parks or open space. In rural areas, native vegetation dominates the area, but is interspersed with agricultural and suburban residential land uses.

Wetland vegetation is usually present in areas where suitable soil and hydrologic conditions exist. Although not as widespread as they once were, important wetland systems still exist. The larger wetland areas are often associated with streams or are located where streams discharge to larger water bodies. Important wetland areas occur in the Duwamish/Green River Valley; Mercer Slough; Union Bay; Juanita Bay; the mouth of the Sammamish River in Lake Washington; the Sammamish River Valley and tributary streams of Swamp Creek, North Creek, and Bear Creek; the Snoqualmie River Valley; and Maple Valley. Common wetland species include red alder, black cottonwood, western red cedar, cascara, salmonberry, hardhack, devil's club, cattail, skunk cabbage, and various species of sedge and rush. Nonnative invasive species include reed canary grass, purple loosestrife, and Eurasian milfoil.

In their natural state, wetlands offer substantial biological, hydrological, cultural, and economic values. Wetlands provide food and cover for a variety of fish and wildlife including several threatened and endangered species. They also provide storage for stormwater runoff, releasing it gradually, which helps to maintain summer stream flows, replenish groundwater, and protect property from flood damage. Wetlands also improve water quality by trapping and filtering nutrients, sediments, and pollutants contained in runoff.

Wildlife

The type and condition of wildlife habitat vary widely throughout the RWSP service area, which includes heavily developed industrial/commercial areas, less developed suburban and rural environments, agricultural lands, and coniferous or deciduous forest. Species tolerant of urban environments are present, as well as species associated with relatively undisturbed habitats.

Heavily developed areas are generally of low habitat value to wildlife, containing little vegetation and subjecting wildlife to noise and disturbance from traffic and other human activity. However, several species have become tolerant of these conditions. Wildlife

species common in such developed areas include house finch, house sparrow, common crow, European starling, American robin, mallard, Canada goose, opossum, raccoon, eastern gray squirrel, northwestern garter snake, and Norway rat. Within heavily developed areas, the most valuable wildlife habitat includes those areas which have not been developed or which have been dedicated to recreation and open space uses. Additional species that may be commonly found in more residential or rural areas include eastern cottontail rabbit, chickadee, California quail, pine siskin, Steller's jay, black-tailed deer, Douglas' squirrel, and long-tailed weasel.

Coniferous and deciduous forest habitats are found mainly in the eastern portions of the service area. Areas of continuous forest of various age classes provide primary breeding and feeding habitat for about 70 wildlife species. A similar number of species are expected to use the coniferous and deciduous forests located in habitat networks such as parks and greenbelts in more urban areas. Typical bird species found in forest habitats include red-tailed hawk, American robin, common crow, varied thrush, Swainson's thrush, black-capped chickadee, Steller's jay, downy woodpecker, and northern flicker. Common mammal species include deer mouse, mountain beaver, Townsend's chipmunk, coyote, and raccoon. Several amphibian species also inhabit forested environments including northwestern salamander, ensatina, and Pacific tree frog.

Riparian forests are found along streams and rivers throughout the service area. This habitat type is generally more productive than surrounding ecosystems, providing habitat diversity and a movement corridor for many species, particularly amphibians. Movement corridors are important in maintaining gene flow between otherwise isolated populations. They also are utilized as important stopover areas for migrating land birds, providing resting and foraging sites. Streams support fish and invertebrate populations, which are an important food source for terrestrial wildlife (including great blue heron, belted kingfisher, coyote, and raccoon).

Agricultural land is limited in the service area. This habitat is intensively managed. Birds such as common crows, European starlings, and house sparrows are the major wildlife species expected in this habitat.

Salt water beach areas in the service area, located along Puget Sound, are used by many species for foraging and resting (including gulls, Northwestern crows, and shorebirds). Harbor seals also use beaches as haulouts.

Fisheries

The abundant surface water resources in the King County wastewater service area provide a valuable habitat for a wide variety of resident and migratory finfish. In the past, these waters and tributary streams have supported five species of salmon (e.g., coho, chum, chinook, pink, sockeye), two species of trout (e.g., steelhead, cutthroat), char, and whitefish. These species have served as the basis for important commercial, tribal, and sport fisheries.

Three anadromous salmon species—chinook, coho, and sockeye—currently inhabit the drainages of the Lake Washington watershed. Chinook spawning occurs in much of the accessible stream area on the Cedar River and in portions of larger Lake Sammamish

tributaries including Issaquah and Bear Creeks. Principal coho spawning habitat is located in portions of the Cedar River and its tributaries, major tributaries to Lake Sammamish, and eight independent Lake Washington drainages. Sockeye spawning occurs in virtually all of the accessible drainages of the Lake Washington basin.

With the exception of a large run reported in 1996, the sockeye fishery in Lake Washington has severely declined in the last 10 to 15 years. The cause of this decline is not clear but has been attributed to urbanization impacts on water and sediment quality. Washington Department of Fish and Wildlife (WDFW) rates salmon stocks as "healthy," "depressed," or "critical." Lake Washington sockeye stocks are currently rated as depressed, but they may be reclassified as critical. This designation requires the highest level of protection of spawning and rearing habitat. There is a similar concern for steelhead trout in the Lake Washington basin. This species has experienced a substantial decline, mostly because of excessive predation at the Hiram Chittenden Locks by California sea lions.

The three salmon species inhabiting the Green-Duwamish watershed include chinook, coho, and chum. Chinook spawning takes place in the Green River from the City of Tacoma diversion to the vicinity of Kent, with most intensive spawning in the Green River occurring in the 19 miles below Green River Gorge. Chinook also inhabit Newaukum and Soos Creeks. Coho and chum are found in virtually all accessible streams in the watershed; the more important spawning habitat includes Newaukum, Spade, Burns, Soos, Spring Brook, and Hill Creeks. Chum salmon are found in nearly all streams as well, but particularly downstream of the Green River Gorge.

In the past, shellfish resources along central Puget Sound shorelines have supported commercial, sport, and tribal fisheries. Where substrate is suitable, geoducks are present in central Puget Sound and Elliott Bay to a depth of 350 feet. There are commercial concentrations in some areas; however, this resource is closed along King County shorelines because of high coliform levels. Other shellfish resources present along King County shorelines are similarly closed to commercial harvest. For public health reasons, the Seattle-King County Health Department recommends against recreational harvesting of shellfish.

Sensitive Species

Under Section 7(c) of the Endangered Species Act of 1973, as amended, the U.S. Fish and Wildlife Service (USFWS) maintains a listing of "threatened" and "endangered" species. In addition, another listing of "candidate" species is maintained as advance notice to federal agencies regarding species proposed for listing or listed in the future. A Biological Assessment (BA) would be required by USFWS if the future environmental review for specific system components indicated a listed species is present in the project area. The BA would identify potential impacts to a listed species and require consultation with USFWS. Federally designated threatened species in the King County wastewater service area include the bald eagle (*Haliaeetus leucocephalus*) and the marbled murrelet (*Brachyramphus marmoratus*). The peregrine falcon (*Falco peregrinus*) is endangered at the federal level. One federal candidate species, the spotted frog, may occur in the project area.

The Washington State Department of Fish and Wildlife (WDFW) maintains files on the occurrence of special animals in the state. WDFW designates sensitive species as endangered, threatened, sensitive, candidate or monitor species, with definitions similar to those of the federal government. The bald eagle and the marbled murrelet are considered threatened at the state level. The peregrine falcon and western pond turtle (*Clemmys marmorata*) are designated endangered. Washington state candidate species that may occur include the spotted frog, western pond turtle, common loon, common murre, merlin, northern goshawk, Vaux's swift, pileated woodpecker, purple martin, Townsend's big-eared bat, and Pacific harbor porpoise. There are also several state candidate invertebrate species that may occur in the project area.

The Washington Natural Heritage Program of the Washington State Department of Natural Resources maintains an information system on significant vegetation in the state. This includes rare plants, high-quality native wetlands, and high-quality native plant communities. There are many high-quality native wetlands in the King County wastewater service area, frequently associated with streams and their discharges to larger water bodies. Plant species of concern in the service area may include the long-styled sedge, the choris' bog-orchid, and the swamp gentian.

LAND AND SHORELINE USE

Land Use Patterns

In the urban growth areas of King and Snohomish counties, the intensity of development generally increases from east to west. East of Lake Washington, land uses are principally residential although major areas of industrial and commercial development are located in large urban centers.

Except for downtown Bellevue, the most heavily urbanized portions of the King County wastewater service area are located west and south of Lake Washington. In addition to the downtown portions of major urban centers, such as Seattle, Tukwila, Renton, and Kent, areas dominated by commercial and industrial land uses include the large area extending south from downtown Seattle into the Duwamish and Green River valleys as far as Kent and Auburn, the area surrounding and including Sea-Tac Airport, and the area extending north from downtown Seattle to include areas in Interbay and along the Ship Canal.

Policies and Regulations

Growth Management Act

The Washington Growth Management Act (GMA) of 1990 requires the fastest growing counties and cities in the state to plan in accordance with the goals of the GMA. One goal of the GMA is outlined below.

“Public facilities and services. Ensure that those public facilities and services necessary to support development shall be adequate to serve the development at the time the development is available for occupancy and use

without decreasing current service levels below locally established minimum standards.”

Implementation of this goal requires that King County, as a regional provider of wastewater services, coordinate with local jurisdictions to plan for long-term provision of its services at appropriate service levels. This Regional Wastewater Services Plan (RWSP) is intended to meet that requirement.

The GMA provides an orderly multistep process to implement its goals. A beginning step is for the counties or cities to establish “urban growth areas” where urban-level services (typically including sanitary sewers) will be provided. Outside these urban growth areas the same level of services will not be provided. Both King County and Snohomish County have delineated urban growth area boundaries to establish specific urban growth areas.

The established urban growth areas in King County generally include the western third of the county (excluding Vashon Island) extending east to include Woodinville, Redmond, most of the Sammamish Plateau, Issaquah, and the western portion of the Soos Creek plateau. In addition, urban growth areas have been established around the outlying towns of Duvall, Carnation, Snoqualmie, North Bend, Black Diamond, and Enumclaw.

Defined urban growth areas in the portion of Snohomish County inside or near the King County wastewater service area generally include the heavily developed southwestern portion of the county extending east to approximately the watershed boundary on the eastern side of the North Creek valley.

Comprehensive Plans

The GMA requires that cities and counties prepare comprehensive plans (or update their existing plans) to conform to GMA goals and urban growth area designations and population projections developed under the GMA planning process. Currently most jurisdictions have updated their comprehensive plans.

Local jurisdiction comprehensive plans establish land use policies and goals and designate specific geographic areas for future development within various land use categories such as industrial, commercial, and residential. Local land use designations in the King County service area broadly follow existing land use patterns.

Local Policies and Regulations

Zoning. Local jurisdiction zoning codes or ordinances include regulations that implement the policies of their comprehensive plans. Zoning codes also designate specific geographic areas that allow special land uses and establish regulations requiring land use compliance. In general, zoning designations within the King County wastewater service area conform to existing land use patterns.

Most local zoning codes define wastewater treatment plants, pump stations, conveyances, and related wastewater facilities as “utilities” or “public utilities.” Utilities are allowed in most residential, commercial, industrial, and other zones but usually require a public

hearing and approval of a conditional use permit, special use permit, or similar land use permit before major wastewater facilities are allowed. Approval of such permits is usually granted only after the proponent of such a permit shows that the impacts on nearby properties and land uses are adequately mitigated.

Shoreline Management. According to the State Shoreline Management Act of 1971, local governments in Washington State are required to develop programs to regulate development and other activities along shorelines. Each local program includes goals, policies, and regulations applicable to specific shoreline designations and to land use activities such as utilities.

In general, local programs give preference to shoreline developments or uses that have water-dependent activities, such as boat marinas that cannot be located away from shoreline areas. In addition, local programs usually promote the maintenance and expansion of public access to shorelines. Most local programs prohibit or limit the location of large wastewater facilities, such as treatment plants, in shoreline areas. Some water-dependent wastewater facilities, such as outfalls, are usually permitted in some shoreline areas managed by local programs. All permitted uses and activities, except those that are quite minor, require either a substantial development permit or a shoreline conditional use permit. Depending on the jurisdiction involved, the review and approval process required for shoreline permits may involve a public hearing or may require only an administrative decision.

Regional Needs Assessment. In May 1994, King County, the City of Seattle, and the Suburban Cities Association began the Regional Needs Assessment, a collaborative process to identify critical surface water issues facing the region. As an outgrowth of the Regional Needs Assessment, the King County Council, on October 9, 1995, directed that watershed forums be created in the Cedar River/Lake Washington, Green/Duwamish River, Lake Sammamish/Sammamish River, and Snoqualmie/Skykomish River watersheds. The purpose of these forums is to:

- Set goals and strategies for surface water management issues
- Sort out overlaps and conflicts
- Develop funding sources for projects and forum coordination
- Encourage interlocal agreements
- Seek technical assistance and funding from external sources
- Share information with other watersheds

ENVIRONMENTAL HEALTH

This section discusses the three major environmental health issues commonly associated with wastewater collection and treatment systems. These issues include public health, noise, and the use of hazardous materials and chemicals.

Public Health

With the exception of occasional breaks or leaks in pipelines, most public health hazards associated with wastewater are the result of overflows of combined sewer systems. In a

combined sewer system, stormwater runoff and sanitary wastes are conveyed to a treatment plant in the same pipes (e.g., West Treatment Plant). When the capacity of the conveyance system or the treatment plant is exceeded, the combined flow is routed directly to receiving waters instead of the treatment plant. This discharge is called a “combined sewer overflow (CSO).” The affected environment used in evaluating human health effects includes waterfront areas where people can come into contact with water or sediments influenced by the discharge of untreated sewage mixed with stormwater.

CSOs allow a wide range of pollutants to enter receiving waters. In addition to disease-causing microorganisms, fecal matter, toxic chemicals, and other materials found in sanitary waste, CSOs also contain pollutants picked up by stormwater as it travels over rooftops, yards, and paved surfaces. These pollutants include dirt, particles from smoke and automobile exhaust, eroded brake linings, fertilizers, pesticides, detergents, animal droppings, and many other contaminants.

Besides CSOs, there are other non-point sources of pollution upstream in the Green/Duwamish River Basin such as urban stormwater, industrial, agricultural and forestry practices. King County is currently conducting a water quality assessment to determine the importance of CSOs’ contribution of contaminants to the Duwamish River and Elliott Bay relative to these other sources.

In the past, overflows resulting from excess stormwater in the combined sewers of the Seattle system have affected water and sediment quality along the shorelines of Lake Washington, Lake Union, the Ship Canal, the lower Duwamish River, Elliott Bay, and central Puget Sound. The locations, frequencies, and volumes of CSOs have been substantially reduced in recent years through the efforts of the City of Seattle and King County. CSO control measures have included sewer separation, construction of new storage facilities, new pumping stations, and computerized methods for maximizing in-line storage.

Although much progress has been made, CSOs continue to occur. As many as seven major King County outfalls convey CSO into each receiving water body, for a cumulative discharge of more than 1.5 billion gallons per year. Some of the waters receive only a few million gallons per year while others receive more than one-half billion gallons. Depending on the outfall, combined sewage and stormwater may be discharged less than one time per year to as often as 56 times per year (Brown and Caldwell, et al., 1995). The greatest density of CSOs is found in and south of downtown Seattle; receiving waters for these outfalls are the Duwamish River and Elliott Bay.

Control of public health in and around the receiving waters is shared by the Seattle-King County Health Department and the Washington State Department of Health. The local health department has jurisdiction over beach closures for mishaps such as excessive concentrations of fecal coliform bacteria. Bacterial contamination of fish and shellfish can be the result of stormwater runoff, failing septic systems where such systems are in use, and CSOs. The Health Department advises against consumption of bottom fish and shellfish in the Duwamish River and Elliott Bay. The State Department of Health has jurisdiction over commercial harvest and shellfish; it may close fisheries, close or decertify shellfish beds, or issue consumption advisories. The State of Washington has currently closed

King County beaches to commercial shellfish harvest because of contamination by fecal coliform bacteria.

People routinely use areas that may be affected by CSOs. Recreational use of shoreline and near-shore environments in the King County wastewater service area is facilitated by public access points, beaches, parks, boat launches, fishing piers, marinas, rental shops, and other water-based facilities. Some of these facilities are near CSO outfalls:

- Elliott Bay Park and fishing pier at Pier 86, and Myrtle Edwards Park in the vicinity of the Denny Way CSO outfall, the largest in the King County system
- Public fishing piers near the Connecticut Street and King Street CSO outfalls in south Elliott Bay
- Public fishing piers near the Hanford and Lander CSO outfalls in the East Waterway of the Duwamish River (east of Harbor Island), and near the Chelan and Harbor CSO outfalls in the West Waterway of the Duwamish River
- Water access and park along the Duwamish River immediately downstream of the Brandon CSO outfall, and a few hundred meters upstream of the Michigan CSO outfall

For many years there has been fishing for crab and bottomfish in the Duwamish Estuary. Because of pollutants in the waterways and abnormalities present in certain demersal fishes, warnings about consuming fish and shellfish caught in these waters have been issued by the Seattle-King County Health Department.

Swimming, scuba diving, windsurfing, and other water contact activities occur in many areas despite the cool water temperatures of Puget Sound. The most popular saltwater beaches in the King County wastewater service area are Alki Beach between Duwamish Head and Alki Point, and Golden Gardens Park north of Shilshole Marina. There are many smaller beaches along Puget Sound as well as many waterways in the metropolitan Seattle area.

Noise

The human ear responds to a very wide range of sound intensities. The decibel scale used to describe sound is a logarithmic rating system that accounts for the large differences in audible sound intensities. This scale shows that loudness is doubled at each 10 dBA interval. Under normal listening conditions, a five decibel change could be perceived. Sound levels are also described by equivalent sound levels (Leq). This is the level of a constant sound that has the same sound energy as the actual fluctuating sound.

Factors affecting noise impact include distance from a source, frequency of the sound, absorbency of the ground, obstructions, and duration of the sound. The degree of impact also depends on the listener and on background sound levels.

King County and some municipalities in its wastewater service area (e.g., Seattle, Renton, Bellevue, and Bothell) have adopted noise ordinances. Many of the noise

ordinances are similar to noise regulations developed by the State of Washington. Although there are some differences among noise ordinances, most address construction noise. The City of Seattle, for instance, has established maximum permissible sound levels based on the land use of the source and receptors, time of day, and duration of the sound (Table 4-1). Noise levels generated in industrially zoned areas ordinarily cannot exceed 60 dBA in neighboring residential areas or 65 dBA in neighboring commercial areas. These maximum sound levels may be exceeded during construction between 7 a.m. and 10 p.m. on weekdays and between 9 a.m. and 10 p.m. on weekends. Regulations further specify the degree and duration by which construction activities may exceed maximum levels. The city also regulates motor vehicle noise. For most heavy trucks (over 10,000 pounds gross vehicle weight), the limit is 86 dBA 50 feet from the source where speed limits are less than 35 miles per hour (mph) and 90 dBA where the speed limit is greater than 35 mph.

Table 4-1. City of Seattle Maximum Permissible Noise Levels			
Zoning of Sound Source	Zoning of Receiving Property		
	Residential dBA	Commercial dBA	Industrial dBA
Residential	55	57	60
Commercial	57	60	65
Industrial	60	65	70
(Ord. 106360 302, 1977)			

King County noise standards (Table 4-2) are based on land use at the noise source, receiving property land use, and time of day.

Table 4-2. King County Environmental Noise Standards (dBA)				
Land Use at Noise Source	Receiving Property Land Use			
	Rural Day/Night	Residential Day/Night	Commercial	Industrial
Rural	49 / 39	52 / 42	55	57
Residential	52 / 42	55 / 45	57	60
Commercial	55 / 45	57 / 47	60	65
Industrial	57 / 47	60 / 50	65	70

The U.S. Environmental Protection Agency evaluates noise impacts based on the relative change in sound because of a project. It classifies an increase of zero to 5 dBA as a “slight” impact, an increase of 5 to 10 dBA as a “significant” impact, and an increase of more than 10 dBA as a “serious” impact.

Hazardous Materials and Chemicals

There are several chemicals used in large quantities at wastewater treatment plants and conveyance facilities. Some of these are potentially hazardous to plant workers and to communities in the vicinities of the treatment plants and pump stations. Frequently used chemicals at plants and facilities in the King County wastewater service area include chlorine, sodium hydroxide, sulfur dioxide, polymers, alum, and activated carbon.

Chlorine

Chlorine is used for odor control as a disinfectant for influent at the headworks of a plant. It is also used as a disinfectant for effluent before discharge through an outfall to receiving waters. At normal temperatures and pressures, chlorine is in a gaseous state and is heavier than air. It is an asphyxiant and immediately dangerous to living organisms at levels of 25 ppm.

At the East Treatment Plant, chlorine is delivered to the plant in 90-ton rail cars that are specifically designed for the purpose of chlorine transport. Rail cars are unloaded in a contained chlorination building at the southeast corner of the plant site. Chlorine is piped directly from the rail car through feed equipment to the desired points of application at the plant. All chlorine is piped under partial vacuum in order to prevent leaks.

At the West Treatment Plant, chlorine is delivered to the plant by special semitrailer trucks carrying up to 12 one-ton cylinder containers. While in use, cylinders are stored in cradles in a contained, concrete storage building. The cylinders are connected to an evaporator that converts the liquid to a gas and then is distributed to various injection points throughout the plant through a vacuum piping system.

Safety features are incorporated into the entire chlorination system. Safety features include pressure and leak detection alarms, emergency use of sodium hydroxide to absorb chlorine in case of system malfunction, vacuum distribution systems and fail-safe shut-down in case of vacuum failure, full containment of the chlorination building in the event of a leak, pressure sensors and alarm systems, backup power supplies, and regular inspection of chlorination equipment.

Caustic Soda (Sodium Hydroxide)

Caustic soda (NaOH) is used to neutralize chlorine in the event of an accidental release. It is extremely alkaline and can react explosively when mixed with organic chemicals. It can cause serious skin burns. Caustic soda is usually delivered in liquid form in a 4,000-gallon tank truck, under strict controls of the U.S. Department of Transportation. A pumping system on the truck delivers the caustic soda solution directly to onsite storage tanks.

At the East Treatment Plant, caustic soda is stored in aboveground outdoor storage tanks near the chlorination building. At the West Treatment Plant, caustic soda is stored in 10,000- and 5,000-gallon storage tanks. Both storage facilities include concrete berms to contain any release from potential leaks or ruptures. At both plants, venting systems direct any chlorine gas to the caustic soda tanks where it is absorbed and neutralized. The

resultant solution becomes saltwater. Use of caustic soda in the past at the East Plant and the West Plant has been minimal.

Sulfur Dioxide

Sulfur dioxide was used in the past at the East Treatment Plant to dechlorinate effluent before discharge to the Duwamish River. Dechlorination was no longer needed when the discharge was shifted to central Puget Sound waters; however, the system has been maintained in case of emergency discharge to the river. Sulfur dioxide is stored as compressed gas in a 10-ton storage tank in a small building designed to contain possible leaks.

Other Chemicals

Polymers are long-chain, charged organic chemicals that are mixed with sludge to bind solids together. Polymers facilitate sludge thickening and dewatering. Activated carbon is used as a sorbent to remove odor-causing agents in many plant processes. Polymers and activated carbon are nontoxic.

A number of chemicals may be used at conveyance facilities (pump stations, force mains, gravity lines) in order to control odors and pipe corrosion. These chemicals may include sodium hypochlorite, potassium permanganate, hydrogen peroxide, and ferrous chloride. Some of these chemicals can be harmful, and special handling precautions are specified for their use.

Hydrogen sulfide and volatile organic carbon compounds (VOCs) are substances generated by wastewater under certain conditions. These are discussed in the air resources section of this chapter.

OTHER ELEMENTS OF THE ENVIRONMENT

Earth Resources

Geology and Soils

The geology and soils of the King County wastewater service area are mostly the result of long-term faulting, folding, and sedimentation. Recent glacial and post-glacial geologic events have also been instrumental in determining the geology and soils of the area. A significant geologic transition occurs in the vicinity of an east-west line running through Duwamish Head and Eastgate in Bellevue. North of this line, which approximates the trace of the Seattle fault, lies the downfolded Seattle basin where bedrock is more than 100 meters below the surface. South of the Seattle fault, upfolded bedrock rises to the surface in the Newcastle Hills, Beacon Hill-Rainier Valley, and Renton vicinities and lies within 100 meters of the surface including most of the service area east of Sea-Tac Airport and north of the city of Auburn (Yount et al., 1985; Galster and Laprade, 1991).

Recent glacial and post-glacial events have created a pattern of predominantly north-south valleys and ridges or drift plains on this older bedrock. The valleys, occupied by

Puget Sound, Lake Washington and Lake Sammamish, the Green and Snoqualmie rivers, and other major drainages, are primarily covered by fine-grained, silt-rich or clay-rich, poorly drained soils developed from deposits of rivers and lakes since the last glaciation. In many areas, these fine-grained valley soils have a high organic content.

The ridges and drift plains between the valleys are covered primarily with coarser-grained soils derived directly from glacial deposits. In many areas these glacially derived soils are underlain at depths of a few feet by a compacted layer of glacial material called till. Locally, finer-grained soils may occur in depressions occupied by lakes or wetlands, in ravine bottoms, and along the edges of ridges and drift plains (SCS, 1973, 1983).

Geological Hazards

Geological hazards include erosion, landslide, and seismic hazards. Erosion potential depends on soil type, slope, vegetative cover, and rainfall characteristics. In the King County wastewater service area, the potential for erosion is usually associated with slopes greater than 15 percent, with areas where the natural vegetation has been removed or with locations downstream of developed areas where a significant portion of the area is usually covered by impervious or slowly permeable surfaces. In addition, the potential for erosion is usually greater in the fall to spring wet-weather season during and immediately after periods of rainfall (King County, 1987).

The King County wastewater service area is located within a seismically active region. Based on the historical record of earthquakes, for planning purposes a “credible maximum [earthquake] event” for the King County wastewater service area is of a magnitude as high as 7.5 on the Richter scale (Galster and Laprade, 1991). Recent research indicates that earthquakes considerably more powerful than magnitude 7.5 have occurred in the past in the Puget Sound region, but the frequency of such earthquakes is less than once in several hundred years (Adams, 1992).

Contaminated Soils

There are contaminated soil sites throughout the King County wastewater service area. These upland and in-water sites are located primarily in areas of current or past industrial development. Some of the in-water sites are located adjacent to existing CSO outfalls, although the CSOs are not the only source of contamination at these sites. Commonly encountered contaminants at sites in the King County wastewater service area include petroleum products, metals, solvents, and polynuclear aromatic hydrocarbons (PAH) as well as other contaminants (Ecology, 1994).

Aesthetics

Within the Puget Sound basin, the Olympic and Cascade mountains, Puget Sound, and lakes Sammamish and Washington are the primary focus of most regional views. The linear crests of ridgelines visible throughout much of the Puget Sound basin along with the shorelines of major lakes and Puget Sound dominate many more local views.

In the plateau-and-valley topography that characterizes the Puget Sound basin, regional views typically extend over valleys toward distant physical features. The valley floors and sides are typically wide and visible from other locations. Valley floors are visually flat planes characterized by broad, visually uniform areas, and structures in these valley areas are typically widely visible. Conversely, sites away from valley floors and sides are typically visible from only a few other locations.

In general, the King County wastewater service area becomes more urban from east to west. East of the Sammamish and Green River valleys on the east Lake Sammamish and Soos Creek plateaus, land use is almost exclusively single-family residential. Residential structures are limited in scale and bulk (generally not exceeding three stories in height and a footprint of about 2,000 square feet). Substantial vegetation exists in and around the residential areas. The green, vegetated areas contrast with the built structures, creating a mosaic texture of green space interspersed with the simple geometric shapes and straight lines of buildings.

More and larger buildings exist in the more urbanized areas west of Lake Sammamish and Soos Creek plateaus. The simple geometric forms and straight lines of built structures are a defining visual element in the most heavily urbanized city centers. In these urbanized areas, there is less vegetation, and colors tend toward muted tones of grays and reds. In the most heavily urbanized areas, profiles of buildings often interrupt and obscure the natural irregular character of ridgelines and shorelines. Major highways and bridges are also visually prominent, linear features in the urbanized portion of the King County wastewater service area.

Recreation

The State of Washington, and cities and counties (except recently incorporated cities) provide parks and other public recreational facilities in the King County wastewater service area. There are more than 700 publicly owned formal recreational facilities located within the service area. These facilities include parks; school athletic facilities; biking, hiking, and equestrian trails; marinas; and golf courses. Most parks provide picnic, playground, ballfield, sport court, swimming, and/or boating facilities. In addition to providing recreational opportunities, most public parks located in urban areas provide open space and educational opportunities. There are also private recreational facilities located within the service area, such as exercise clubs, private golf courses, sailing and rowing clubs, and shooting ranges.

Data showing the amount of use of individual parks and other formal recreational facilities are extremely limited. In the King County wastewater service area, parks with developed facilities in urban areas are used most frequently, while parks in non-urban areas and those with undeveloped facilities are used less. Many jurisdictions in the service area classify parks as neighborhood, community, or regional parks. While regional parks are usually the largest parks with the most diverse facilities and the most visitors, individual facilities in large regional parks (e.g., ballfields) may not receive a substantially different level of use from that of comparable individual facilities in smaller neighborhood or community parks.

The most used large parks and other formal recreational facilities receive from 100,000 to more than 1 million visits a year. Formal recreational facilities are used most often on weekends, during the dry weather season, and during special events. Frequent use also occurs during other times for particular facilities (e.g., weekday evenings for soccer and softball fields at many parks).

In addition to formal recreational facilities, there are informal recreational activities throughout the King County wastewater service area. Informal water-related recreational activities include boating, swimming, beachcombing, fishing and clamming, diving, water-skiing, and boardsailing. Other informal recreational activities include bicycling on roadways not formally designated as bikeways, and backyard basketball. There is little data available on levels of informal recreation.

Recreational facilities adjacent to existing major wastewater facilities include Discovery Park, adjacent to the West Plant; Waterworks Gardens, adjacent to the East Plant; Carkeek Park, adjacent to the Carkeek stormwater plant; the public walkway and beach, across Beach Drive SW from the Alki stormwater plant; and Bar-S playfield, adjacent to the Alki stormwater plant. Discovery and Carkeek parks, the beach at Alki, and the Bar-S playfield are all heavily used facilities.

Cultural Resources

Cultural and historic resources located within the RWSP service area are discussed generally within this section. Additional discussion and detail on the history, ethnography, and archaeological resources of the service area (including locations of historic sites and structures) are included in a separate report on archaeological and cultural resources prepared for the RWSP; this report is available at the King County Wastewater Treatment Division offices.

Ethnography and Archaeology

The RWSP service area is located within the territory of the Duwamish Indians, a fishing-gathering-hunting group who lived on the Duwamish, Green (formerly White), and Cedar Rivers, Elliott Bay, Lake Washington, Lake Union, and Salmon Bay (LAAS, 1995). Salmon was the primary source of food for the Duwamish and was harvested in local marine waters, rivers, lakes, and streams. Other food sources included nonsalmonid fish species, shellfish, waterfowl, and roots and berries.

Most of the archaeological research in the Seattle/Lake Washington area has been conducted for environmental compliance purposes associated with industrial development, sewer conveyance, and sewage treatment. The King County Wastewater Treatment Division (formerly part of Metro) has been responsible primarily for large projects on the Seattle and Elliott Bay shorelines and the Duwamish River and River valley. These areas have experienced closer scrutiny and more intensive cultural resource investigations than Lake Washington, Lake Union, the Lake Washington Ship Canal, and North Beach. As river and lake shorelines were focal points for prehistoric settlement and commerce, archaeological sites may be discovered in these locations. In particular, Lake Washington is very likely to contain archaeological resources.

Based on ethnographic documentation, the King County wastewater service area may contain several kinds of archaeological resources including the following:

- Remnants of long-house and potlatch house structures
- Shell middens or refuse heaps associated with permanent settlements or camping sites
- Fire pits or hearths associated with resource processing stations
- Human remains and grave goods from burial grounds
- Lithic material from tool-making
- Bone and stone tools
- Remnants of fish weirs and traps
- Rock piles from sweat lodges

A review of site records for the RWSP service area identified 20 archaeological sites. All are hunter-fisher-gatherer sites except one, a historic dump at Fort Lawton. The sites are located primarily on the Sammamish River, the banks of the former Black River (which dried up when its source, Lake Washington, was lowered during construction of the Ship Canal), and the former mouth of the Duwamish River. Listings, descriptions, and evaluation status for the National Register of Historic Places (NRHP) are included in the archaeological and cultural resources report prepared for the RWSP.

In addition to land-based cultural resources described above, there is a strong probability that Elliott Bay contains unidentified shipwrecks on its bottom. Of 60 documented shipwrecks in Elliott Bay, only 18 have been recovered. Seven of the shipwrecks occurred off the Duwamish Head. More information of these shipwrecks and their locations is available in the background report referred to above.

Historic Resources and Structures

Historic resources in Seattle and its environs are primarily related to the history of settlement by non-native immigrants, beginning in the mid-nineteenth century, and its development as a center of commerce and shipping. Review of the literature suggests the service area may contain as-yet-unidentified historic resource materials, including materials related to the logging and lumbering industry, establishment of homesteads and farms, road building, railroad construction, and development of maritime industries.

There are numerous historic structures within one-quarter mile of potential RWSP facilities, as identified in surveys commissioned by local governments, recorded by local individuals, and/or nominated to the State or National Registers of Historic Places. A full listing of these structures is included in the background report on archaeological and cultural resources prepared for the RWSP (LAAS, 1995).

Air Quality

Regulatory Background and Regional Status

Under the authority of the federal Clean Air Act, the U.S. Environmental Protection Agency (U.S. EPA) sets standards for a number of air pollutants, known as “criteria pollutants.” Within the state of Washington, Ecology and the regional air quality agencies have established standards for levels of criteria pollutants in ambient air and have been granted authority by U.S. EPA to issue certain air quality-related permits. The Puget Sound Air Pollution Control Agency (PSAPCA) has jurisdiction over air quality in the project area. At present, the Puget Sound region is classified as attaining all federal and local air quality standards.

PSAPCA also regulates new sources of toxic air pollutants (TAPs). New point sources (i.e., fixed facilities that will generate TAPs) are required to demonstrate that emissions will not exceed ambient source impact levels (ASILs), which have been established for over 600 TAPs. The source must also demonstrate that best available control technology (BACT) for toxic substances will be used. Both of these demonstrations must be presented as a part of the air permit application.

Air Emissions from Existing Treatment Facilities

Like all wastewater treatment facilities, King County's existing West and East Treatment Plants emit a number of substances that can affect air quality on a local or regional level. Emissions directly related to the operation of treatment facilities include volatile organic compounds (VOCs); odor; and combustion products, primarily oxides of nitrogen (NO and NO₂, referred to collectively as NO_x) and CO, from onsite biosolids handling facilities. CO is also released in emissions from vehicles associated with facility operations, particularly the transport of biosolids for recycling. These pollutants and the regulations pertaining to them are described below.

Volatile Organic Compounds

VOCs can be described, in general, as chemical compounds composed of carbon or carbon chains that are readily volatilized into the atmosphere. Their emission is subject to regulation in the Puget Sound basin because they interact with NO_x in the presence of sunlight to form ozone. Some VOCs are also regulated as toxic air contaminants (TACs) by Ecology and PSAPCA. Their source at wastewater treatment facilities is the influent wastewater streams. Residential, commercial, and industrial activities all contribute to concentrations of VOCs in wastewater; commonly identified contaminants include paint solvents, cleaning solutions, degreasing solutions, gasoline and other petroleum products, and pesticides. VOCs can be released through evaporative processes during both primary and secondary treatment. Source control measures, including King County's Industrial Pretreatment Program and education and outreach to businesses and the public, are effective ways of reducing VOC concentrations in influent.

Because of the practical difficulties of controlling their volatilization at treatment facilities, VOC emissions from such facilities are not regulated by air quality agencies. The most effective way of reducing VOCs at treatment facilities is to use source control

measures to limit their concentrations in the influent stream; however, some level is likely to remain even with the most aggressive measures. Overall emissions of VOCs from wastewater treatment facilities (estimated conservatively at approximately 0.2 ton per mgd per year) are not considered to represent a substantial contribution to regional ozone formation.

Odor

Odors associated with wastewater treatment facilities are chiefly the result of biological activity in the collection and treatment systems. The anaerobic decomposition of compounds containing nitrogen and sulfur results in a number of gases, including hydrogen sulfide, ammonia, carbon dioxide, methane, nitrogen, hydrogen, and oxygen. Of these, hydrogen sulfide and ammonia are the primary sources of odors considered objectionable to nearby residents. The location of a treatment plant, the size of the plant site, the proximity of residential areas, the direction of prevailing winds and other atmospheric conditions, and the characteristics of the sewer system that conveys influent to the plant are all factors in determining whether the odors the plant produces are likely to have a significant effect on the surrounding community.

An increase in odor *potential* (i.e., treatment of higher volumes of wastewater) does not necessarily entail greater odor impacts, as the potential for odors can be offset by design and operation procedures incorporated into treatment plants. Typical technologies for controlling odor include covering as many process facilities as practicable (which will also reduce VOC emissions); scrubbing of air from the headworks, screenings building, solids facilities, and other odor-generating equipment; use of activated carbon vessels at digester vents; and establishment of buffer areas between odor-generating activities and nearby residential areas. Appropriate technologies are determined during detailed project design.

King County actively pursues measures to reduce odor emissions from its existing facilities. Because odor impacts are not quantifiable in the traditional sense (e.g., by measurements of odor-causing chemicals), they are typically regulated, if at all, by means of such methods as conditions on land use permits.

In 1997, an independent odor consultant will conduct comprehensive West Point Treatment Plant odor surveys to identify and characterize treatment plant odors and identify the most likely source(s) of the odors. Recommendations for prevention, containment or treatment of odors that could exceed permit levels, adversely impact visitors to Discovery Park or adversely impact onsite work conditions will be prepared. The survey could result in procedural changes and/or system modifications as needed to mitigate (reduce or eliminate) identified odors.

Combustion Pollutants

Combustion pollutants are produced by the burning of hydrocarbon fuels in combustion engines. They are generated by both point sources (e.g., large stationary engines used for industrial or other purposes) and mobile sources (primarily vehicles). The major combustion pollutants produced by treatment plant operations—oxides of nitrogen and carbon monoxide—are discussed in this section.

Oxides of nitrogen (NO_x) are produced during high-temperature combustion with excess air. NO_x is currently produced at the West Treatment Plant through the operation of engines that use digester gas to produce electricity. Because NO_x emissions contribute to the chemical reactions that form ozone, NO_x is controlled as a point-source pollutant (e.g., from vents and stacks). Measures to control NO_x emissions from point sources are typically specified as a condition of the Notice of Construction (NOC) permit, which requires a determination by PSAPCA that potential emission sources are designed to make use of best available control technology (BACT) and that no adverse air quality impact will occur as a result of project operation.

Like NO_x, CO is a product of combustion, and is emitted primarily by vehicle engines and stationary combustion sources. All vehicle activities associated with construction and operation of wastewater treatment, conveyance, and CSO facilities generate CO, which contributes incrementally to regional levels. It is regulated as a criteria pollutant by U.S. EPA and PSAPCA.

Transportation

Roadways

There are three interstate facilities in the King County wastewater service area: Interstate 5 (I-5), Interstate 90 (I-90), and Interstate 405 (I-405). The major north-south interstate is I-5, an important commuter route and a major facility for local, regional, and interstate truck service. I-5 links Seattle with Everett and Bellingham to the north and Tacoma and Olympia to the south. The major east-west facility is I-90, connecting I-5 just south of Seattle's urban core with communities east of Lake Washington (Bellevue, Issaquah, North Bend), Snoqualmie Pass, and eastern Washington. I-90 is also a major commuter route. I-405 is a major north-south facility on the east side of Lake Washington. It connects communities north, east, and south of Lake Washington, including Bothell, Woodinville, Redmond, Kirkland, Bellevue, Renton, and Tukwila. I-405 connects with I-5 just east of Lynnwood in Snohomish County and near Southcenter Mall in Tukwila south of Seattle. I-405 intersects with I-90 at Factoria in Bellevue. In addition, eight major state routes (SRs) in western King County provide linkages between interstates and are integral to the framework of King County's transportation system.

West Treatment Plant. The West Treatment Plant is accessed by roadways through the Interbay area and Magnolia neighborhood. A road through Discovery Park and Fort Lawton leads directly to the treatment plant, connecting to the city street system at W. Government Way. W. Government Way, Gilman Avenue W., and 20th Avenue W. connect to W. Dravus Street and 15th Avenue W. Fifteenth Avenue W. is designated a truck route and provides connections to SR 99 and I-5.

East Treatment Plant. The East Treatment Plant is accessed directly by the following roadways: SW 7th Street on the north, Longacres Drive S.W. on the south, and Monster Road S.W. on the northwest. Oaksdale Ave S.W. runs along the east side of the plant and intersects with S.W. 7th Street. S.W. Grady Way is a heavily traveled roadway on the south side of EDRP, and intersects with Longacres Drive S.W. and Oaksdale Avenue S.W. S.W. Grady Way provides access to I-5, I-405, and SR 181 (Interurban Ave S.).

Rail Transportation

Burlington Northern and Union Pacific own and operate rail lines and yards throughout the King County wastewater service area. Major rail lines run primarily north and south with connecting spurs serving the industrial areas in the Seattle waterfront and the Duwamish Valley.

Transit

King County Transit provides comprehensive bus and associated transportation services. Supporting facilities in King County include 7 operation centers, 8 vehicle maintenance centers, 10 regional and community transit centers, 42 park-and-ride locations, 37 leased parking lots, and approximately 1,200 bus shelters (King County, 1994). King County Transit also operates the Seattle Monorail and the Waterfront Streetcar system. In addition, Community Transit (Snohomish County) and Pierce County Transit operate routes which use roadways and some park-and-ride facilities within King County and the RWSP service area.

Pedestrian and Bicycle Transportation

The King County wastewater service area includes a number of off-street bicycle and multiuse paths, and numerous on-street bike routes and lanes. Major trails include the Burke-Gilman/Sammamish River Trail system, which extends from Ballard in Seattle along the west and north sides of Lake Washington and along the Sammamish River to Marymoor Park in Redmond, and the Duwamish Waterway Trail/Green River Trail system, which extends from near Duwamish Head in west Seattle and along Elliott Bay and the Duwamish/Green River to near SR 18 east of Auburn. Segments of this trail are incomplete.

Public Services, Utilities, and Energy

Public services in the King County wastewater service area include fire/emergency response, police, medical care, and education. Public utilities include wastewater disposal, water supply, solid waste disposal, electricity, natural gas, and communications. King County facilities place no significant demands on medical services, educational services, or communication utilities; therefore, these services and utilities are not discussed in this section.

Public Services

Approximately 25 fire districts or city fire departments provide fire and emergency services in the King County wastewater service area and the area potentially affected by proposed King County facilities. In addition to emergency aid services, most fire districts and fire departments provide hazardous materials containment services. Those fire districts without hazardous materials capabilities usually contract with adjoining districts or departments to provide these services. The response time for fire/emergency services in the King County wastewater service area is typically less than 10 minutes.

Each incorporated city in the King County wastewater service area provides police services within its municipal boundaries. King County and Snohomish County police departments provide police services in unincorporated portions of their counties. The response time for high-priority calls is usually less than 10 minutes for municipal police departments, and from 8 to 15 minutes for county police services because of the large geographic areas covered by county services.

Public Utilities

Wastewater Disposal. King County provides regional wastewater services within a 680-square-mile area referred to here as the King County wastewater service area. Existing and proposed wastewater facilities and services are described in the Regional Wastewater Services Plan and in Chapters 2 and 3 of this document.

Water Supply. In the King County wastewater service area 34 purveyors deliver water. Of these purveyors, 29 obtain all or part of their supply from the Seattle Water Department system. The Seattle system obtains surface water from two watersheds in the Cascade Mountains (South Fork Tolt and Cedar rivers) and groundwater from the Highline Wellfield south of Seattle. The Seattle Water Department delivers an annual average of about 175 mgd to residential, business, institutional customers, and the 29 purveyors purchasing water from the Seattle system. A small amount of the 175 mgd is used outside the King County wastewater service area, in the Edmonds, Duvall, and Des Moines areas. About half the 175 mgd is used in single-family homes; 15 percent is used in multifamily dwellings; 28 percent is used by commercial and industrial customers; and the remaining 7 percent is used by governmental and institutional customers (SWD, 1993).

Water in the Snohomish County portion of the King County wastewater service area is delivered primarily by the Alderwood Water District, which purchases water from the City of Everett system that serves a large area in south Snohomish County. *The Point Wells vicinity and Woodway obtain their water from the Olympic View Water and Sewer District.* Customers in King County on the eastern and southern sides of Lake Sammamish get their water from groundwater sources by the Union Hill Water Association, the Northeast Lake Sammamish Sewer and Water District, the Sammamish Plateau Water and Sewer District, and the City of Issaquah. The Renton, Kent, and Auburn Water Departments in the Green River Valley supply water in their planning areas primarily from groundwater (springs and wells).

Solid Waste Disposal. *Municipal and most demolition solid waste from the City of Seattle is collected locally and exported to a private landfill in Arlington, Oregon.*

Municipal solid waste in King County outside Seattle is collected locally for disposal at the Cedar Hills and Vashon landfills. Construction, demolition, and land-clearing waste is exported to Klickitat County and Arlington, Oregon, under county contracts with private vendors. King County's primary in-county landfill, Cedar Hills, receives over 97 percent of the county's municipal solid waste. The landfill's remaining capacity (as of 1996) was approximately 18-26 million tons through 2014 to 2020, depending on the level of waste reduction and recycling achieved in the county and future development at the landfill. Cedar Hills Landfill accepts mixed municipal solid waste including various

special wastes such as asbestos and treated biomedical wastes (King County, 1993a). In the 1980s, biosolids generated by the Metro system were accepted at Cedar Hills Regional Landfill. Biosolids were stored and also used in final cover for completed areas.

Municipal and demolition solid waste in Snohomish County is collected locally and exported to Klickitat County for disposal at the Roosevelt Regional Landfill operated by the Regional Disposal Company. The Roosevelt landfill has a capacity of about 120 million tons for 40 years. The Roosevelt Regional Landfill is permitted to handle incinerator ash as well as municipal, construction, demolition, and other nondangerous, noninfectious solid waste (Klickitat County, 1992).

Energy. Seattle City Light provides electrical power to about 320,000 customers in Seattle and areas north and south of the city. Puget Sound Energy (formerly Puget Sound Power and Light and Washington Natural Gas) provides electrical power to customers elsewhere in the King County portion of the King County wastewater service area. Snohomish County Public Utility District No. 1 provides electrical power to the portion of the King County wastewater service area within Snohomish County. Puget Sound Energy also provides natural gas service within the King County wastewater service area.

The major facility consumers of energy in the King County wastewater service area are treatment plants and pump stations. Smaller facilities, such as regulators, storage systems, odor control units, and ventilation systems, have low energy requirements. Depending on the facility, King County uses a combination of energy sources that includes electrical power and natural gas, which are generated onsite using digestion of biosolids at treatment plants. Primary King County vendors are Seattle City Light (City Light), and Puget Sound Energy.

West Treatment Plant

The West Treatment Plant generates electricity for sale to City Light (Metro, 1988). This electricity is produced by using gases generated by the sludge stabilization process. In 1995, the West Treatment Plant purchased 38.8 million kWh of power from City Light while generating 9.2 million kWh.

East Treatment Plant

Electrical power is supplied to the East Treatment Plant by Puget Power by transmission lines located south of the site. A high voltage (115 kV) substation was constructed to serve the plant as part of the Phase II expansion in 1985. In 1995, the plant purchased about 64.9 million kWh of power.

All of the digester gas produced at the site is sold to Puget Sound Energy, formerly the Washington Natural Gas Company. Digester gas, about 65 percent methane and 35 percent carbon dioxide, is scrubbed to remove impurities and sold at a price equivalent to that paid to major pipeline suppliers. In 1995, Washington Natural Gas purchased 1.81 million therms (equivalent to about 53.1 million kWh). When the plant treats 115 mgd (capacity now under construction), the amount purchased is expected to increase to about 3.3 million therms (96.9 million kWh) per year.

Pump Stations

There are approximately 40 pump stations throughout the King County system. These pump stations require electrical energy for pump operation, electrical control systems, mechanical systems, and odor and corrosion control facilities. Total power consumption at the pump stations in 1994 was about 26,387,000 kWh. Of this total, pump stations within the West and East service areas consumed 16.7 million kWh and 9.7 million kWh, respectively.