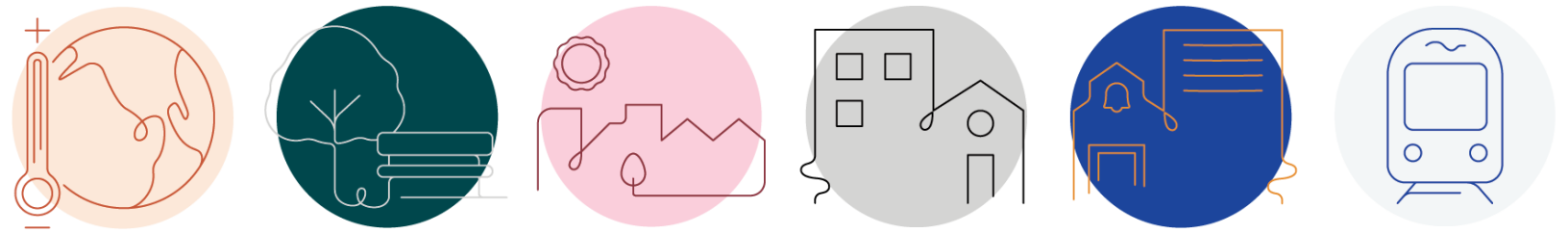
3.1 Earth & Water Quality



Source: City of Seattle, 2023.

This section discusses critical land areas and water resources in the study area, including:

- Landslide hazard areas
- Steep slopes
- Potential soil settlement areas
- Surface waters (streams, lakes, and marine waters)
- Shorelines
- Groundwater

Thresholds of significance of this earth and water resources impact analysis involve comprehensive planning changes that could result in the following:

- Runoff Increases: Impervious surface expansions that would increase runoff flow volumes and durations to streams by magnitudes resulting in bank scour and erosion;
- Surface Water Quality: Increases in amount of pollution to receiving waters that would impair their designated uses (such as human contact and fish habitat);
- Groundwater Recharge: Impervious surface expansions that would decrease groundwater recharge beyond designated limits;
- Groundwater Quality: increases in amount of pollution discharged to levels that would contaminate groundwater supplies;
- Environmental Earth and Soil Hazards: Disturbances of existing contaminated areas to levels that could endanger human health or the environment;
- Climate Change—Extreme Precipitation: Growth concentrated into areas that are reasonably expected to be at risk for future flooding and landslides; and
- Climate Change—Sea-level Rise: Growth concentrated into areas that are reasonably expected to be at risk for future sea-level rise.

3.1.1 Affected Environment

Citywide

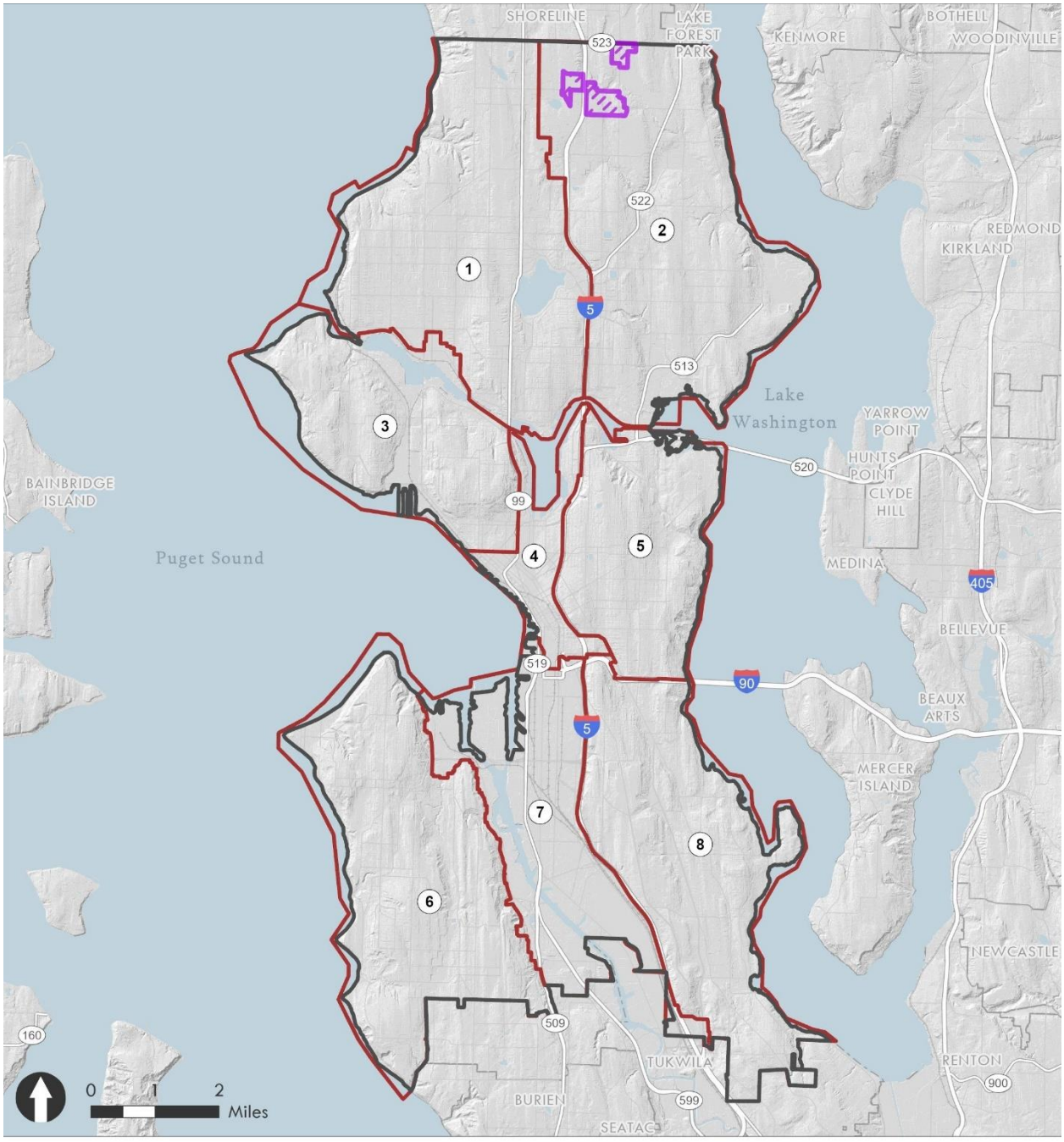
Critical Land Areas

Seattle's landforms consist of glacial-influenced, generally hilly terrain, bounded by Lake Washington on the east and Elliott Bay and Puget Sound on the west. City topography is presented in **Exhibit 3.1-1**. Areas around the Duwamish Waterway, Interbay, and the Thornton Creek valley contain alluvial or sandy soil conditions that pose a higher risk of movement and/or liquefaction during major earthquake events. In addition, steep slopes and known landslide locations have been documented throughout the city, with focus along shorelines and stream corridors. There are also Category 1 and Category 2 peat settlement-prone areas throughout the city, with Category 1 classified as higher quality environment with stricter protections than Category 2. Critical land areas in the city are shown in **Exhibit 3.1-2**.

Landcover & Hard Surfaces

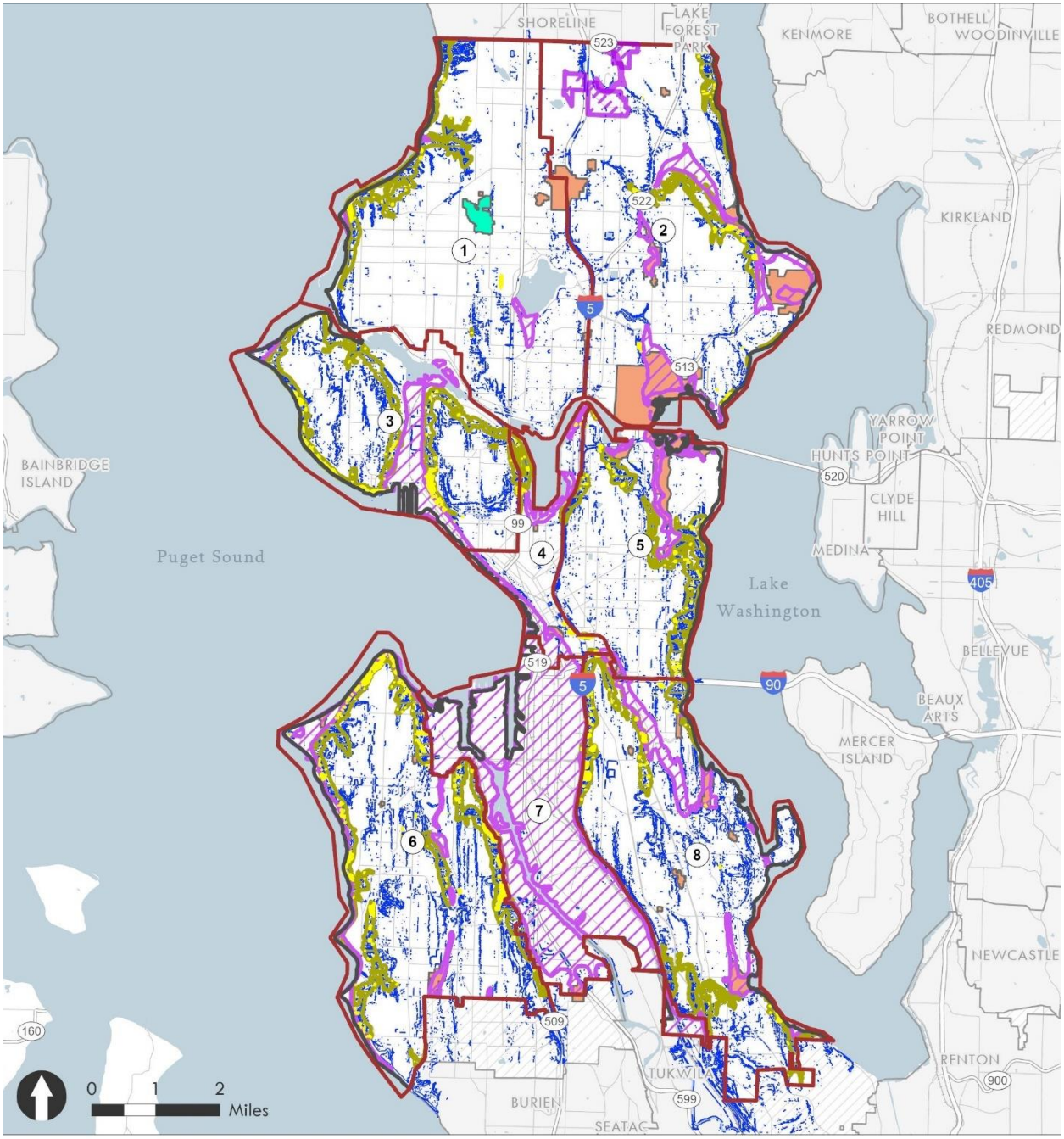
Landcover across most of the city has been extensively modified for over a century by development. The Washington State Department of Ecology has mapped areas in the state that have had over 40% impervious cover for about the last 40 years, and many of these areas are concentrated in Seattle as shown in **Exhibit 3.1-3**.

Exhibit 3.1-1. Topography



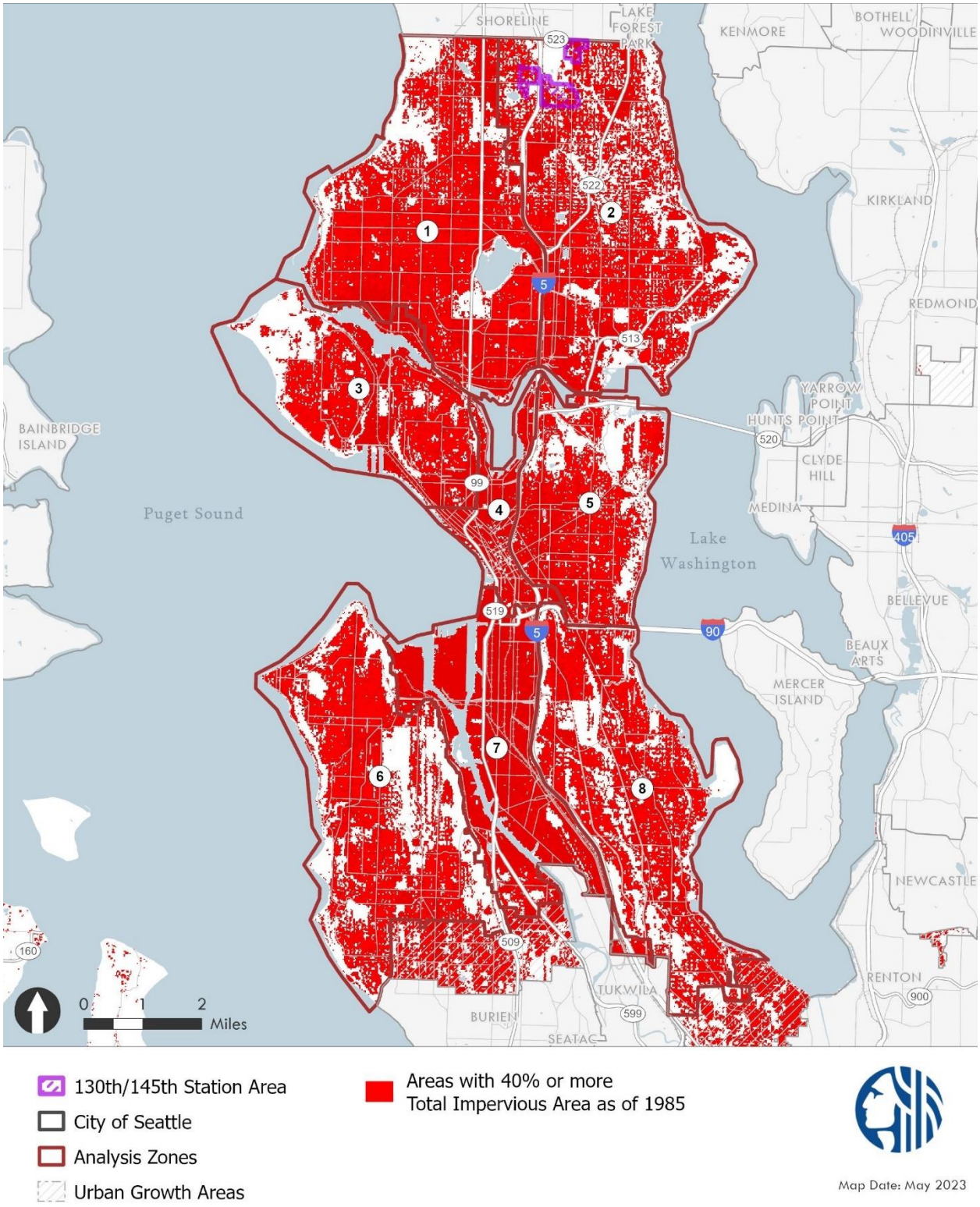
Sources: King County 2023a; Seattle, 2023.

Exhibit 3.1-2. Critical Land Areas



Source: Seattle, 2023.

Exhibit 3.1-3. Historically Impervious Surfaces



Sources: Ecology, 2019a; Seattle, 2023.

Surface Water

The City categorizes surface waters in four regulated classifications. These categories and an overview of their associated water bodies are summarized in **Exhibit 3.1-4**. Mapping of relevant surface water features, floodplains, water quality, and other characteristics is shown in **Exhibit 3.1-5** through **Exhibit 3.1-8.** Surface water fish presence, habitat, and wetland protections are discussed in **Section 3.3 Plants & Animals**. The municipal drainage system and combined sewer treatment areas are discussed in **Section 3.12 Utilities**.

Shorelines

Seattle has a major saltwater shoreline along its western boundary with Puget Sound, Elliott Bay, and the Duwamish Waterway. Along the city's eastern boundary, Lake Washington is classified as a Lake of Statewide Significance under WAC 173-20-370 and is protected against certain uses of its shoreline. Several of the city's shorelines have been impacted by port and industrial activities around Elliott Bay, Lake Union, and Ballard; and engineering activities such as the construction of the Ballard Locks, Montlake Cut, Harbor Island; and modifications to the Duwamish Waterway. Other shorelines across the city have low-density residential development while others are in more natural conditions**. Exhibit 3.1-9** depicts city shoreline environments.

Groundwater

As previously discussed, the land across the city has been heavily modified through development over the past 100 years. As such, groundwater recharge is limited. Also, groundwater use is generally limited to emergency and industrial supply wells for non-drinking use, with wells shown in **Exhibit 3.1-10**. No drinking water wells, wellhead protection areas, critical aquifer recharge areas, or sole source aquifers are identified in the study area.

Sea Level Rise

Areas of the city most susceptible to sea level rise are shown in **Exhibit 3.1-11.**

Socioeconomic Environmental Health Disparity

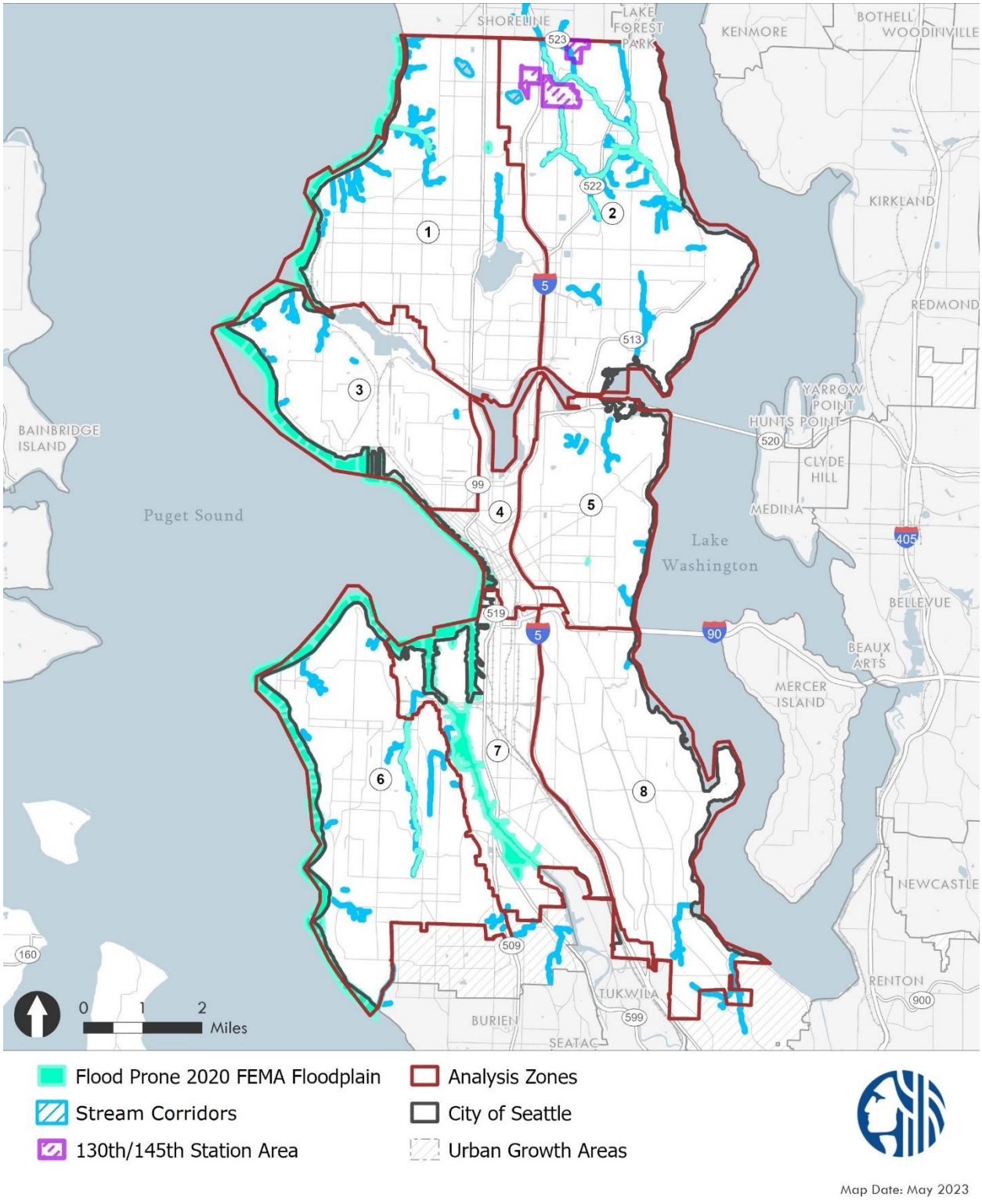
The Washington State Department of Health (WA DOH) has compiled state and national data to map over a dozen indicators of community and environmental health, including factors like proximity to hazardous waste facilities, proximity to wastewater discharges, income, and race. The data have been combined into a cumulative score to compare environmental and socioeconomic risk factors across all of Washington US census tracts. The compiled environmental health disparity scores for the US census tracts in Seattle are shown in **Exhibit 3.1-12.**

Exhibit 3.1-4. Seattle Surface Waters

City Category	Water Body	Water Quality Impairments	Flow Control Standards
Listed creeks	▪ Blue Ridge Creek ▪ Broadview Creek ▪ Discovery Park Creek ▪ Durham Creek ▪ Frink Creek ▪ Golden Gardens Creek ▪ Kiwanis Ravine/Wolfe Creek ▪ Licton Springs Creek ▪ Madrona Park Creek ▪ Mee-Kwa-Mooks Creek ▪ Mount Baker Park Creek ▪ Puget Creek ▪ Riverview Creek ▪ Schmitz Creek ▪ Taylor Creek ▪ Washington Park Creek	▪ Taylor Creek—temperature	Generally stricter flow control standards for development that require meeting forested-condition targets.
Non-listed creeks	▪ Fauntleroy Creek ▪ Longfellow Creek ▪ Piper's Creek ▪ Thornton Creek ▪ Any other stream not listed	▪ Fauntleroy Creek—bacteria ▪ Longfellow Creek—bacteria, dissolved oxygen, temperature ▪ Piper's Creek—bacteria ▪ Thornton Creek—bacteria, dissolved oxygen, temperature	Standards for development to meet forested-condition targets only when the existing condition is forested.
Small lakes	▪ Bitter Lake ▪ Green Lake ▪ Haller Lake	(None listed by Ecology)	Flow control requirements for development over a certain size threshold.
Designated receiving waters	▪ Duwamish River ▪ Elliott Bay ▪ Puget Sound ▪ Portage Bay ▪ Union Bay ▪ Lake Union ▪ Lake Washington ▪ Lake Washington Ship Canal ▪ Other City-identified and Ecology-approved waters	▪ Duwamish River—ammonia, bacteria, benzenes, bioassay, dibenzofuran, dioxins, dissolved oxygen, metals, PAHs, pesticides, pH, phenols, plasticizers, rubberizers, temperature ▪ Puget Sound—bacteria, benzenes, dioxins, furans, metals, PAHs, PCBs, phenol ▪ Lake Union—metals, PAHs, PCBs, temperature ▪ Lake Washington—Bacteria, dioxins, metals, PAHs, PCBs, pesticides, phenol ▪ Lake Washington Ship Canal—bacteria, PAHs, PCBs, pesticides, metals, temperature	Determined to have sufficient capacity to receive discharges of rainwater runoff without flow control.

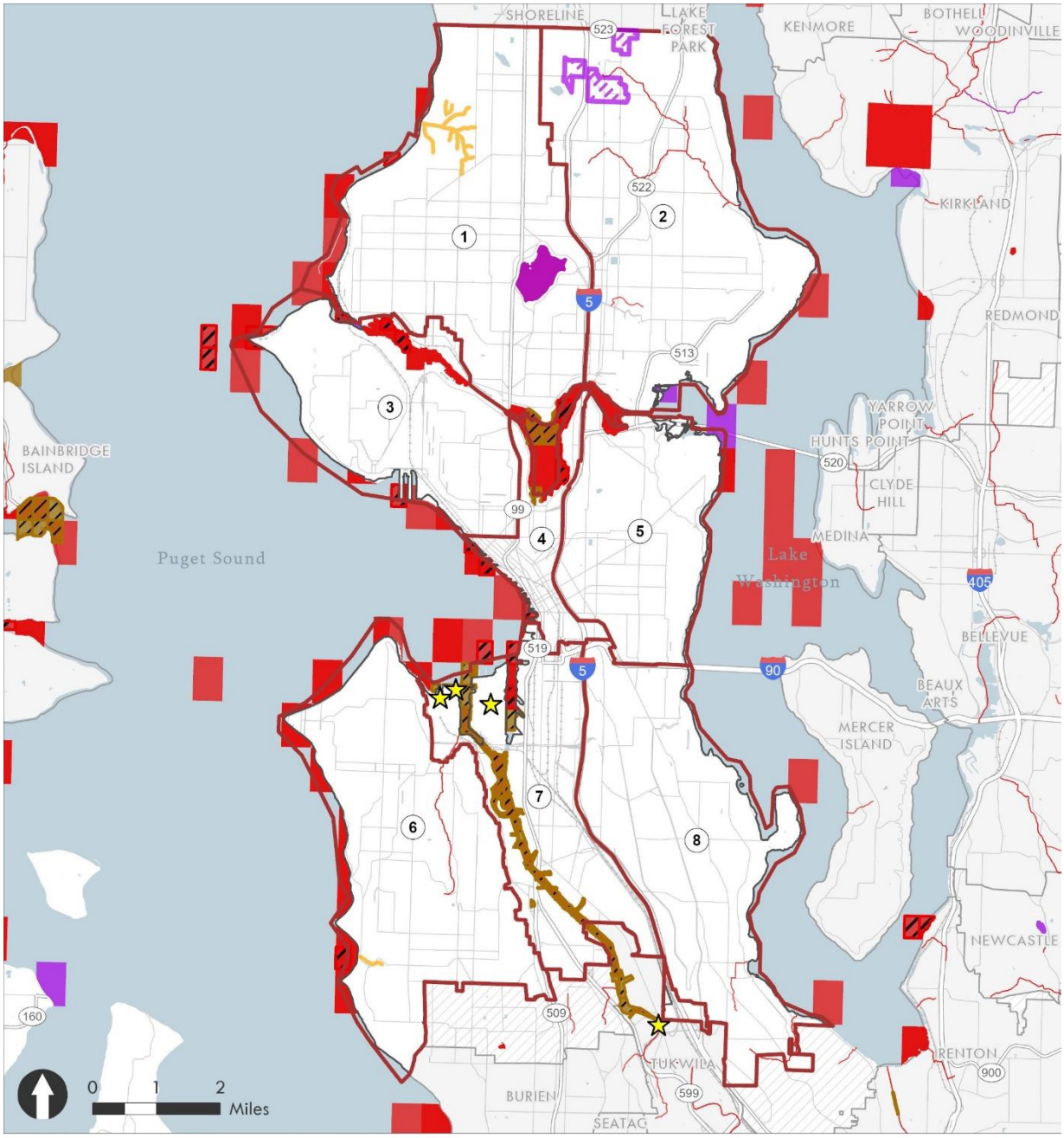
Notes: Metals include arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc; PAHs: polycyclic aromatic hydrocarbons; PCBs: polychlorinated biphenyls. Water quality treatment requirements are the same throughout the city regardless of the receiving water body.
Sources: Ecology, 2018; Seattle, 2021.

Exhibit 3.1-5. Water Resources



Source: Seattle, 2023a.

Exhibit 3.1-6. Impaired Water Bodies



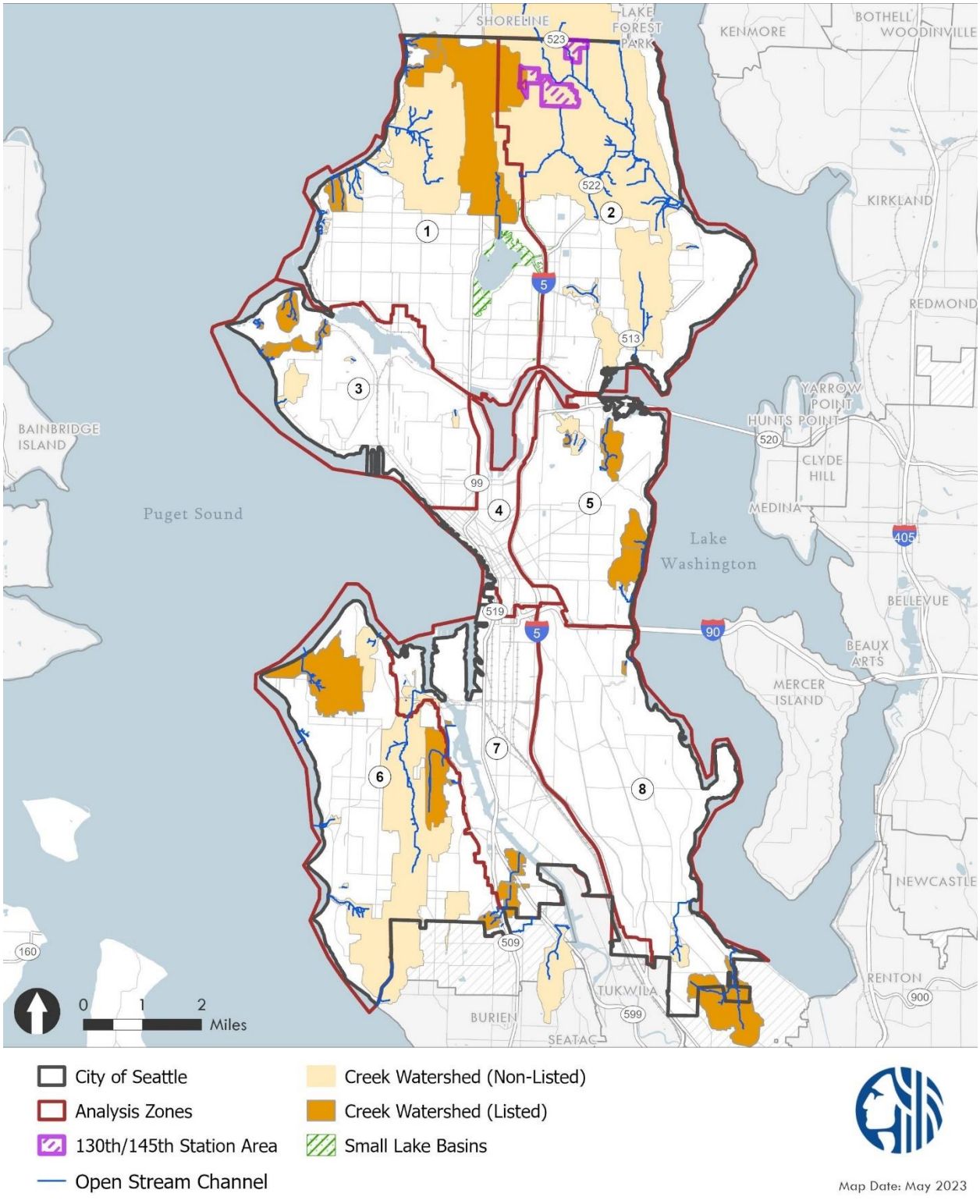
Water Quality Impairments
- Category 5 - 303d (Impaired Water Bodies)
- Category 4A (EPA-approved TMDL)
- Category 4B (Pollution Control Program)
- Category 4C (TMDL Not Applicable)
- Seattle Superfund Sites
- City of Seattle
- Urban Growth Areas

Sediment Impairments
- Category 5 - 303d (Impaired Water Bodies)
- Category 4A (EPA-approved TMDL)
- Category 4B (Pollution Control Program)
- Category 4C (TMDL Not Applicable)
- 130th/145th Station Area
- Analysis Zones

Map Date: May 2023

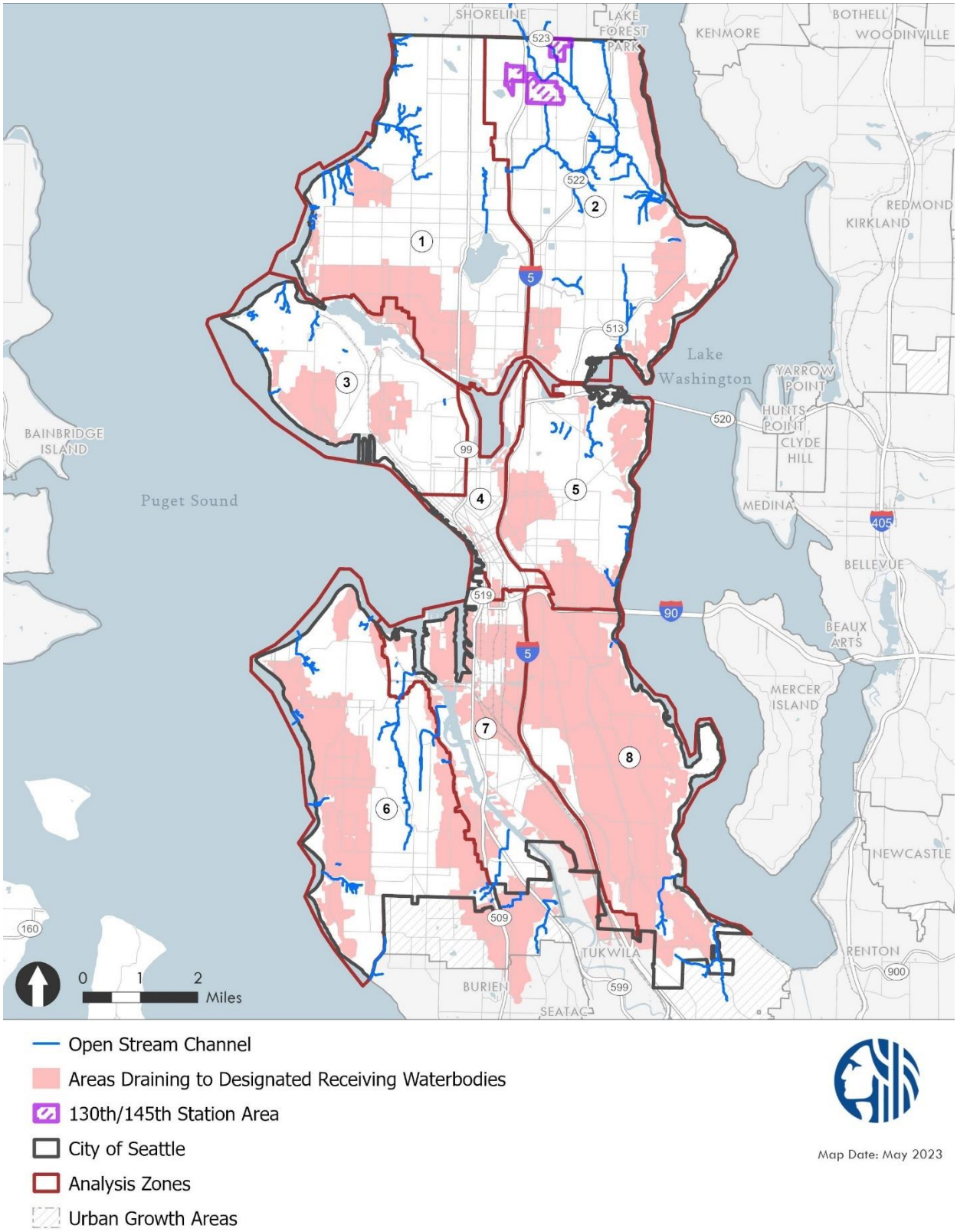
Source: Ecology, 2018; U.S. EPA, 2023.

Exhibit 3.1-7. Regulated Stream and Lake Watersheds



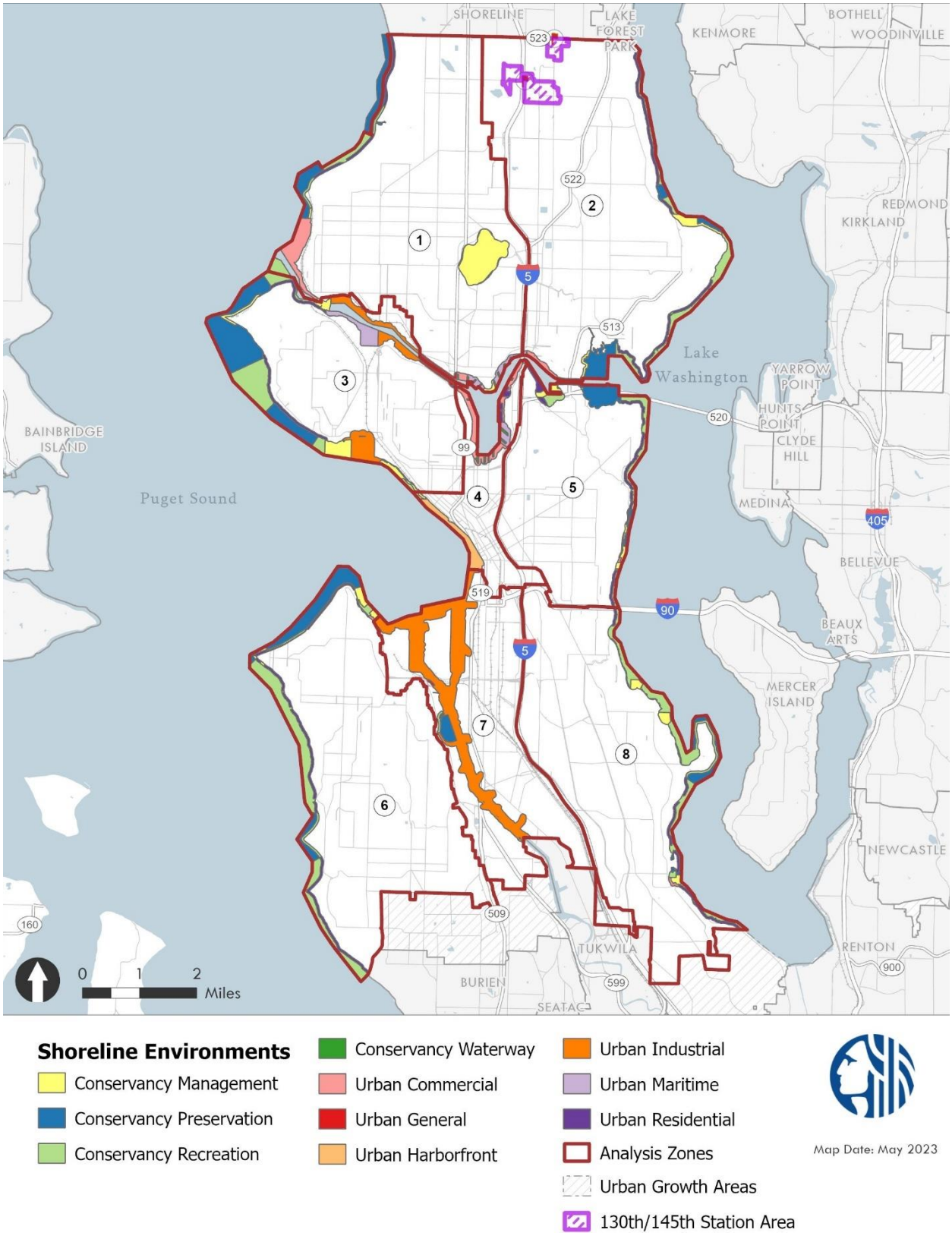
Source: Seattle, 2021.

Exhibit 3.1-8. Areas Draining to Receiving Waters Not Requiring Flow Control



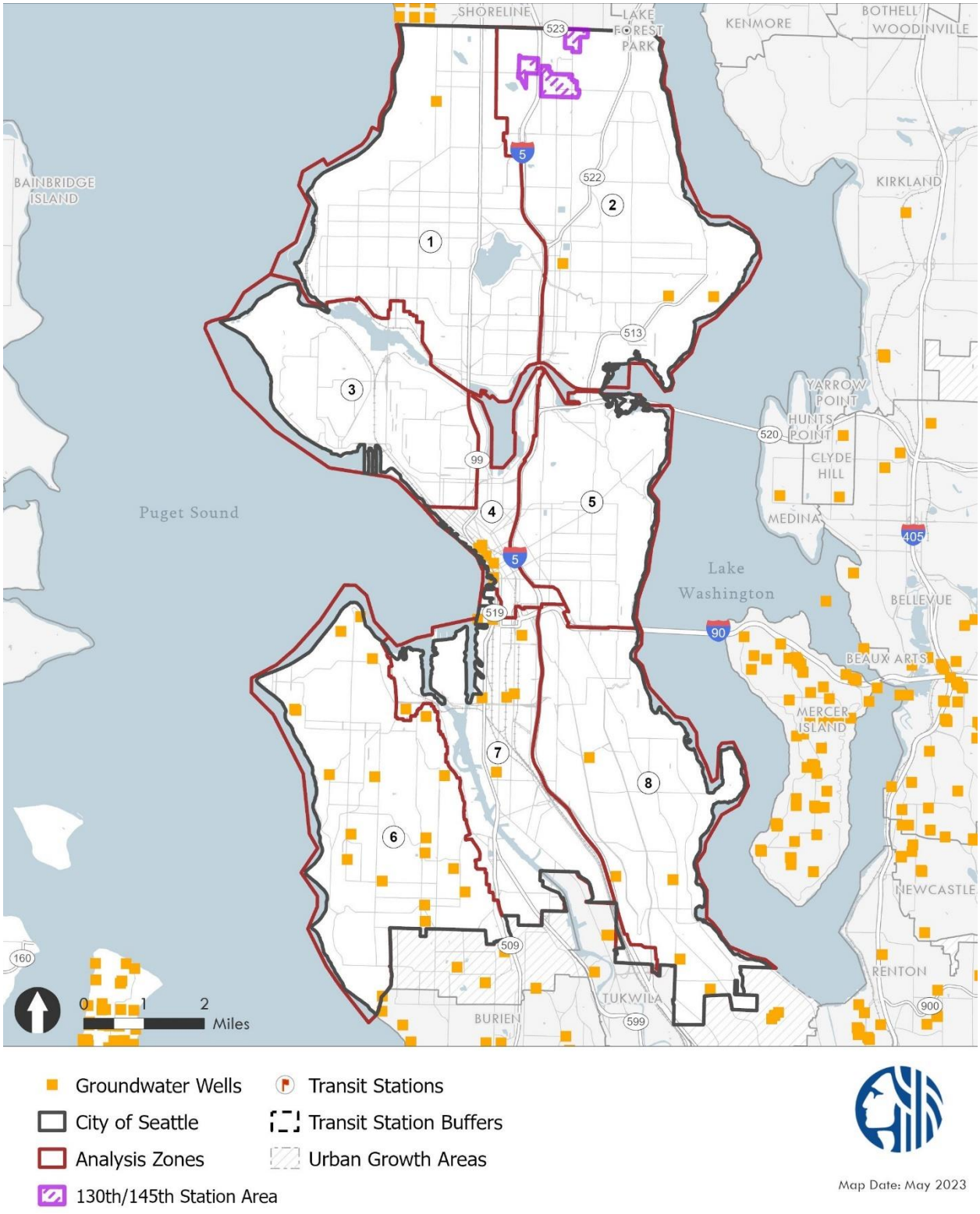
Source: Seattle, 2021.

Exhibit 3.1-9. Shoreline Areas



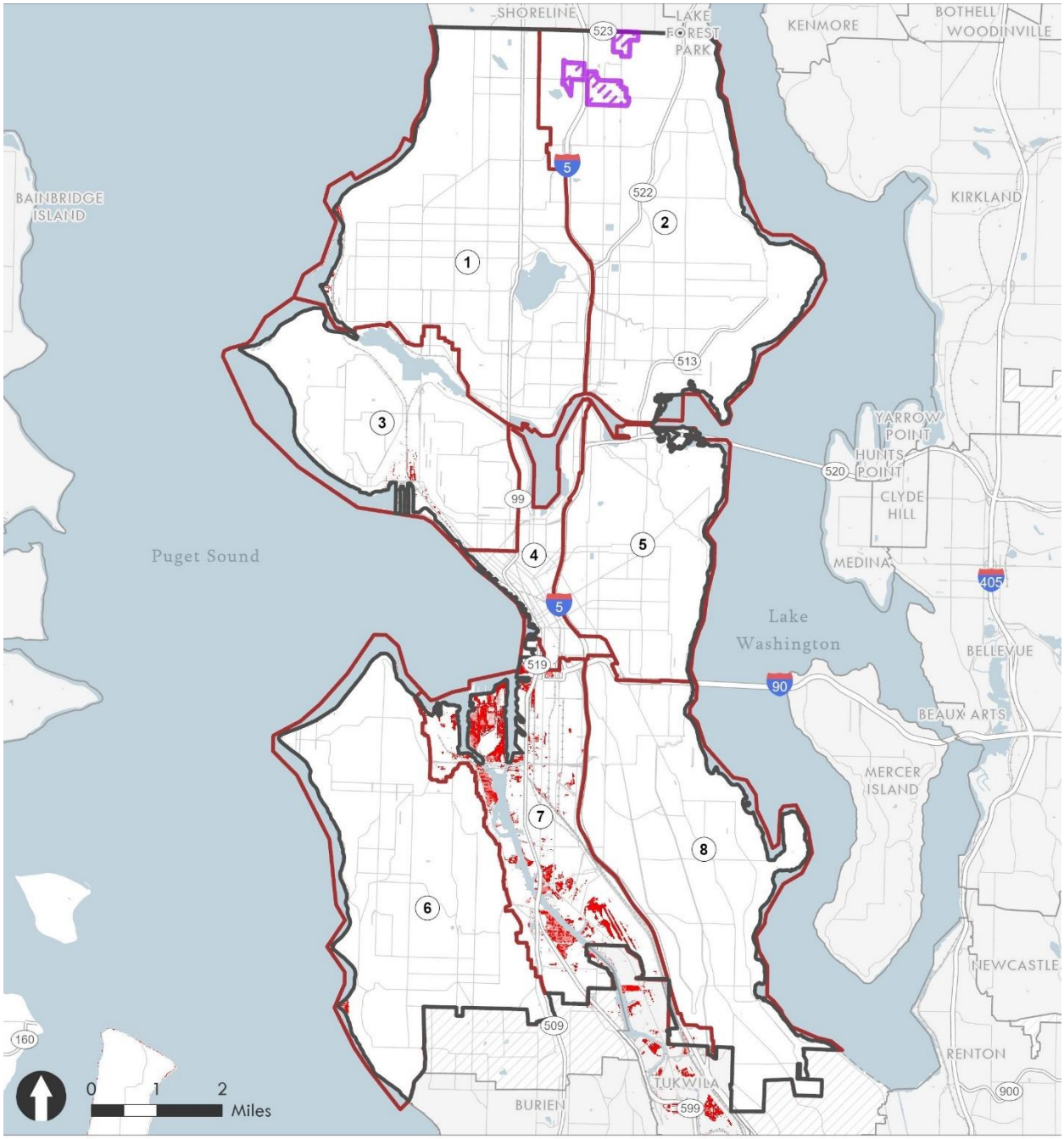
Source: Seattle, 2023a.

Exhibit 3.1-10. Groundwater Wells



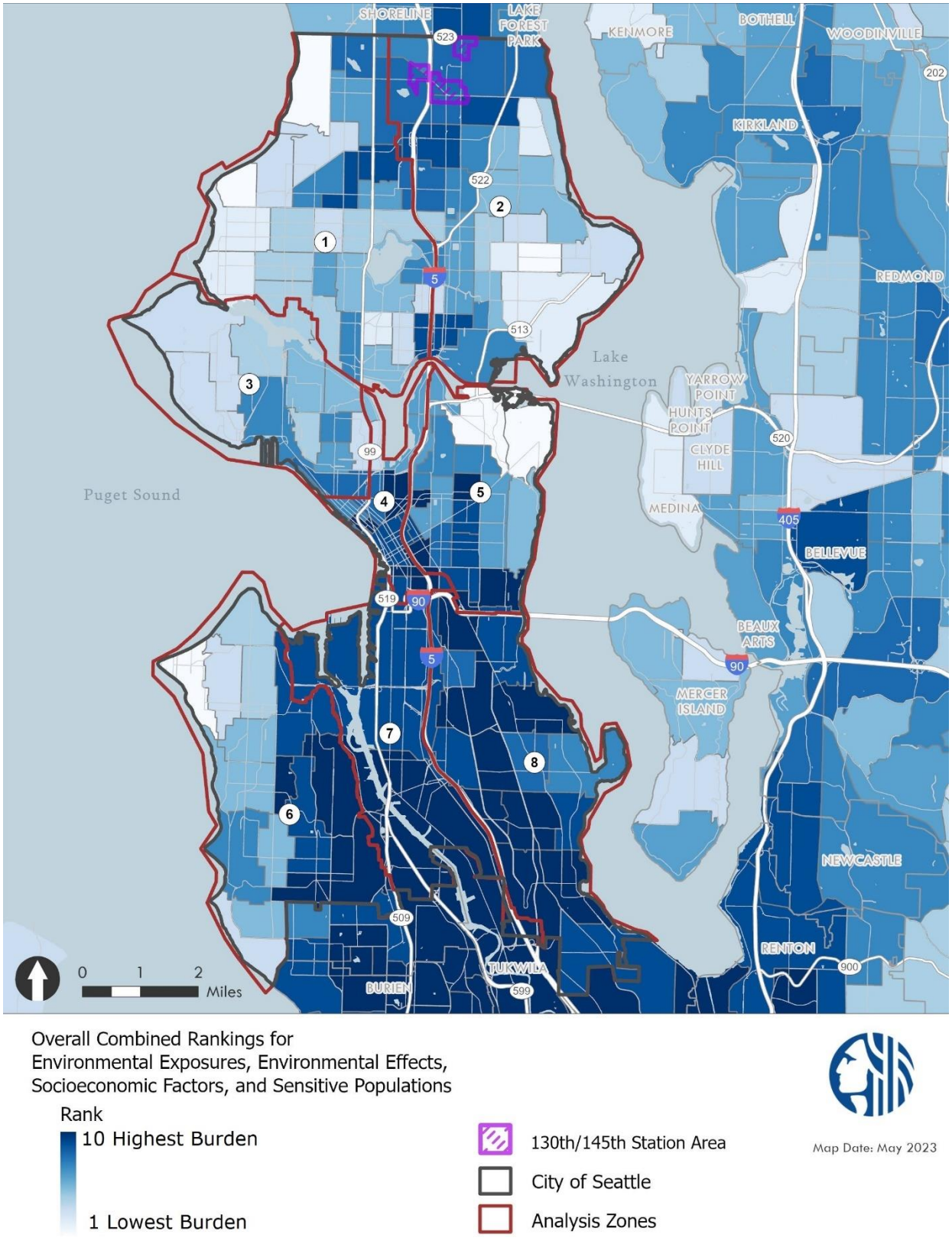
Sources: King County 2023b; Seattle, 2023a.

Exhibit 3.1-11. Forecasted Sea Level Rise



Source: NOAA, 2023; Seattle, 2023b.

Exhibit 3.1-12. Environmental Health Disparities



Source: WA DOH, 2023.

Analysis Areas

In addition to the citywide earth and water resources identified above, features unique to each area are identified in the following sections.

Area 1: NW Seattle

Key surface waters in and around Area 1 include:

- Blue Ridge Creek
- Broadview Creek
- Golden Gardens Creek
- Licton Springs Creek
- Piper's Creek
- Bitter Lake
- Green Lake
- Lake Union
- Lake Washington Ship Canal
- Puget Sound

Area 1 is the only area in the city with Category 1 peat settlement-prone areas, and also contains one of the largest areas of listed-creek watersheds in the city.

Area 2: NE Seattle

Key surface waters in and around Area 2 include:

- Thornton Creek
- Haller Lake
- Portage Bay
- Union Bay
- Lake Washington Ship Canal
- Lake Washington

Area 2 also contains more areas of Category 2 peat settlement-prone soils than any other area in the city.

130th/145th Study Area

The key surface water resource in and around 130th/145th Study Area is the north fork of Thornton Creek. The areas around the stream in the 130th/145th Study Area are classified as steep slopes, liquefaction-prone areas, and flood-prone areas.

Area 3: Queen Anne/Magnolia

Key surface waters in and around Area 3 include:

- Discovery Park Creek
- Kiwanis Ravine/Wolfe Creek
- Lake Washington Ship Canal
- Puget Sound

The center of Area 3 along the Interbay valley is categorized as liquefaction-prone. Also, Area 3 has the largest amount of Conservancy Preservation and Conservancy Recreation shoreline in the city.

Area 4: Downtown/Lake Union

Key surface waters in and around Area 4 include:

- Lake Union
- Lake Washington Ship Canal
- Elliott Bay

Area 4 is also the location of Downtown Seattle, the most densely developed area in the city.

Area 5: Capitol Hill/Central District

Key surface waters in and around Area 5 include:

- Frink Creek
- Madrona Park Creek
- Washington Park Creek
- Portage Bay
- Union Bay
- Lake Washington Ship Canal
- Lake Washington

Area 5 contains some of the largest areas of listed-creek watersheds in the city. In addition, Area 5 has the largest share of area mapped as not having been 40% impervious or more since 1985.

Area 6: West Seattle

Key surface waters in and around Area 6 include:

- Durham Creek
- Fauntleroy Creek
- Longfellow Creek
- Mee-Kwa-Mooks Creek
- Puget Creek
- Riverview Creek

- Schmitz Creek
- Elliott Bay
- Puget Sound

Area 6 contains some of the largest areas of listed-creek watersheds in the city.

Area 7: Duwamish

Key surface waters in and around Area 7 include:

- Duwamish River
- Elliott Bay

Topographically, the Duwamish River and Waterway corridor that makes up most of Area 7 is the flattest terrain in the city and almost all of it is classified as liquefaction-prone. Also, as shown in **Exhibit 3.1-11**, Area 7 is the most at-risk to effects from sea level rise out of any area in the city. This area has a long history of industrial use, the Duwamish River is identified as being impaired for more pollutants than any surface water in the city, and Area 7 contains 4 Superfund sites (the only area in the city to contain any). As shown in **Exhibit 3.1-12**, almost all census tracts in Area 7 are highly ranked (in the upper half of the range) for environmental health disparity.

Area 8: SE Seattle

Key surface waters in and around Area 8 include:

- Mount Baker Park Creek
- Taylor Creek
- Lake Washington

Area 8 has the largest amount of area draining to designated receiving waters (water bodies that are large enough to not be impacted by receiving runoff without flow control) in the city. Also, as shown in **Exhibit 3.1-12**, almost all census tracts in Area 8 are highly ranked (in the upper half of the range) for environmental health disparity.

3.1.2 Impacts

Impacts Common to All Alternatives

Direct

This section discusses impacts to earth and water resources that are common to all alternatives. It should be noted, though, that most impacts of future development projects on earth and water resources would be avoided or minimized through compliance with the City's Stormwater Code, Critical Areas Code, and other applicable regulations discussed in **Section 3.1.3**.

Big Picture Impacts

The comprehensive future planning associated with the plan alternatives would focus growth in the city's already developed area as opposed to allowing that same growth to impact more rural, undeveloped areas outside of the city. This is expected to help prevent impacts to higher-quality earth and water resources throughout the region.

The impacts to earth and water resources common to all plan alternatives are:

- Construction impacts—Construction activities can involve removal of vegetation and soil disturbance, causing erosion, water quality impacts, and potential for soil contamination. Construction activities and associated rainfall runoff controls are required to meet permitting requirements that should prevent or minimize adverse impacts.
- Vehicle Use—All of the plan alternatives would result in increased vehicle use. Higher numbers of vehicle trips can potentially increase contamination of local receiving waters, depending on the level of stormwater runoff treatment provided to the roadways. Expected changes to single-occupancy vehicle trips are used as an indicator of potential increased pollution from vehicles. Increases in single-occupancy vehicle trips are presented in **Exhibit 3.1-13**, which is based on data from **Section 3.10 Transportation**.
- Hard Surfaces—All of the plan alternatives would result in an increase in the amount of hard surfaces (i.e., parking, buildings, etc., also known as impervious surfaces) in the city. The amount of hard surface versus vegetation in each place type impacts the way rainwater runoff mixes with potential pollution and soaks into the earth or is transported to natural receiving waters. Typically, areas with more hard surface and less vegetation produce greater impacts to earth and water resources. They increase runoff volumes, erode streams, increase stream temperatures, decrease groundwater recharge, and can increase flooding and habitat contamination. In places where some runoff does infiltrate into the ground, untreated stormwater that soaks into the earth could potentially contaminate groundwater. For the earth and water impacts analysis, factors that are used as gauges of increased hard surfaces are summarized in **Exhibit** 3.1-13 and include number of housing units and their distribution of housing (new development is assumed to create more hard surfaces when it is spread into areas like Neighborhood Residential rather than concentrated into urban centers). Additional considerations of changes in land cover, including changes in vegetation, are discussed in **Section 3.3 Plants & Animals**.

Exhibit 3.1-13. Impacts Based on Expected Pollution and Runoff Increases

Metric	Alt. 1	Alt.2	Alt.3	Alt.4	Alt.5
Pollution Indicator: Daily Single-Occupancy Vehicle Trips (millions)	1.78	1.85	1.85	1.85	1.91
Hard Surface Indicator: Housing Units	80,000	100,000	100,000	100,000	**120,000**
Hard Surface Indicator: Share of Developable Acres					
Existing Centers	58%	58%	58%	58%	58%
Additions: Centers and Corridors	0%	6%	0%	15%	**20%**
Neighborhood Residential	0%	0%	**29%**	0%	13%
Outside Subareas*	42%	36%	13%	27%	9%
Impact of Alternative Compared to No Action	**Baseline**	**Lowest Impact**	**Highest Impact**	**Moderate Impact**	**Highest Impact**

* "Outside Subareas" includes all areas outside the other listed geographies. No change to place type is proposed in these areas, though growth will continue to occur throughout the 20-year planning period.
Source: City of Seattle, 2023; BERK, 2023.

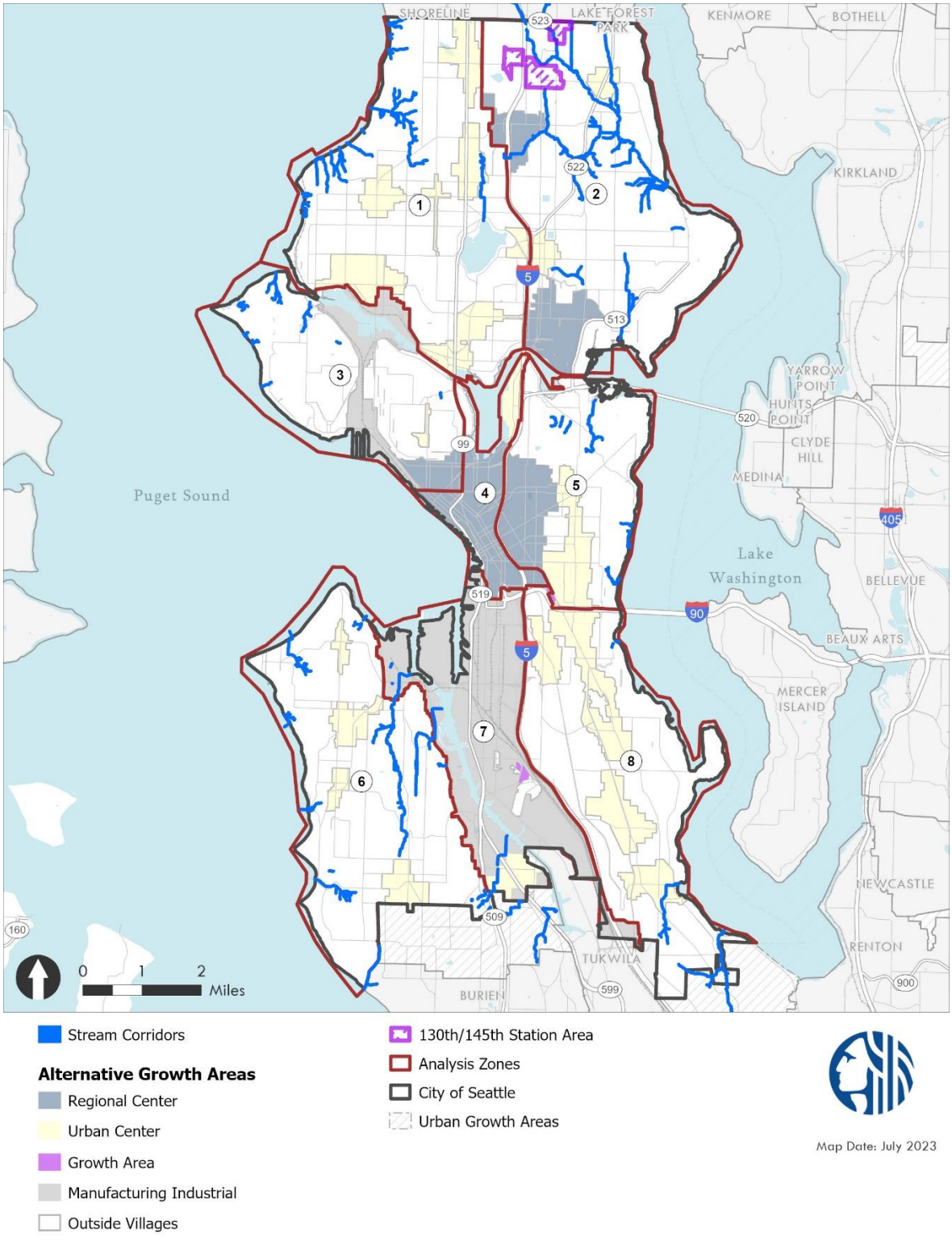
- Proximity to Water Resources—As discussed in **Section 3.1.1**, natural water resources (streams, lakes, and associated floodplains) exist throughout the city. Each of the plan alternatives could have increased impacts on these resources where development density is focused in closer proximity to these resources. The increased density associated with each alternative in proximity to water resources is shown in **Exhibit 3.1-14** and **Exhibit 3.1-15.** However, development within and near these surface water resources is regulated and impacts would be mitigated under the applicable City codes, as discussed in **Section 3.1.3**.

In summary, every alternative would increase density in the city boundary and likely result in increased vehicle use, increased hard surfaces, and focus additional development closer to water resources. However, as mentioned above, the redevelopment associated with each plan alternative would comply with City codes requiring stormwater management, critical area protections, building upgrades, and other measures to avoid or minimize potential impacts to earth and water resources.

Indirect

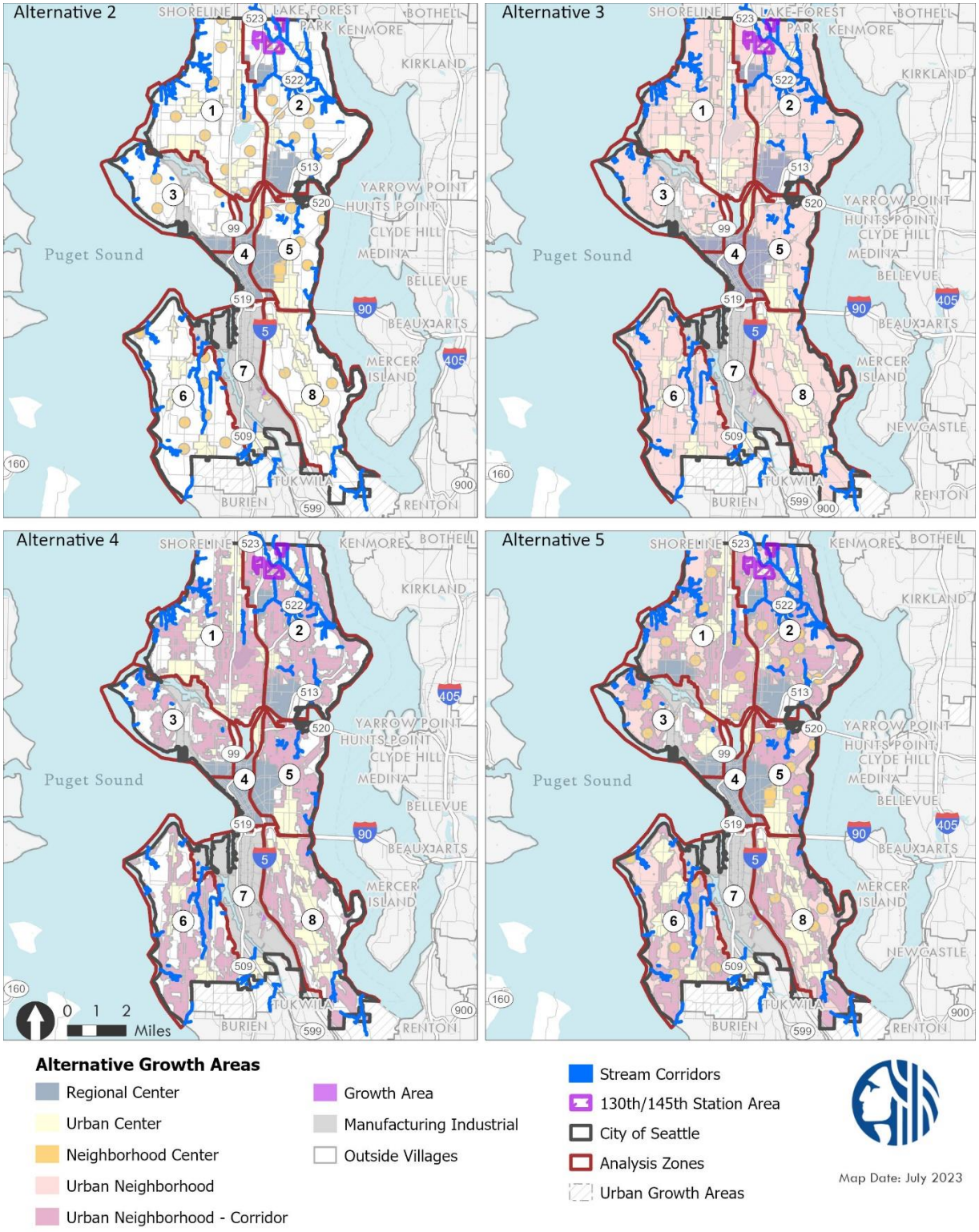
Indirect impacts potentially occur as a result of the proposed action and are reasonably foreseeable, but they occur later in time or farther removed in distance. Indirect impacts on earth and water resources generally come from each alternative's potential indirect changes to pollutant sources and land cover through changes to the pattern and locations of population density and growth rate. As outlined in Vision 2050 (PSRC, 2020), focusing growth in previously developed urban areas will result in less impact on regional earth and water resources than focusing the same growth in previously undeveloped areas outside of cities that add new impervious surfaces controlled under current standards. Expected changes to population density is presented in **Exhibit 3.1-14** and **Exhibit 3.1-15**, which are based on data from **Section 3.10 Transportation**. Overall, the indirect effect from every alternative is considered beneficial to earth and water resources in the region that includes the city and areas beyond.

Exhibit 3.1-14. Proximity of Increased Density to Water Resources (Alternative 1 No Action)



Note: See **Exhibit 2.1-1** in **Chapter 2** for a cross-walk of existing place types (existing and Alternative 1) versus proposed place type names under Alternatives 2-5.
Source: Seattle, 2023a; BERK, 2023.

Exhibit 3.1-15. Proximity of Increased Density to Water Resources (Alternatives 2 through 5)



Note: See **Exhibit 2.1-1** in **Chapter 2** for a cross-walk of existing place types (existing and Alternative 1) versus proposed place type names under Alternatives 2-5.
Source: Seattle, 2023a; BERK, 2023.

Equity & Climate Vulnerability Considerations

As shown in **Exhibit 3.1-12**, several areas of the city rank high (in the upper half of the scoring range) for environmental health disparities. Redevelopment in these areas associated with the plan alternative could have both beneficial and detrimental impacts to the population in these areas, as follows:

- Water Quality: As discussed in the sections that follow, areas of a city that have been developed for decades in the past may not have rainwater runoff management that captures pollution or controls flow volumes to the maximum extent practicable. Redevelopment often triggers requirements to upgrade stormwater management to meet current standards, which can either avoid impacts or result in a benefit to earth and water resources, and in turn to those living in the surrounding community. Also, newer stormwater infrastructure can be designed to be more resilient to changes in rainfall frequencies and volumes, thereby lowering the flood risks for the community. As such, in cities like Seattle with landcover that has been historically developed for centuries, redevelopment that is focused in areas with underserved populations can sometimes help address environmental inequities related to water quality. Considering the pattern of density in **Exhibit 3.1-14** and **Exhibit 3.1-15**, Alternative 1 would have the lowest level of redevelopment and Alternative 5 the most. If resources are directed equitably, it could reduce environmental inequities. However, as previously discussed and shown in **Exhibit 3.1-14** and **Exhibit 3.1-15**, each of the plan alternatives could have increased environmental impacts where development density is focused in closer proximity to water resources.
- Exposure to Contaminated Sites: Populations living near historically contaminated sites can be at risk from environmental hazard exposure, and disturbance of the ground surface in these areas can sometimes increase the risk. However, larger redevelopment in these areas can trigger site remediation to either more safely contain the contaminants up to current standards or remove the contaminants to a designated hazardous waste disposal site. Therefore, redevelopment can sometimes pose a risk of exposure from contaminated sites or motivate additional clean-up and protection, depending on the scale of the project. The City regulates development around known contaminated sites, as discussed further in **Section 3.1.3**.
- Exposure to Flooding and Landslides: Where redevelopment would trigger installation of newer stormwater infrastructure as described above, that infrastructure can be designed to be more resilient to changes in rainfall frequencies and volumes, thereby lowering the flood risks for the community. In addition, as discussed in **Section 3.1.3**, the City regulates development in areas that are landslide-prone, steep slope erosion hazards, and liquefaction-prone. While Alternative 1 retains current plans and regulations, the action alternatives advance the City's climate resilience with a new climate element based on a climate vulnerability assessment.
- Future Affect by Sea-Level Rise: As discussed in **Section 3.1.3**, the City limits development in designated shoreline areas, which are areas most likely to be affected by sea-level rise. However, the current codes are based on current water surface elevation metrics and may

not fully address resiliency to potential impacts from forecasted sea-level rise. As shown in **Exhibit 3.1-11**, the area more likely to continue to see coastal flooding is in Area 7, which is primarily used and planned for industrial purposes under all alternatives. Other areas that may also be affected by sea-level rise and storm surges include Ballard and Broadview (Area 1), Discovery Park and Lower Queen Anne (Area 3), Downtown (Area 4), and West Seattle (Area 6). Growth levels are similar in Downtown (Area 4) across alternatives but tend to be lower in Alternative 1 and higher in Alternative 5 in other areas. Depending on the location of growth, Alternative 5 could result in exposure of more people to sea level rise. Compared to Alternative 1 No Action, the action alternatives would potentially have less risk of sea level rise exposure to communities because of the new climate element required under the Growth Management Act (GMA) and climate resilience strategies included to direct growth away from shorelines.

Impacts of Alternative 1: No Action

Alternative 1 represents the No Action baseline against which all other alternatives are compared. It would allow a continuation of growth of 80,000 dwellings and 158,000 jobs on redevelopable and vacant lands, with most residential growth directed to urban centers and villages considering current place types. Alternative 1 No Action would have the lowest potential land cover conversions of vegetation to hard surface, the lowest expected increase in daily vehicle trips, lowest potential to locate growth in sea level rise hazard areas and would focus increased density farther away from water resources than all other alternatives. It would emphasize place types that have benefits; however, its lower amount of new housing in the city compared to the other plan alternatives could result in housing growth in the region beyond the city. This could indirectly result in adverse impacts to more pristine water resources throughout the region, as described under Impacts Common to All Alternatives.

130th/145th Station Area

The 130th/145th Station Area is in close proximity to Thornton Creek, and runoff from these areas is in the associated regulated stream basin. For the reasons described above, Alternative 1 No Action presents the lowest potential for direct impacts on earth and water resources within the 130th/145th Station Area.

Impacts of Alternative 2: Focused

Alternative 2 would have the least potential land cover conversions of vegetation to hard surface, the lowest expected increase in daily vehicle trips, and would focus increased density farther away from water resources than all other action alternatives. Therefore, Alternative 2 is expected to have the lowest potential for direct impacts to earth and water among the alternatives.

For sea level rise, Alternative 2 has a moderate potential to locate growth in sea level rise hazard areas outside of Area 7. In Area 3, its growth is similar to that of Alternative 5 and depending on growth location near shorelines could have a similar risk as Alternative 5 in that area.

Alternative 2 (along with Alternatives 3 and 4) offers a lower amount of new housing in the city among the action alternatives and could result in housing growth in the region beyond the city. Based on this, Alternative 2 could indirectly result in adverse impacts to some of the more pristine water resources throughout the region, as described under Impacts Common to All Alternatives.

130th/145th Station Area

The 130th/145th Station Area is in close proximity to Thornton Creek, and runoff from these areas is in the associated regulated stream basin. For the reasons described above, Alternative 2 presents the lowest potential for direct impacts on earth and water resources within the 130th/145th Station Area among the action alternatives.

Impacts of Alternative 3: Broad

Alternative 3 would have the highest potential land cover conversions of vegetation to hard surface, high expected increase in daily vehicle trips, and would focus a higher amount of increased density closer to water resources than other action alternatives. Therefore, (along with Alternative 5) Alternative 3 is expected to have the highest potential for direct impacts to earth and water among the alternatives.

For sea level rise, Alternative 3 has a moderate risk of growth in sea level rise hazard areas in Areas outside of Area 7.

Also, Alternative 3 (along with Alternatives 2 and 4) offers a lower amount of new housing in the city among the action alternatives and could result in housing growth in the region beyond the city. Based on this, Alternative 3 could indirectly result in adverse impacts to some of the more pristine water resources throughout the region, as described under Impacts Common to All Alternatives.

130th/145th Station Area

A station area plan would not be implemented under Alternative 3; designations and zoning would match the overall intent of Alternative 3 for more growth spread to urban neighborhoods.

Impacts of Alternative 4: Corridor

Alternative 4 would have the moderate potential land cover conversions of vegetation to hard surface, high expected increase in daily vehicle trips, and would focus some increased density

closer to water resources compared to the baseline. Therefore, Alternative 4 is expected to have the moderate potential for direct impacts to earth and water among the alternatives.

Like Alternative 3, there is a moderate risk of added growth from Alternative 4 in areas that may have a long-term potential risk of exposure to sea level rise.

Also, Alternative 3 (along with Alternatives 2 and 4) offers a lower amount of new housing in the city among the action alternatives and could result in housing growth in the region beyond the city. Based on this, Alternative 3 could indirectly result in adverse impacts to some of the more pristine water resources throughout the region, as described under Impacts Common to All Alternatives.

130th/145th Station Area

A station area plan would not be implemented under Alternative 4; designations and zoning would match the overall intent of Alternative 4 for more growth spread to corridors.

Impacts of Alternative 5: Combined

Alternative 5 would have high potential land cover conversions of vegetation to hard surface, the highest expected increase in daily vehicle trips, and would focus the highest amount of increased density closer to water resources than all other action alternatives. Therefore, (along with Alternative 3) Alternative 5 is expected to have the highest potential for direct impacts to earth and water among the alternatives.

Alternative 5 may expose more populations to sea level rise with storm surges, depending on the location of housing.

Among all of the alternatives, however, Alternative 5 offers the highest amount of new housing in the city, which would deter housing growth in the region beyond the city. Based on this, Alternative 5 could indirectly avoid adverse impacts to some of the more pristine water resources throughout the region, as described under Impacts Common to All Alternatives.

130th/145th Station Area

The 130th/145th Station Area is in close proximity to Thornton Creek, and runoff from these areas is in the associated regulated stream basin. For the reasons described above, Alternative 5 presents the highest potential for direct impacts on earth and water resources within the 130th/145th Station Area among the action alternatives.

3.1.3 Mitigation Measures

Incorporated Plan Features

None of the alternatives described in **Chapter 2** of this EIS include plan features that explicitly address earth and water resources. However, the Comprehensive Plan includes policies relevant to the city-wide protection and restoration of earth and water resources in the following sections:

- Growth Strategy—Natural Environment
- Land Use—General Development Standards
- Land Use—Environmentally Critical Areas
- Capital Facilities—Operations and Maintenance
- Utilities—Resource Management
- Utilities—Facility Siting and Design
- Environment—Land
- Environment—Water
- Environment—Climate

Action alternatives would amend all elements as part of the Periodic Update; this includes similar and improved policies addressing earth and water resources. The Draft One Seattle Plan includes a new climate element required under the Growth Management Act (GMA). It will include greenhouse gas reduction policies and climate resilience policies to avoid and adapt to climate risks including sea level rise, flooding, and risks of landslides due to extreme precipitation based on the Seattle Climate Vulnerability Assessment 2023.

Regulations & Commitments

Federal

- Clean Water Act, 33 United States Code (USC) 1251 et seq., including Sections 401—Water Quality Certification, 402—National Pollutant Discharge Elimination System, and 404—Permits for Dredge or Fill
- Coastal Zone Management Act, 16 USC 1451 et seq.
- Section 14 of the Rivers and Harbors Act of 1899, 33 USC 408 (Section 408)
- National Flood Insurance Act of 1968 and Flood Disaster Protection Act of 1973, 42 USC 4001 et seq.
- Floodplain Management Presidential Executive Order 11988
- Endangered Species Act (ESA) Biological Opinion for the Implementation of the National Flood Insurance Program in the State of Washington (National Marine Fisheries Service 2008)
- Safe Drinking Water Act, 42 USC 300 et seq., Chapter 6A

State & Regional

- Water Quality Standards for Surface Waters, Washington Administrative Code (WAC) 173201A
- Water Quality Standards for Groundwater, WAC 173-200
- Flood Control Management Act, Revised Code of Washington (RCW) 86
- Water Pollution Control Act, RCW 90.48
- Shoreline Management Act, RCW 90.58, WAC 173-26
- National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit (Washington State Department of Ecology [Ecology], 2021)
- National Pollutant Discharge Elimination System (NPDES) Western Washington Phase I Municipal Stormwater General Permit (Ecology, 2019b)
- Stormwater Management Manual for Western Washington (Ecology Manual) (Ecology, 2019a)
- Washington State Department of Transportation (WSDOT) Highway Runoff Manual (WSDOT, 2019a)
- WSDOT Hydraulics Manual (WSDOT, 2019b)
- Washington State Hydraulic Code, WAC 220-660

City of Seattle

The City is subject to the state regulations described above. In addition, the City has also enacted several local regulations that govern water quality in the study area, which are described below.

Stormwater Code and Manual—SMC Title 22, Subtitle VIII (22.800 to 22.808). To support implementation of the City's Stormwater Code and other applicable regulations, the Director of Seattle Public Utilities (SPU) and the Director of the Department of Planning and Development have promulgated rules that provide approved technical methodology, criteria, guidelines, and additional information pursuant to the Stormwater Code authority. Currently, there are four of these joint "Directors' Rules" covering source control, construction stormwater control, stormwater flow control and water quality treatment, and stormwater code enforcement. The City's Stormwater Manual is a compilation of the Directors' Rules (Seattle, 2021); as such, it describes guidance for complying with the Seattle Stormwater Code. Key aspects of the Stormwater Code and manual that may be applicable to the alternatives are summarized in the following sections.

- **Construction.** All projects that have ground-disturbing activity must develop and submit a Construction Stormwater Control and Soil Management Plan. The plan must outline how the project will apply BMPs in 18 specified categories identified in the manual to minimize project impacts, protect the public drainage system and receiving waters, prevent erosion and sedimentation, and manage pollution-generating activities and sources. The requirements of this plan are similar to those of the construction stormwater pollution

prevention plan required under Ecology's NPDES Construction Stormwater General Permit provisions; the City-required plan can be modified to meet the NPDES requirements.

- **Development.** Development projects that disturb certain ground area thresholds are required to install permanent stormwater management systems to mitigate potential impacts from changes to the site runoff. These required stormwater management measures are designed to minimize pollution at the source, remove or reduce the amounts of pollutants in the stormwater before it enters the receiving water, or manage the rate at which stormwater flows into a receiving water, the separated storm system, or the combined sewer system. Most development associated with the plan alternatives would likely require on-site (within the developed parcel) stormwater management (where determined feasible based on the project design), which includes controls like infiltration trenches, rain gardens, or permeable pavements. However, the plan alternatives would likely not include development that would trigger flow control facilities (like stormwater ponds or vaults) or water quality treatment facilities (like media filtration facilities). These Stormwater Manual requirements are summarized in **Exhibit 3.1-16**.

Exhibit 3.1-16. Seattle Stormwater Manual—Requirement Summary

Project Type[1]	Soil Amendment	On-site Stormwater Management	Flow Control and Water Quality Treatment
Single-Family Residential (SMC 22.805.030) Trail and Sidewalk (SMC 22.805.040) Parcel-Based (SMC 22.805.050)	Retain and protect undisturbed soil; and amend all disturbed or compacted soil with organic matter.	For projects where either the total new plus replaced hard surface is generally at least **1,500 square feet** (**750 square feet** for lots created in 2016 or after; **2,000 square feet** for trail and sidewalk) or the land disturbing activity is **7,000 square feet** or more.	Not required
Roadway (SMC 22.805.060)	Retain and protect undisturbed soil; and amend all disturbed or compacted soil with organic matter.	For **2,000 square feet** or more of new plus replaced hard surface or **7,000 square feet** or more of land disturbing activity.	Flow control is typically required for projects that change **5,000 square feet** or more of hard surfaces (plus other thresholds) that discharge to wetlands, creek basins, small lakes, or a capacity-constrained system. Water quality required for projects not discharging to the public combined sewer that generally change **5,000 square feet** or more of hard surfaces (plus other thresholds).

Notes: 1. Project types are shown for comparison. Single-family residential, sidewalk, and other parcel-based projects are those most likely to be associated with the alternatives. Roadway changes are not expected to be included in most of the development projects. Other project types may apply.
Source: Seattle, 2021.

Shoreline Master Program—SMC 23.60A. The City prohibits any development in designated shoreline areas (see **Exhibit 3.1-9**) without a review by the City that the development is consistent with the Seattle Shoreline Master Program outlined in SMC23.60A. The restrictions apply even if no shoreline substantial development permit is required. Most of the boundaries and elevation restrictions in the Shoreline Master Program are based on the Ordinary High-

Water Mark (the highest mark on the bank of a water body that presents scientific features of the regular presence of water).

Critical Areas Ordinance—SMC 25.09. The City prohibits any development in critical land areas (see **Exhibit 3.1-2**) without a review by the City that the development is consistent with the Critical Areas Ordinance outlined in SMC 25.09. In most cases, the types of activities that may be included as part of development in critical areas are restricted. Also, certain engineering, geotechnical, biological, or other scientific studies are often required before beginning work to determine areas that may require heightened protections, potential risks to areas deemed suitable for development, and appropriate mitigation measures. In addition, often when work is allowed it is restricted to certain portions of the critical area behind designated buffers. Subsections of the Critical Area Code pertain to the following protected and specially regulated lands:

- SMC 25.09.080—Landslide-Prone Areas
- SMC 25.09.090—Steep Slope Erosion Hazard Areas
- SMC 25.09.100—Liquefaction-Prone Areas
- SMC 25.09.110—Peat Settlement-Prone Areas
- SMC 25.09.160—Wetlands and Wetland Buffers
- SMC 25.09.200—Fish and Wildlife Habitat Conservation Areas
- SMC 25.09.220—Abandoned Landfills

Through compliance with the Critical Areas Ordinance, it is expected that potential risk of impacts to the above types of protected and specially regulated lands would be minimized or avoided.

Other Potential Mitigation Measures

- Continued implementation of SDOT policy to avoid adding or expanding roadways through transit and other approaches.
- Strengthen critical areas ordinances and restore critical area buffers.
- Update the Shoreline Master Program to increase sea-level rise resiliency actions (such as construction of barriers or property acquisitions) by basing boundaries and elevation restrictions on the Mean Higher High Water Mark (the average of the higher daily tides) or some other metric higher than the Ordinary High Water Mark.
- Install updated stormwater controls on roadways, which are not likely to be upgraded as part of the parcel redevelopments included in the alternatives.
- Continue research and implementation of innovative stormwater best management practices, especially those focused water quality treatment in the most urban areas.
- Implement the Puget Sound Partnership Action Agenda and Water Resource Inventory Area Salmon Recovery/Habitat Protection plans.
- Continue to implement PSRC's Four-Part Strategy to reduce greenhouse gas emissions.

3.1.4 Significant Unavoidable Adverse Impacts

As discussed in **Section 3.1.1**, landcover across most of the city has been extensively modified for over a century by development, which has already resulted in long-term impacts to earth and water resources. Redevelopment of these areas associated with every project alternative would be required to install permanent stormwater management systems to mitigate potential impacts from changes to the site runoff. These required stormwater management measures are designed to minimize pollution at the source; remove or reduce the amounts of pollutants in the stormwater before it enters the receiving water; or manage the rate at which stormwater flows into a receiving water, the separated storm conveyance system, or the combined sewer system. Furthermore, the comprehensive future planning associated with the project alternatives that would focus growth in the city's already developed area as opposed to allowing that same growth to impact more rural, undeveloped areas is also expected to be beneficial to earth and water resources. Therefore, no significant unavoidable adverse impacts to earth and water resources are expected.